Cardiac Rehabilitation

A Guide to Practice in the 21st Century

edited by
Nanette K. Wenger
L. Kent Smith
Erika Sivarajan Froelicher
Patricia McCall Comoss

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edited by

Nanette K. Wenger
Emory University School of Medicine,
Grady Memorial Hospital
and Emory Heart and Vascular Center
Atlanta, Georgia

L. Kent Smith
Arizona Heart Institute
Phoenix, Arizona

Erika Sivarajan Froelicher
University of California
San Francisco, California

Patricia McCall Comoss
Nursing Enrichment Consultants, Inc.
Harrisburg, Pennsylvania

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MARCEL DEKKER, INC. NEW YORK • BASEL

ISBN: 0-8247-6092-1

This book is printed on acid-free paper.

Headquarters
Marcel Dekker, Inc.
270 Madison Avenue, New York, NY 10016
tel: 212-696-9000; fax: 212-685-4540

Eastern Hemisphere Distribution
Marcel Dekker AG
Hutgasse 4, Postfach 812, CH-4001 Basel, Switzerland
tel: 41-61-261-8482; fax: 41-61-261-8896

World Wide Web
http://www.dekker.com

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Current printing (last digit):
10 9 8 7 6 5 4 3 2

PRINTED IN THE UNITED STATES OF AMERICA

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To our colleagues, whose scientific contributions helped clarify the recommendations for best practices. In addition, we acknowledge the patients who participated as research subjects in the studies that provided the evidence for clinical practice. Finally, we salute the cardiac rehabilitation practitioners whose daily efforts convert these words into action to benefit the cardiac patients they serve.

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Series Introduction

Cardiac Rehabilitation: A Guide to Practice in the 21st Century fulfills an important and often overlooked need in the daily management of patients with cardiovascular problems. Too often, the sole focus is on providing a list of cardiac medications, with admonitions on activity restriction rather than exercise prescription. This is certainly too narrow an approach.

This book, written by leaders in the field, stresses the interdisciplinary aspects of a successful approach. It fills an important niche. I know that I will keep my copy of this book readily available for the broad spectrum of patients under my care, ranging from those in the Coronary Care Unit to those returning for annual office visits. As Editor-in-Chief of Marcel Dekker's Fundamental and Clinical Cardiology Series, I feel privileged to add this 38th contribution to our series.

Samuel Z. Goldhaber, M.D.

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Preface

In 1995, publication of the U.S. Agency for Health Care Policy and Research (AHCPR) Clinical Practice Guideline, *Cardiac Rehabilitation,* brought cardiac rehabilitation to the forefront of both the professional and public arenas. The Guideline, cited often in this text, concluded that:

> *Cardiac rehabilitation services are an essential component of the contemporary management of patients with multiple presentations of coronary heart disease and with heart failure. Cardiac rehabilitation is a multifactorial process that includes exercise training, education and counseling regarding risk reduction and lifestyle changes, and use of behavioral interventions; these services should be integrated into the comprehensive care of cardiac patients.*

The Guideline presented the extensive scientific data base that provides the foundation of contemporary cardiac rehabilitation practice and offered recommendations regarding the components of optimal outpatient cardiac rehabilitation. Also highlighted was the fact that, despite the substantial benefits of cardiac rehabilitation services, on average only 25% of cardiac patients who could benefit from cardiac rehabilitative care actually receive such services. Underutilization is most prominent among elderly patients, women, and minority populations. The major reasons for underutilization include:

- Lack of physician awareness of the scope of cardiac rehabilitation (i.e., not solely the provision of exercise training, but also delivery of comprehensive secondary preventive services)
- Inadequate insurance reimbursement for cardiac rehabilitative services (i.e., payers fail to translate the short-term costs into the long-term value of cardiac risk reduction)
- Limited patient access to traditional hospital-based outpatient programs due to travel distance, lack of transportation, or program hours that conflict with work or personal schedules, all problems that may be rem-

edied by home-based or other nontraditional venues for cardiac rehabilitative care

This volume is designed to expand the reader's awareness of cardiac rehabilitative care and its availability. It is a contemporary and succinct, yet rich, resource that describes the scope of contemporary cardiac rehabilitative care and reviews progress in scientific research since publication of the Clinical Practice Guideline in 1995. In addition, the scientific recommendations are translated into practical applications designed to improve the quality and consistency of cardiac rehabilitation practice.

The audience for whom this book is intended includes cardiologists, cardiovascular surgeons, internists, and primary care and family practitioners, all of whom are in an ideal position to refer cardiac patients for these services. This volume will also be of value to the entire spectrum of healthcare professionals in various disciplines (physicians, nurses, exercise specialists, dietitians, physical and occupational therapists, behavioral counselors, vocational rehabilitation counselors, etc.) whose daily work brings them into contact with recovering cardiac patients whose physical and psychosocial status could be improved by participation in a cardiac rehabilitation program.

This book will also be of interest to administrators and managers of hospitals, health systems, managed care organizations, and health insurance companies who seek information about the most effective and efficient models of delivery of cardiac rehabilitation in diverse settings and may assist in upgrading current practice for the next century. Further, students in all cardiac-related venues will find state-of-the-art descriptions of both the science and the practice of cardiac rehabilitation, and research scientists can ascertain areas of cardiac rehabilitation in need of additional study.

The editors and contributors hope that the knowledge and expertise shared in this volume will emphasize the need for and value of cardiac rehabilitation services so that benefits derived from participation in cardiac rehabilitation can be maximized. In the 21st century, all patients who can benefit from cardiac rehabilitation services should receive them. This book is designed to provide a unified step toward that new reality.

Nanette K. Wenger
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Contributors

Philip A. Ades, M.D. Professor and Director, Cardiac Rehabilitation and Preventive Cardiology, Department of Medicine, University of Vermont College of Medicine, Burlington, Vermont

Gary J. Balady, M.D. Professor and Director, Preventive Cardiology, Boston University Medical Center, Boston, Massachusetts

Kathy Berra, M.S.N., A.N.P., F.A.A.C.V.P.R. Project Director, Stanford Center for Research in Disease Prevention, Stanford University School of Medicine, Palo Alto, California

Matthew M. Burg, Ph.D. Chief, Health Psychology, Veterans Affairs Medical Center, and Assistant Clinical Professor, Section of Cardiovascular Medicine, Yale University School of Medicine, New Haven, Connecticut

Lora E. Burke, Ph.D., M.P.H., R.N. Postdoctoral Fellow, Cardiovascular Behavioral Medicine, Department of Psychiatry, University of Pittsburgh, Pittsburgh, Pennsylvania

Rebecca P. Cameron, M.D. Professor, Department of Psychiatry and Behavioral Sciences, Stanford University School of Medicine, Palo Alto, California

Lauralyn B. Cannistra, M.D. Assistant Professor, Brown University School of Medicine and Memorial Hospital of Rhode Island, Pawtucket, Rhode Island

Patricia McCall Comoss, R.N., B.S., F.A.A.C.V.P.R. Consultant for Cardiac Rehabilitation, Nursing Enrichment Consultants, Inc., Harrisburg, Pennsylvania

Karen Congdon, R.N., M.S. Former Director of Cardiac Rehabilitation, University of Rhode Island, Kingston, Rhode Island

Jill Crandall, M.D. Assistant Clinical Professor, Mount Sinai School of Medicine, New York, New York

Anne M. Dattilo, Ph.D., R.D., C.D.E. Nutritionist, Hawthorne Internal Medicine, Athens, Georgia

Dwight Davis, M.D. Director, Cardiac Rehabilitation, and Professor of Medicine, Pennsylvania State University College of Medicine, Hershey, Pennsylvania

Robert F. DeBusk, M.D. Professor, Department of Medicine, Stanford University School of Medicine, Palo Alto, California

Charles Dennis, M.D. Chairman, Cardiology Department, Deborah Heart and Lung Center, Browns Mills, New Jersey

Sue Dill, R.N., M.S.N., J.D. Director, Risk Management, Ohio Hospital Association, Columbus, Ohio

Mitzi A. Ekers, M.S., A.R.N.P. Vascular Nurse Practitioner, Clearwater, Florida

Joan M. Fair, A.N.P., Ph.D. Research Project Director, Stanford Center for Research in Disease Prevention, Stanford University School of Medicine, Palo Alto, California

Barbara J. Fletcher, R.N., M.N., F.A.A.N. Clinical Associate Professor, Department of Nursing, College of Health, University of North Florida, Jacksonville, Florida

Gerald F. Fletcher, M.D. Professor, Department of Cardiovascular Disease, Mayo Clinic Jacksonville, Jacksonville, Florida

Amy L. Fowler, B.S. Exercise Specialist, Cardiac Rehabilitation and Exercise Laboratories, William Beaumont Hospital, Royal Oak, Michigan

Barry A. Franklin, Ph.D. Director, Cardiac Rehabilitation and Exercise Laboratories, Department of Cardiology, William Beaumont Hospital, Royal Oak, Michigan

Erika Sivarajan Froelicher, R.N., M.P.H., Ph.D., F.A.A.N. Department of Physiological Nursing and Department of Epidemiology and Biostatistics, Schools of Nursing and Medicine, University of California, San Francisco, California

Valentin Fuster, M.D., Ph.D. Professor of Medicine and Director, Zena and Michael A. Wiener Cardiovascular Institute, Mount Sinai Medical Center, New York, New York

Alan J. Goble, M.D., F.R.C.P. (Lond), F.R.A.C.P. Heart Research Center, Carlton, Victoria, Australia

Paulo Sergio Gomes, Ph.D. Professor, Instituto de Educão Física, Universidade Gama Filho, Rio de Janeiro, Brazil

Neil F. Gordon, M.D., Ph.D., M.P.H. Medical Director, Center for Heart Disease Prevention, St. Joseph's/Candler Health System, Savannah, Georgia

Philip Greenland, M.D. Harry W. Dingman Professor of Cardiology and Chairman, Department of Preventive Medicine, Northwestern University Medical School, Chicago, Illinois

Linda K. Hall, Ph.D. Administrator, Health and Disease Management Service Line, BMHCC, Memphis, Tennessee

William Haskell, Ph.D., F.A.A.C.V.P.R., F.A.C.S.M. Professor of Medicine, Deputy Director, Stanford Center for Research in Disease Prevention, Stanford University School of Medicine, Palo Alto, California

Jody C. Heggestad, R.N., B.S.N., M.S., F.A.A.C.V.P.R. President, Heggestad Consulting Group, Boulder, Colorado

William G. Herbert, Ph.D., F.A.A.C.V.P.R., F.A.C.S.M. Professor, Exercise Science, Department of Human Nutrition, Foods, and Exercise, Virginia Polytechnic Institute and State University, Blacksburg, Virginia

Martha N. Hill, R.N., Ph.D. Professor and Director, Center for Nursing Research, Johns Hopkins University School of Nursing, Baltimore, Maryland

Nancy Houston-Miller, R.N., B.S.N. Associate Director, Stanford Cardiac Rehabilitation Program, Stanford University School of Medicine, Palo Alto, California

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Laura L. Kee, R.N., Ph.D. Clinical Nurse Specialist, Division of Cardiology, and Assistant Clinical Professor, School of Nursing, University of California, San Francisco, California

Carl N. King, Ed.D., F.A.A.C.V.P.R. Director, Heart Path Cardiac and Pulmonary Rehabilitation, Mission/St. Joseph's Health Care System, Asheville, North Carolina

Carl J. Lavie, M.D. Medical Co-Director, Cardiac Rehabilitation and Prevention, Ochsner Heart and Vascular Institute, New Orleans, Louisiana

Arthur S. Leon, M.D., F.A.C.C., F.A.C.S.M. Henry L. Taylor Professor, Division of Kinesiology, University of Minnesota, Minneapolis, Minnesota

Martha D. Livingston, R.N., M.S., M.B.A. Administrator, Heart Services, Grant/Riverside Methodist Hospitals, Columbus, Ohio

Cynthia L. MacDonald, M.S.N., R.N., C.S., A.N.P., F.A.A.C.V.P.R. Cardiovascular Case Manager, Resource Management, Trident Medical Center, Charleston, South Carolina

Richard V. Milani, M.D. Medical Co-Director, Cardiac Rehabilitation and Prevention, Ochsner Heart and Vascular Institute, New Orleans, Louisiana

Henry S. Miller, M.D. Professor, Wake Forest University School of Medicine, Winston-Salem, North Carolina

Fredric J. Pashkow, M.D. Medical Director, Exercise Testing Laboratory, Department of Cardiology, The Cleveland Clinic Foundation, Cleveland, Ohio

Peg Pashkow, P.T., M.Ed., F.A.A.C.V.P.R. Heart Watchers International, Inc., Solon, Ohio

Thomas A. Pearson, M.D., M.P.H., Ph.D. Professor and Chair, Department of Community and Preventive Medicine, University of Rochester School of Medicine, Rochester, New York

Ileana L. Piña, M.D. Professor of Cardiology and Director, Heart Failure and Cardiac Rehabilitation, Temple University, Philadelphia, Pennsylvania

Carol Rogers Pitula, Ph.D., R.N. Director of Psychiatric Nursing and Partial Hospitalization Program, Department of Psychiatry and Substance Abuse Services, Illinois Masonic Medical Center, and Associate Professor, RUSH University College of Nursing, Chicago, Illinois

Michael L. Pollock, Ph.D. Professor, College of Medicine and College of Health and Human Performance, and Director, Center for Exercise Science, University of Florida, Gainesville, Florida (Deceased)

Diane Shea Pravikoff, R.N., Ph.D. Director of Research, Cinahl Information Systems, Glendale Adventist Medical Center, Glendale, California

James Prochaska, Ph.D. Cancer Prevention Research Center, University of Rhode Island, Kingston, Rhode Island

Sanuj K. Ravindran, M.D. Jefferson Medical College, Philadelphia, Pennsylvania

Susan Rogutski, B.S.N., M.S. Cardiac Home Care Consultant, Columbia Montour Home Health, Bloomsburg, Pennsylvania

Robert A. Schweikert, M.D. Department of Cardiology, The Cleveland Clinic Foundation, Cleveland, Ohio

Donald A. Smith, M.D., M.P.H. Clinical Associate Professor of Medicine and Community and Preventive Medicine, Mount Sinai School of Medicine, New York, New York

L. Kent Smith, M.D., M.P.H. Director, Cardiac Rehabilitation and Drug Research, Arizona Heart Institute, Phoenix, Arizona

Wayne M. Sotile, Ph.D. Wake Forest University Cardiac Rehabilitation Program and Sotile Psychological Associates, Winston-Salem, North Carolina

Barbara H. Southard, R.N., M.S. Consultant, Health Management Consultants, Floyd, Virginia

Ray W. Squires, Ph.D. Director, Cardiovascular Health Clinic, and Associate Professor of Medicine, Division of Cardiovascular Diseases and Internal Medicine, Mayo Clinic and Foundation, Rochester, Minnesota

Eileen M. Stuart-Shor, M.S., R.N., C.S. Nurse Practitioner, Preventive Cardiology, Roxbury Heart Center, and Adjunct Faculty in Nursing, Graduate School for Health Studies, Simmons College, Boston, Massachusetts

Susan Herr Swails, R.N., B.S.N., M.Ed., F.A.A.C.V.P.R. Cardiac Rehabilitation Coordinator, Holy Spirit Hospital, Camp Hill, Pennsylvania

C. Barr Taylor, M.D. Professor, Department of Psychiatry and Behavioral Sciences, Stanford University School of Medicine, Palo Alto, California

Ken Tobin, D.O. Northern California Cardiology Associates, Sacramento, California

Barbara Tate Unger, R.N., B.S., F.A.A.C.V.P.R. Former Director, Cardiac Rehabilitation, Itasca Medical Center, and Director of Clinical Services, Grand Rapids Clinic, Grand Rapids, Minnesota

Deidre A. Warren, R.N., B.S.N., F.A.A.C.V.P.R. Cardiac Education/MULTIFIT Coordinator, Health Education Department, Kaiser Permanente, Oakland, California

Nanette K. Wenger, M.D., F.A.C.C., M.A.C.P., F.A.A.C.V.P.R. Professor of Medicine, Division of Cardiology, Emory University School of Medicine, Chief of Cardiology, Grady Memorial Hospital, and Consultant, Emory Heart and Vascular Center, Atlanta, Georgia

1

Overview: Charting the Course for Cardiac Rehabilitation into the 21st Century

Nanette K. Wenger
Emory University School of Medicine, Grady Memorial Hospital, and Emory Heart and Vascular Center, Atlanta, Georgia

INTRODUCTION

The U.S. Public Health Service definition of cardiac rehabilitation (1) states that:

> Cardiac rehabilitation services are comprehensive, long-term programs involving medical evaluation, prescribed exercise, cardiac risk factor modification, education, and counseling. These programs are designed to limit the physiological and psychological effects of cardiac illness, reduce the risk for sudden death or reinfarction, control cardiac symptoms, stabilize or reverse the atherosclerotic process, and enhance the psychosocial and vocational status of selected patients.

Simply stated, cardiac rehabilitation is a combination of services that helps patients with cardiovascular disease improve their functional abilities, particularly their tolerance for physical activity; decrease their symptoms; and achieve and maintain optimal health.

Several variables are likely to significantly influence the delivery of cardiac rehabilitative care in the next millennium. Pivotal among these are changes in the demography of the U.S. population, changes in the demography of cardiovascular

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disease, and changes in the patterns of clinical practice. Each will be addressed in turn.

CHANGES IN THE DEMOGRAPHY OF THE U.S. POPULATION

Since the middle of the nineteenth century, there has been an almost doubling of life expectancy at birth in the United States, from about 40 years to about 80 years. More than half of all individuals who ever lived beyond 65 years of age are alive today. Between 1988 and 2025 the total U.S. population will increase by about 23%; however, the most dramatic increase will occur among the elderly, with the 60- to 74-year age group predicted to increase by 85% and the group older than 75 years of age by 98%. The over-85 population subgroup is the fastest growing segment of the U.S. population. Since cardiovascular disease remains the major health problem in this elderly population, there will be an unprecedented acceleration in the requirement for cardiac rehabilitation services. As well, owing to their greater life expectancy, women will continue to be disproportionately represented among the elderly. A far greater proportion of U.S. inhabitants will be from the populations previously considered as racial and ethnic minorities. Thus, the landscape of patients with cardiovascular disease will increasingly be characterized by elderly age (2), more often women and individuals from minority groups, many of whom are from lower socioeconomic background. There is currently a substantial disparity in the utilization of cardiac rehabilitation, with lower rates documented among older individuals, women, those with less education, and the unemployed; the need for and utilization of cardiac rehabilitation services by these undeserved populations will likely entail a further major expansion.

Arguably, progressive education of the U.S. population regarding the benefits of rehabilitative care and improved patient expectations of favorable outcomes of cardiovascular illness should likewise escalate the demand for cardiac rehabilitation services. Finally, health values of the U.S. population increasingly target a lessening of symptoms and an improvement in functional status (i.e., enhancement of the quality of life). These goals are concordant with those of cardiac rehabilitation (i.e., limitation of the progression of cardiac illness and maintenance of the functional capabilities of the patient).

CHANGES IN THE DEMOGRAPHY OF CARDIOVASCULAR DISEASE

During the past two decades, unprecedented medical and surgical advances have increased the survival and limited the physiological morbidity of many cardiac patients. Owing to the increased effectiveness of medical and surgical management of cardiovascular disease, two polar patient populations are likely to be encountered for cardiac rehabilitation care. The first are patients who have benefited from the newest medical and surgical therapies, who bring a lesser burden of illness to rehabilitation, and who are at low risk of subsequent cardiovascular complications; for these individuals, preventive therapies must be highlighted. At the other end of the spectrum are patients whose survival has been enhanced by advanced technologies, but who now present, often at elderly age, with end-stage disease, particularly with serious residual myocardial ischemia and congestive heart failure. Heart failure has increased in prevalence related both to the growth of the elderly population and to improved heart failure therapies that have enhanced the duration of survival. Heart failure remains the major hospital discharge diagnosis at elderly age; overall, hospital discharges for heart failure have increased from 377,000 in 1979 to more than 800,000 in 1992 (3). The rehabilitative goals for these latter patients, rather than improvement in survival and return to work and an active lifestyle typical for their younger counterparts, should be diminution of symptoms, improvement in functional capabilities, and, particularly valued by these individuals, maintenance of self-sufficiency and functional independence, characterized by the ability to perform self-care and activities of daily living; and achievement of a personally satisfying lifestyle.

CHANGES IN THE PATTERNS OF CLINICAL PRACTICE

A cornerstone of the clinical practice of cardiology in the next millennium will be evidence-based medicine. The Clinical Practice Guideline *Cardiac Rehabilitation* (4) of the U.S. Agency for Health Care Policy and Research and the National Heart, Lung and Blood Institute is such a landmark document, providing the first comprehensive and objective examination of the specific outcomes of the delivery of cardiac rehabilitation. It documents the most substantial benefits or outcomes of cardiac rehabilitation as improvement in exercise tolerance, improvement in symptoms, improvement in blood lipid levels, reduction in cigarette smoking, improvement in psychosocial well-being and stress reduction, and reduction in mortality. Particular benefit of exercise training is recognized for patients with a decreased functional capacity at baseline. This evidence-based model defines that elderly patients attain improvement in functional capacity from exercise training comparable to their younger counterparts. Improvement in functional status occurs equally in elderly women and elderly men. Initially in observational studies and subsequently in randomized clinical trials, patients with compensated heart failure, including those with significant cardiac enlargement and following myocardial infarction, improved their functional capacity with exercise training (with this benefit additive to that of pharmacotherapy), without exercise training adversely affecting myocardial function. Similar evidence-based models will likely subsequently address the previously understudied patient subgroups—the elderly, women, and those with serious and advanced cardiovascular illness.

During the past three decades, progressive changes have occurred in the delivery of rehabilitative care for cardiac patients. These have included an expansion of the spectrum of cardiovascular illnesses considered eligible for and likely to benefit from cardiac rehabilitation in general and exercise rehabilitation in particular (5). Whereas in the early years of cardiac rehabilitation most patients were those recovered from uncomplicated myocardial infarction, included today are patients with complications of myocardial infarction including residual myocardial ischemia, heart failure, and arrhythmias; those recovering from myocardial revascularization procedures; elderly patients; patients with valvular heart disease with and without surgical correction; patients with cardiac enlargement and compensated heart failure; patients with surgically "corrected" congenital heart disease; medically complex patients with significant comorbidity, often receiving multiple cardiac medications; those with implanted cardiac pacemakers; and those following cardiac transplantation, among others. Many of these categories of patients were initially arbitrarily excluded from exercise rehabilitation regimens. The optimal modes, duration, and needs for surveillance of the exercise training of these severely ill patients have yet to be determined.

Changes in patterns of cardiac clinical care and changes in policies for insurance reimbursement also have altered substantially the components and timing of cardiac rehabilitation. Rehabilitative care is initiated earlier, particularly for coronary patients who received acute interventions designed to salvage myocardium and subsequent revascularization preocedures to improve outcomes; there is abbreviation of the intensity and duration of professional surveillance, with earlier transition to independence in rehabilitative activities, and with an escalating emphasis on return-to-work as an economic imperative.

A concomitant occurrence has been major evidence-based changes in the recommendations for and application of exercise training (4). Prominent among these are the decreased level of supervision for low-risk patients, a lower intensity of exercise compensated for by an increase in exercise duration, and the application of resistance exercises for appropriately selected patients. Because economic constraints and logistics often limit the availability of supervised cardiac rehabilitation, home-based rehabilitation will likely prove attractive to a variety of low- to moderate-risk cardiac patients, who may also participate in rehabilitation regimens in the workplace. Randomized clinical trial data have shown comparable benefit from supervised and home-based exercise training. The cost-saving aspects of this alteration in the delivery of cardiac rehabilitation services is currently being ascertained.

Education and counseling for patients and their family members is a cornerstone of cardiac rehabilitation (4), designed to provide the information needed

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to assume responsibility for personal health care and the skills needed to insure attainment and maintenance of optimal cardiovascular health. Skill building and motivation are integral components of rehabilitative education and counseling. Modification of lifestyle and other risk factors in patients with cardiovascular disease can reduce cardiac events and deaths, improve symptoms, and enhance the quality of life. Clinical practice pathways are likely to encourage the application of preventive services and thus the utilization of rehabilitative care. The application of behavioral intervention techniques to encourage patients to adopt and systematically implement new healthy behaviors is likely to constitute an important component of the cost-effectiveness of the delivery of these rehabilitation services. Home-based programs of education and counseling involve planned communication and guidance by specially trained rehabilitation personnel. Newer and interactive technologies (6) have potential advantages in effectively tracking and following patient data; in enabling high-quality and more readily available instruction distant from a medical care setting; and in extending the influence of health professionals.

Psychosocial consequences of cardiac illness often impair the cardiac patient's functional capabilities to a greater extent than do their residual physical limitations. Interventions must be designed to limit emotional and social disability.

Although secondary preventive services for cardiovascular risk reduction are routinely recommended for patients with cardiovascular disease, many high-risk populations including older individuals, women, those with less education and the unemployed are less likely to utilize cardiac rehabilitation (7). Changes in managed care will most likely focus increasingly on preventive and rehabilitative care, with this care often being delivered in the home, in the workplace, or in other previously nontraditional care sites.

There will be increased emphasis both on multidisciplinary care and on the individualization of services, such that the assessment, enhancement, and maintenance of physiological, psychosocial, and vocational status will be appropriate for an individual patient's medical needs, goals, and personal preferences. Individualization of rehabilitative care should affect favorably a patient's coping skills, perceptions of personal health status, and functional capabilities and thereby improve the quality of the patient's life. Cost-effectiveness will also require increased diversity in the delivery of rehabilitative care to meet the needs and desires of diverse cardiac populations, diverse as to age, severity of illness, symptoms, comorbidity, and expectations of outcomes. The increased requirement for the diversity of provision of services and the diversity of sites for ambulatory care provides a major opportunity for the creative delivery of cardiac rehabilitation. The challenge to health care professionals is to maintain quality care, efficacy, and safety in a setting of diminishing resources. Patient care guidelines involving physician–nonphysician collaboration continue to proliferate (8); this is the model of care on which cardiac rehabilitation services have traditionally been built.

Cost utility analyses have shown the costs of cardiac rehabilitation to be comparable to those of other routinely offered treatments (9). As well, cardiac rehabilitation can produce financial savings by lessening rates of hospital readmission and potentially by improving rates of reemployment.

SUMMARY

Given the prominent benefits documented from the application of cardiac rehabilitation, of concern is that fewer than one-third of cardiac patients in the United States eligible for cardiac rehabilitation currently participate. The challenge is to overcome barriers to such participation for this sizeable population of cardiac patients; barriers include lack of access, lack of physician referral, reimbursement issues, and personal reluctance to modify lifestyle habits.

A further challenge for the twenty-first century will be to select, develop, and provide appropriate rehabilitation services for individual cardiac patients; this includes tailoring the method of delivery of these services. The selection strategy should incorporate both the recommendations of health care providers and patient preferences and should be designed to facilitate progressive independence in cardiac rehabilitation and long-term comprehensive care.

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Benefits of Exercise Training

L. Kent Smith
Arizona Heart Institute, Phoenix, Arizona

Nanette K. Wenger
Emory University School of Medicine, Grady Memorial Hospital, and Emory Heart and Vascular Center, Atlanta, Georgia

INTRODUCTION

The U.S. Public Health Service defines cardiac rehabilitation services as

> comprehensive, long-term programs involving medical evaluation, prescribed exercise, cardiac risk factor modification, education, and counseling. These programs are designed to limit the physiological and psychological effects of cardiac illness, reduce the risk of sudden death or reinfarction, control cardiac symptoms, stabilize or reverse the atherosclerotic process, and enhance the psychosocial and vocational status of selected patients (1).

Thus, contemporary cardiac rehabilitation encompasses a multifactorial approach to individualized prescriptive exercise training and education, counseling, and behavioral interventions. This chapter addresses the exercise training component and highlights the benefits of such training.

The most rigorous scientific examination of benefit derives from the Clinical Practice Guideline *Cardiac Rehabilitation* of the Agency for Health Care Policy and Research (AHCPR) and the National Heart, Lung and Blood Institute (NHLBI) (2), an evidence-based document that relates the effects of exercise training in a cardiac rehabilitation setting to specific outcomes (e.g., exercise tolerance, symptoms, coronary risk reduction, psychosocial factors, etc). AHCPR Guidelines require that all scientific evidence be considered, the consequences of different options be assessed, and the scientific evidence and subjective judg-

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ments supporting the chosen options be described explicitly. As such, this is a comprehensive and objective examination of specific results or outcomes of the implementation of exercise training. Based on this detailed and extensive review of the scientific literature, the most consistently observed benefits of cardiac rehabilitation exercise training include improvement in exercise tolerance, improvement in symptoms, improvement in psychosocial well being, improvement in social adjustments and functioning, and reduction in mortality. The Guideline detailed the rehabilitation outcomes for patients with multiple presentations of coronary heart disease, as well as patients with heart failure and ventricular systolic dysfunction and those following cardiac transplantation. Each of these aspects will be addressed in more detail.

Other guidelines have used expert opinion as well as data from the scientific literature to define benefits and included broader categories of patients based on cardiovascular diagnosis.

THE CLINICAL PRACTICE GUIDELINE, *CARDIAC REHABILITATION: OUTCOMES OF AND RECOMMENDATIONS FOR EXERCISE TRAINING*

Exercise Tolerance

The beneficial effect of cardiac rehabilitation exercise training on exercise tolerance was one of the most clearly established favorable outcomes for coronary patients with a wide variety of clinical presentations: angina pectoris, myocardial infarction, and following myocardial revascularization with coronary artery bypass graft surgery or percutaneous transluminal coronary angioplasty, as well as for patients with compensated heart failure, decreased ventricular ejection fraction, and following cardiac transplantation. Objective measures of exercise tolerance improved consistently, without significant cardiovascular complications or adverse outcomes. Appropriately prescribed and conducted exercise training is recommended as an integral component of cardiac rehabilitation, with particular benefit identified for patients with decreased exercise tolerance. It was highlighted that continued exercise training is required to sustain the improvement in exercise tolerance (3).

Strength Training

Strength or resistance training improves skeletal muscle strength and endurance in clinically stable coronary patients. The absence of signs and symptoms of myocardial ischemia, abnormal hemodynamic changes, and cardiovascular complications in the studies reviewed suggest that training measures designed to increase skeletal muscle strength can safely be included in the exercise-based rehabilitation of clinically stable coronary patients, typically those who previously participated in rehabilitative aerobic exercise training. Appropriate instruction and surveillance must be provided (4). Improvement in muscle strength can benefit patients' performance of activities of daily living.

Exercise Habits

Although cardiac rehabilitation exercise training promotes increased participation in exercise by patients after myocardial infarction and coronary artery bypass surgery, this effect does not persist long term after completion of exercise rehabilitation. Health care providers must encourage patients to continue exercise activities following formal cardiac rehabilitation, since long-term exercise training is requisite to maintain the benefit of enhanced exercise tolerance (5).

Symptoms

Exercise rehabilitation decreases angina pectoris in patients with coronary heart disease and decreases symptoms of heart failure, particularly dyspnea and fatigue, in patients with left ventricular systolic dysfunction (6). Exercise training is recommended as an integral component of the symptomatic management of these patients.

Smoking

Although exercise training as a sole intervention had little or no effect on smoking cessation, specific smoking cessation strategies are recommended. A combined approach of cardiac rehabilitation education, counseling, and behavioral interventions results in smoking cessation and relapse prevention (7).

Lipids

Exercise training as a sole intervention has an inconsistent effect on lipid and lipoprotein levels, emphasizing the need for multifactorial interventions to achieve optimal lipid levels. The rehabilitation studies that reported the most favorable impact on lipid levels were multifactorial, providing exercise training, dietary education and counseling, and in some studies, pharmacological treatment, psychological support, and behavioral training. The specific effects of exercise training could not be isolated (8).

Body Weight

Exercise training as a sole intervention has an inconsistent effect on controlling overweight, although no exercise training studies specifically targeted overweight patients. Optimal management for overweight patients to promote maintenance of weight loss requires multifactorial rehabilitation, including nutrition education and counseling, and behavioral modification in addition to exercise training (9).

Blood Pressure

Exercise training as a sole intervention has no demonstrable effect on lowering blood pressure levels, although most of the scientific reports analyzed included a mixed sample of normotensive patients and a small proportion of hypertensive patients; no study was specifically designed to address hypertension control in patients with elevated blood pressures participating in exercise-based cardiac rehabilitation. Expert opinion supports a multifactorial education, counseling, behavioral, and pharmacological approach as the recommended strategy for control of hypertension.

Psychological Well-Being

Exercise training improves measures of psychological status and functioning, although inconsistent effects were evident in improving measures of anxiety and depression. Prominent benefit was noted among patients with high levels of distress at the time of entry into the cardiac rehabilitation study. Patients participating in exercise rehabilitation perceive themselves as improving in a number of psychosocial domains, although these perceptions may not be objectively documented. Studies of exercise rehabilitation as a sole intervention are confounded by the consequences of group interaction, the formation of social support networks, peer and professional support, and counseling and guidance, all of which may affect the patient's depression, anxiety, and self-confidence. Education, counseling, and/or psychosocial interventions, either alone or as a component of multifactorial cardiac rehabilitation, result in improved psychological well being and are recommended to complement the psychosocial benefits of exercise training (10).

Social Adjustment and Functioning

Exercise training improves social adjustment and functioning as determined by measures such as the Sickness Impact Profile scores, leisure and social questionnaire scores, social activity scores, and scores of satisfaction with work and social interactions.

Return to Work

Cardiac rehabilitation exercise training exerts less of an influence on rates of return to work than many nonexercise variables including employer attitudes, prior employment status, economic incentives, and the like. Many patients return to work without formal interventions. Exercise training as a sole intervention has little influence on rates of return to work. However, in selected patients, formal cardiac rehabilitation vocational counseling may improve rates of return to work.

Morbidity and Safety Issues

The safety of exercise rehabilitation is well-established, with very low rates of myocardial infarction and cardiovascular complications during exercise training (11). No increase in cardiovascular complications or serious adverse outcomes was reported in any trial that evaluated exercise training of patients with coronary heart disease. No deterioration in measures of exercise tolerance was reported, nor did any controlled study document significantly greater improvement in exercise tolerance in control groups compared with exercise training groups.

Cardiac rehabilitation exercise training does not change rates of nonfatal reinfarction (12).

Mortality and Safety Issues

Based on meta-analyses, total and cardiovascular mortality are reduced in patients following myocardial infarction who participate in cardiac rehabilitation exercise training, especially as a component of multifactorial rehabilitation. However, these studies antedate contemporary nonrehabilitation interventions such as myocardial revascularization procedures and the use of newer pharmacological agents that may have far more powerful effects on survival. Information available from two large surveys of cardiac rehabilitation program responses to questionnaires provided retrospective safety data regarding exercise training; these identified that few fatal cardiac events occurred during or immediately following exercise training. Again, data from both survey reports antedate the use of contemporary risk stratification procedures and contemporary medical and surgical therapies for coronary heart disease and heart failure (13). Definitive information was not available regarding the effect of levels of supervision and of ECG monitoring of exercise training.

Pathophysiological Measures

Pathophysiological outcomes of exercise training were examined to identify the mechanisms whereby exercise training may engender benefit or harm. Cardiac rehabilitation exercise training as a sole intervention does not result in regression or limitation of progression of angiographically documented coronary atherosclerosis. However, exercise training, combined with intensive dietary intervention, with and without lipid-lowering drugs, results in regression or limitation of progression of angiographically documented coronary atherosclerosis (3).

Nor does cardiac rehabilitation exercise training have any apparent effect on the development of a coronary collateral circulation; it produces no consistent changes in cardiac hemodynamic measurements at cardiac catheterization. However, exercise training in patients with heart failure and a decreased ventricular ejection fraction produces favorable hemodynamic changes in the skeletal musculature and is recommended to improve skeletal muscle functioning.

Exercise training decreases myocardial ischemia as measured by exercise ECG, ambulatory ECG recording, and radionuclide perfusion imaging and is recommended to improve these measures of myocardial ischemia (14). Exercise training has little effect on ventricular ejection fraction and regional wall motion abnormalities and is not recommended to improve ventricular systolic function. The effect of exercise training on left ventricular function in patients after anterior Q-wave myocardial infarction with ventricular dysfunction is inconsistent (15). However, randomized trial data subsequent to publication of the Guideline showed improvement in functional capacity without deterioration of ventricular function in such patients (16).

Cardiac rehabilitation exercise training has inconsistent effects on ventricular arrhythmias.

Effect of Cardiac Rehabilitation Exercise Training on Special Populations

Cardiac rehabilitation exercise training improves functional capacity and symptoms in patients with heart failure and moderate-to-severe left ventricular systolic dysfunction (17), without adverse changes in left ventricular function (6). This approach is recommended to attain functional and symptomatic improvement in such patients. Adaptations in the peripheral circulation and skeletal musculature, rather than adaptations in the cardiac musculature, appear to mediate the improvement in exercise tolerance. Cardiac rehabilitation exercise training also improves measures of exercise tolerance in patients following cardiac transplantation.

Elderly coronary patients have exercise trainability comparable to younger patients participating in similar cardiac rehabilitation exercise training (18), with elderly female and male patients showing comparable improvement. No complications or adverse outcomes of exercise training at elderly age were described in any study reviewed. Thus, elderly patients of both genders should be strongly encouraged to participate in exercise-based cardiac rehabilitation.

REHABILITATION AFTER CARDIOVASCULAR DISEASES: REPORT OF THE EXPERT COMMITTEE OF THE WORLD HEALTH ORGANIZATION

This 1993 report (19) concluded that cardiac rehabilitation, which encompasses individualized physical activity regimens and the health education and counseling appropriate for an individual patient's needs and specific cardiac problems, should be an integral part of the long-term comprehensive care of all cardiac patients. The anticipated benefits enumerated included improvement in function and health status, quality of life, social independence and place in society, and work resumption and continuation. The World Health Organization (WHO) report highlighted that cardiac rehabilitation services can improve recovery from cardiovascular illness via several pathways, including increasing the capability for physical activity, increasing the rapidity of physical recovery, and aiding in the prevention of cardiac invalidism.

GUIDELINES FROM THE AMERICAN COLLEGE OF SPORTS MEDICINE

The American College of Sports Medicine statement pertaining to the role of cardiac rehabilitation and exercise training in patients with cardiac disease is presented in the third edition of the resource manual (20). It identifies that "Comprehensive cardiac rehabilitation combines prescriptive exercise training with risk factor modification." Several important goals of cardiac rehabilitation are also enumerated: improved functional capacity, improved or lessened activity-related symptoms, reduced disability, and identification and modification of coronary artery disease risk factors in an effort to reduce subsequent cardiovascular-related morbidity and mortality.

THE NATIONAL INSTITUTES OF HEALTH CONSENSUS DEVELOPMENT PANEL ON PHYSICAL ACTIVITY AND CARDIOVASCULAR HEALTH

This consensus conference emphasized that more than 10 million Americans have cardiovascular disease and that increased physical activity appears to benefit these patients. Among the benefits recognized were reduction in cardiovascular mortality, reduction of symptoms, improvement in exercise tolerance and functional capacity, and improvement in psychological well-being and quality of life (21).

The panel concluded that appropriately prescribed and conducted exercise training programs improve exercise tolerance and physical fitness in patients with coronary heart disease and cited that moderate as well as vigorous exercise training regimens were of value. Also addressed was that patients with congestive heart failure appeared to show improvement in symptoms, exercise capacity, and functional well-being in response to exercise training.

The recommendation was that clear medical and economic reasons are present for implementing cardiac rehabilitation programs. Optimal outcomes are achieved when exercise training is combined with educational messages and feedback about changing lifestyle. Patients who participate in cardiac rehabilitation programs show a lower incidence of rehospitalization and lower charges per hospitalization. Cardiac rehabilitation is a cost-efficient therapeutic modality that should be used more frequently.

OTHER BENEFICIAL RESULTS OF EXERCISE TRAINING

In coronary patients, physiological adaptations to exercise training decrease the myocardial oxygen demand for any submaximal task, such that angina often does not limit activities of daily living. This, combined with improvement in endurance and physical work capacity, can prolong the duration of an active lifestyle, particularly at an elderly age (22). As well, the enhancement of flexibility, joint mobility, balance, stability, muscle strength and tone, and neuromuscular coordination can decrease the likelihood of falls at elderly age. Moderate exercise can retard bone demineralization and resultant osteoporotic fractures, particularly important in elderly women among whom osteoporosis predominates (23,24).

Physical activity has been described to favorably affect a number of coronary risk factors. Improvements include an increase in HDL cholesterol, a decrease in triglycerides, better blood pressure control, improved glucose tolerance and insulin sensitivity, improvement in body fat distribution, enhanced fibrinolysis, and more favorable platelet function, among others (25–28). The increased energy expenditure of exercise can also aid in weight control.

Improvement in self-confidence, sense of well-being, and self-image with lessening of anxiety, depression, and loss of motivation is also described (29). Although some studies describe an association between exercise training and improved cognitive and motor speed function at elderly age, it is likely that elderly patients who are less depressed test better and this, more likely, reflects the favorable effect of exercise on depression rather than on cognitive and motor function.

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The National Institutes of Health Consensus Conference Statement on Physical Activity and Cardiovascular Health

Arthur S. Leon
University of Minnesota, Minneapolis, Minnesota

The National Institutes of Health (NIH) Consensus Development Conference was held on the NIH Campus in Bethesda, MD, December 18 to 20, 1995. The major topics addressed at this Conference included the contributions of physical activity to health in the United States, current issues related to the type and intensity of physical activity to the prevention of cardiovascular disease (CVD), the effects of physical activity on risk factors for CVD, behavioral and sociocultural detriments of a physically inactive lifestyle, the cardiac risks of vigorous physical activity, recommendations for the promotion of physical activity by health care providers and communities, and the principal focus of this chapter, the contribution of physical activity to cardiac rehabilitation and the secondary prevention of CVD. The consensus development panel consisted of 11 academically based health professionals from disciplines other than exercise science, a practicing pediatric cardiologist, and a bank executive. It was chaired by Dr. Russell Luepker, Professor and Head of the Division of Epidemiology, School of Public Health, University of Minnesota. The Consensus Statement ensuing from this conference was based on the panel's deliberations following the presentations and public discussions and was published in 1996 (1). In addition, extended detailed summaries of the 28 conference presentations on which the Consensus Statement was based were published (2).

Topics specifically pertaining to cardiac rehabilitation services discussed

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at the conference included the following: the current clinical practice guidelines (3,4), an update on the contributions of exercise programs to the secondary prevention of CVD (4), behavioral and psychosocial issues (5), the safety and effectiveness of alternate modes of delivery of rehabilitation services (including home exercise programs) (6), the effects on health-related quality of life (7), and cost-effectiveness economic analyses (7). These topics are summarized in the Consensus Statement under the heading "What are the benefits and risks of different types of physical activity for people with CVD?" and are briefly reviewed below.

The prevalence of known clinically significant CVD among Americans is currently over 10.6 million, including people with myocardial infarction, angina pectoris, peripheral vascular disease, congestive heart failure, and those who have had coronary artery bypass graft surgery and coronary angioplasty. There was a consensus that, in general, all these categories of people with CVD can potentially benefit by an increase in physical activity. The benefits of increased physical activity include a reduction in CVD symptoms and mortality and improvements in functional capacity, psychological well-being, and quality of life.

Comprehensive cardiac rehabilitation services, including exercise training and multiple risk factor intervention, appear based on reports in the literature to reduce overall mortality as well as CVD mortality in approximately 25% of participants after an initial acute myocardial infarction. Both moderate and vigorous habitual physical activity have been associated with reduced risk for fatal cardiac events in people with CVD or at high risk for CVD; however, uncertainty exists regarding the minimal and optimal intensity and duration of exercise required to reduce CVD mortality. Data also are inadequate as to the role of physical activity status or exercise training in primary or secondary prevention of stroke.

In evaluating the safety of exercise cardiac rehabilitation, it was the Consensus Panel's judgment that the risk of death was very low during medically supervised exercise programs; however, it was recognized that previously sedentary individuals with poor functional capacity were at higher risk than other CVD patients for fatal complications during exercise. Thus, it was recommended that a medical evaluation is warranted prior to participation of cardiac patients in a vigorous exercise program.

The Panel discussed in more detail specific documented benefits from "appropriately prescribed and conducted exercise training programs" for patients with heart disease. These include improved cardiorespiratory fitness and skeletal muscle strength from even moderate-intensity endurance and resistance exercise training, particularly in patients with low initial levels of functional capacity. These adaptations result in improved exercise and work capacity. However, the panel felt that this unfortunately has been found to have less of an impact on rates of return to work than many nonexercise-related variables (e.g., employer's attitude, prior job status, and economic incentives). Symptomatic improvement of patients with stable angina pectoris and selected patients with congestive heart failure (CHF) also have been demonstrated by exercise training to the satisfaction of the Panel. Decreased myocardial oxygen demand during submaximal exercise and increased work capacity were the mechanisms proposed for the clinical improvement in patients with angina. The reduction in symptoms and improved functional capacity with exercise training in patients with CHF occur in the absence of improvement in left ventricular systolic function; presumably the improvement in functional capacity is due to peripheral adaptations, involving exercise-trained skeletal muscle. It is advised that CHF patients have carefully designed exercise prescriptions and that the exercise be carefully monitored because of their marked predisposition for ischemic events and serious arrhythmias.

In addition to exercise training, multifactorial risk factor intervention is recommended to reduce risk factors for CVD and to improve the general health status of cardiac patients. This should include dietary and smoking intervention and administration of appropriate medications.

The Panel deplored the currently low medical referral rate and low participation rate of potentially eligible patients with CVD in traditional institutional and group-based cardiac rehabilitation programs. Referral rates are lower for women than for men and for nonwhite as opposed to white CVD patients. Home-based programs were felt to have the potential to extend rehabilitation programs to a wider patient population. Such programs, which incorporate limited hospital visits with regular mail or telephone follow-up by a nurse manager, have demonstrated improvements in functional capacity and other risk factors in participating CVD patients.

The Panel concluded that there are clear medical and economic reasons for cardiac rehabilitation services. Optimally, these should provide exercise training together with educational messages and feedback about changing lifestyles affecting CVD risk factor status. Finally, it was the Panel's opinion that cardiac rehabilitation is a cost-effective therapeutic modality that results in a lower rate of rehospitalization as well as costs per hospitalization.

ACKNOWLEDGMENTS

Appreciation is expressed to Marilyn Borkon for preparation of this manuscript. Dr. Leon is supported in part by the Henry L. Taylor Professorship in Exercise Science and Health Enhancement and by a grant from the NHLBI (2RO1-HL47323-06A1).

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Rehabilitation Considerations in Exercise Testing

Barry A. Franklin and Amy L. Fowler
William Beaumont Hospital, Royal Oak, Michigan

Ken Tobin
Northern California Cardiology Associates, Sacramento, California

According to a World Health Organization Expert Committee on Rehabilitation, the primary purpose of an exercise test is to determine the responses of the individual to effort at given levels, and from this information to estimate probable performance in specific life and occupational situations (1). Assessing exercise tolerance and, if possible, aerobic capacity or maximal oxygen consumption ($\dot{V}O_{2max}$), is an important part of the evaluation to develop a safe and effective activity prescription. Results from the exercise test help to establish appropriate intensities for training the lower and/or upper extremities and identify occupational and leisure-time activities that are compatible with the patient's physical work capacity.

This chapter addresses diagnostic and functional applications for exercise testing in the evaluation of cardiac patients, with specific reference to purposes (indications and contraindications), fundamentals (methodology), and physiological principles, exercise prescription, and return to work.

PURPOSES, FUNDAMENTALS, AND PHYSIOLOGICAL PRINCIPLES

Exercise stress testing is generally recommended for one or more of the following reasons (2): to evaluate cardiopulmonary fitness, commonly expressed in millili-

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ters of oxygen per kilogram per minute (mL/kg/min) or as metabolic equivalents (METs; 1 MET = 3.5 mL/kg/min); to assess the efficacy of interventions such as coronary artery bypass graft (CABG) surgery, percutaneous transluminal coronary angioplasty (PTCA), medications, or physical conditioning; to clarify the safety of vigorous physical exertion; to formulate an effective exercise prescription; to ascertain work-related capabilities; and to aid in clarifying prognosis via risk stratification. Although the occurrence of cardiovascular events associated with exercise testing is relatively low (3), the ability to maintain a high degree of safety depends on knowing when not to perform the test (i.e., absolute and/or relative contraindications), when to terminate the test, and being prepared for any emergency that may arise (4). Common contraindications to exercise testing include unstable angina, uncontrolled atrial or ventricular dysrhythmias that may compromise cardiac function, acute congestive heart failure, severe aortic stenosis, acute infection, third-degree heart block (without pacemaker), active myocarditis or pericarditis, and a recent significant change in the electrocardiogram (ECG) (5).

Equipment and Methodology

Standard lower and upper extremity exercise tests, using either the cycle ergometer or the treadmill, have the advantage of reproducibility and quantitation of physiological responses to known external work loads. The cycle ergometer has several advantages in that it is portable, requires less space, makes less noise, and generally costs less than the treadmill. It also minimizes movement of the torso and arms, which may facilitate better quality ECG recordings and easier blood pressure measurements, and provides an alternative to treadmill testing for patients with lower extremity limitations that restrict weight bearing (4). Its main disadvantage is that it often results in localized leg fatigue.

Treadmill testing provides a more common form of physiological stress in which subjects are likely to attain a slightly higher $\dot{V}O_{2max}$ and heart rate than that obtained during cycle ergometry. The treadmill protocol should generally last 8 to 12 min for patients limited by fatigue, and all patients should reach their peak performance by 15 min (6). Because it is inconvenient to measure oxygen consumption directly (this requires sophisticated equipment, technical expertise, and frequent calibration), clinicians have increasingly sought to predict or estimate $\dot{V}O_{2max}$ from the treadmill speed and percent grade (Figs. 1 and 2) (2,7). Postexercise procedures generally involve either continued walking or an immediate supine recovery; the former has been suggested for increased safety (8) whereas the latter is associated with enhanced sensitivity (9).

A recent advance in test methodology that can overcome many of the limitations of conventional exercise test protocols is ramping (10). Ramping involves a nearly continuous and uniform increase in work rate that replaces the "staging"

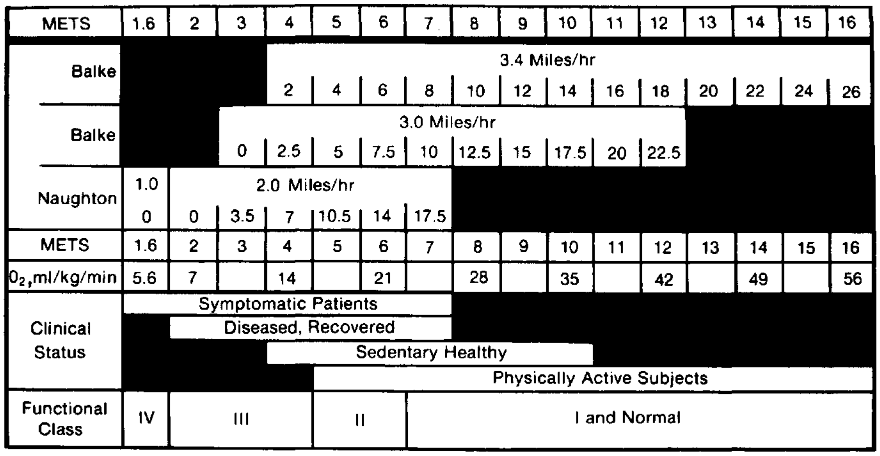

Figure 1 Metabolic cost of three common treadmill protocols; one metabolic equivalent (MET) signifies resting energy expenditure, equivalent to approximately 3.5 mL/kg/min. Unlabeled numbers refer to the treadmill grade, expressed as a percentage. The patient's clinical status and functional class (I–IV) corresponding to the peak attained workload are also shown.

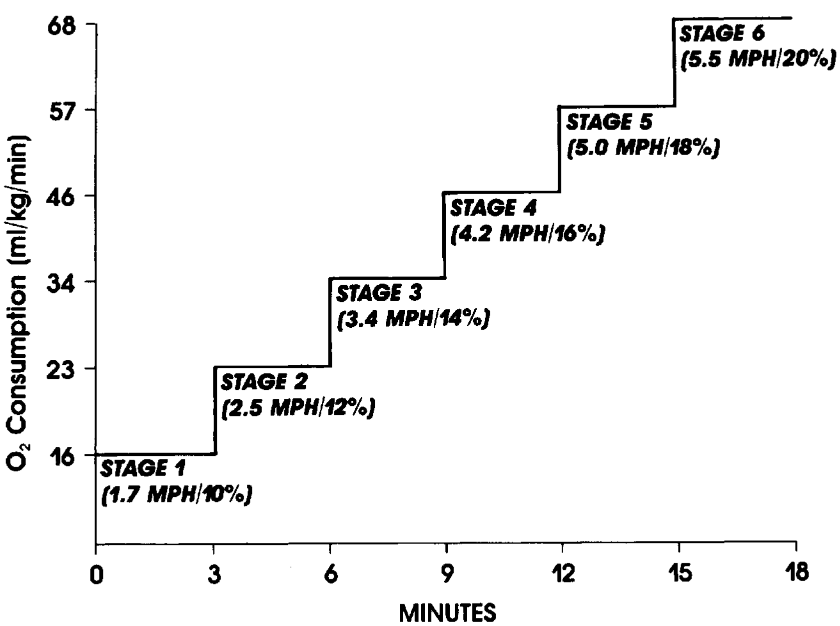

Figure 2 The standard Bruce treadmill protocol showing progressive stages (speed, percentage grade) and the corresponding aerobic requirement, expressed as mL/kg/min.

used in conventional treadmill tests. The gradual increase in demand allows a steady increase in somatic and myocardial aerobic requirements. Protocols have been developed for use with both the treadmill and cycle ergometer that provide for ramping increments appropriate to the wide range of patient exercise capacities.

Dynamic arm exercise testing provides a satisfactory but perhaps less sensitive alternative to leg ergometry to evaluate cardiorespiratory function in subjects with neurological, vascular, or orthopedic impairment of the lower extremities (Table 1) (11). In addition, arm exercise testing appears to be the functional evaluation of choice for persons whose occupational and leisure time physical activity is dominated by upper extremity efforts, since leg exercise testing suboptimally predicts arm performance capacity, and vice versa (12).

Because a smaller muscle mass is used in arm ergometer testing, and because most persons are not physically conditioned for sustained upper extremity exercise, low initial work loads (≤200 kgm/min) and small work load increases per stage (100 to 150 kgm/min) are recommended. The protocol may consist of continuous or intermittent progressive exercise, with each exercise stage lasting 2 to 3 min; the latter typically allows 1 to 2 min of rest between stages. A unique

Table 1 Indications for Upper Extremity Exercise Tests

Type of test	Equipment	Objectives/ evaluations	Applications
Rhythmic, isotonic, upper extremities	Modified Arm-Crank Ergometer, Monarch Rehab Trainer, Schwinn Air-Dyne Ergometric Exerciser	To determine submaximal and maximal cardiorespiratory and hemodynamic responses to sustained upper extremity exertion	*Occupations:* Sawing, machine operation, manual labor, ditch digging, landscaping *Recreation:* Swimming, canoeing, cross-country skiing, paddleball *Clinical:* Patients with intermittent claudication, orthopedic/arthritic limitations, paraplegia

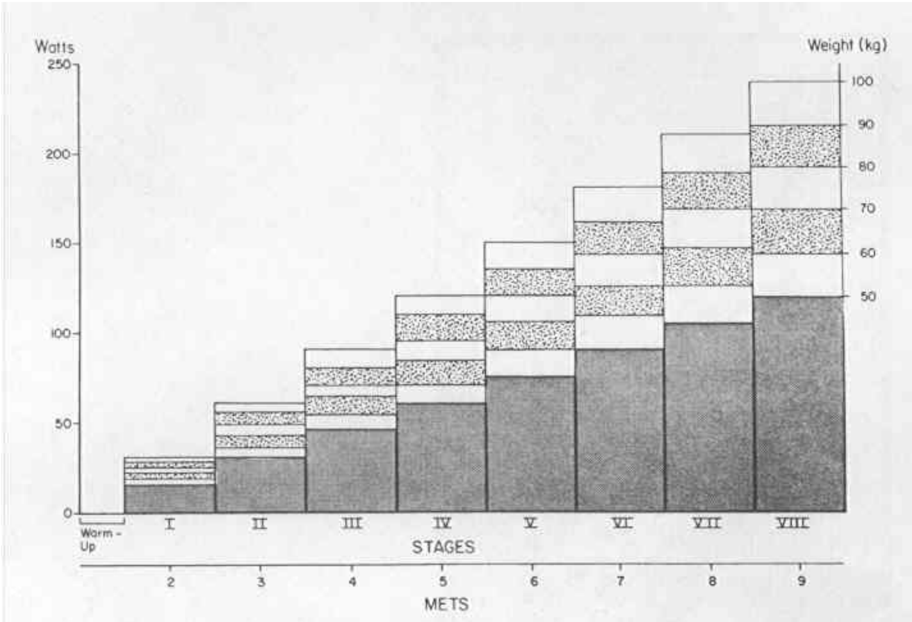

Figure 3 Weight-adjusted arm ergometry protocol. Two-minute stages are employed at a crank rate of 60 revolutions per minute. One watt ~ 6 kgm/min. (Adapted from Ref. 13).

arm ergometer protocol in which the initial and incremental work loads are individually determined, based on the subject's body weight, with 1 MET increments per stage, is shown in Figure 3 (13). Peak effort is defined as the power output at which the patient is no longer able to maintain the designated cranking speed (generally 40 to 60 rpm) or the work rate at which adverse signs or symptoms develop.

Responses to Exercise Testing

Exercise testing of the cardiac patient permits evaluation of the $\dot{V}O_{2max}$; hemodynamics, assessed by the heart rate and systolic/diastolic blood pressure responses; limiting clinical signs or symptoms; and associated changes in electrical functions of the heart, especially supraventricular and ventricular dysrhythmias and ST segment displacement (Fig. 4).

Electrocardiographic responses to exercise testing should be interpreted according to the magnitude and configuration of ST segment displacement and

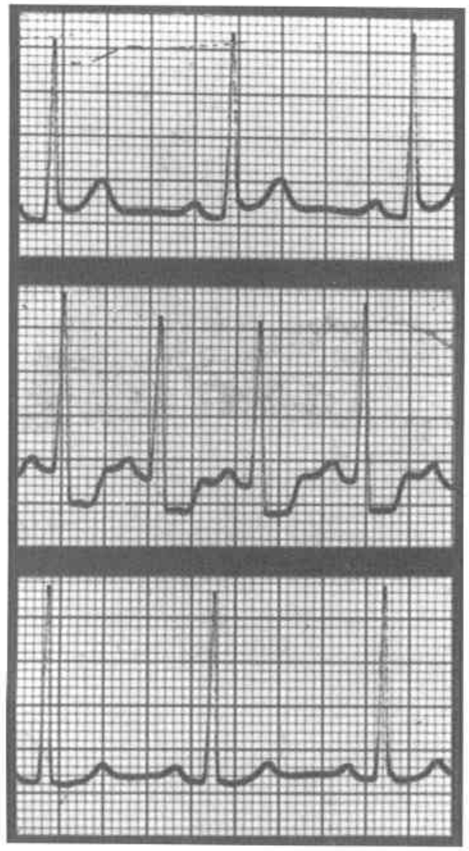

Figure 4 **(Top)** A patient's resting ECG (lead V_5) taken before exercise testing. **(Middle)** ECG obtained after 3 min of exercise testing, showing significant ST segment depression. The patient had concomitant anginal symptoms. **(Bottom)** Resting ECG recorded 6 min after exercise, representative of a normal configuration.

the presence of supraventricular and ventricular dysrhythmias. However, in the presence of digitalis, substantial ST segment depression at rest, left ventricular hypertrophy, left bundle branch block, or the pre-excitation (Wolff-Parkinson-White) syndrome, ST-segment abnormalities that develop during exercise are uninterpretable with respect to evidence of myocardial ischemia (14). Additional variables that may contribute to spurious ST segment depression are anemia, mitral valve prolapse, diuretics, and estrogen therapy (15). These limitations in the conventional exercise ECG have led to the use of exercise testing with concomitant rest–stress myocardial perfusion imaging (e.g., using thallium-201 or technetium Tc 99m sestamibi [Cardiolite]) or radionuclide ventricular angiography to evaluate cardiac function. Moreover, the evaluation of symptoms and hemodynamic responses has been shown to enhance the predictive value of exercise testing. A summary of ECG, cardiorespiratory, and hemodynamic responses to exercise testing is shown in Table 2, with specific reference to their clinical significance.

EXERCISE TESTING FOR EXERCISE PRESCRIPTION

Exercise stress testing is widely recommended to establish safe and appropriate guidelines for physical activity, especially for patients with heart disease. Patients who demonstrate evidence of left ventricular dysfunction (e.g., exertional hypotension); exercise-induced myocardial ischemia, manifested as significant ST segment depression, angina pectoris, or both; threatening ventricular arrhythmias; or a reduced functional capacity (<5 METs) are at moderate to high risk for future cardiac events (5). In such instances, a reduced exercise intensity may be warranted and compensated for by increases in the frequency and/or duration of training. Moreover, post-myocardial infarction (MI) patients who have both significant left ventricular dysfunction and myocardial ischemia are unlikely to demonstrate an adequate training response, at least within the first 12 weeks of exercise rehabilitation (16).

Serial exercise testing may also be used to assess changes in functional capacity. Futhermore, it may provide motivation and reassurance for patients and their family members. Increased aerobic fitness and a reduction in submaximal cardiac demands may serve to motivate the patient by providing evidence of favorable adaptation and improvement. On the other hand, a decrease in exercise performance may suggest noncompliance or herald a deterioration in clinical status.

Components of the Exercise Session

Exercise training sessions should include a preliminary warm-up (10 min), a cool-down (5 min) and, ideally, an optional recreational game (10–15 min). A conditioning phase (30–60 min of continuous or accumulated activity), interspersed between the warm-up and cool-down, should involve aerobic-endurance exercise and, for selected patients, a resistance training period.

Warm-Up

The warm-up prepares the body for more intense activity by stretching the large muscle groups and gradually increasing blood flow. Moreover, a preliminary

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Table 2 Electrocardiographic, Cardiorespiratory, and Hemodynamic Responses to Exercise Testing and Their Clinical Significance

Variable	Clinical significance
ST segment depression (ST ↓):	An abnormal ECG response is defined as ≥1.0 mm of horizontal or downsloping ST ↓ at 80 ms beyond the J-point, suggesting myocardial ischemia.
ST segment elevation (ST ↑):	ST ↑ in leads displaying a previous Q-wave MI almost always reflects an aneurysm or wall motion abnormality. In the absence of significant Q waves, exercise-induced ST ↑ is often associated with a fixed high-grade coronary stenosis.
Supraventricular dysrhythmias:	Isolated atrial ectopic beats or short runs of SVT commonly occur during exercise testing and do not seem to have any diagnostic or prognostic significance for CAD.
Ventricular dysrhythmias:	The suppression or progression of PVCs during exercise testing does not necessarily signify the absence or presence of ischemic CAD, respectively. Threatening forms of ventricular ectopy (e.g., frequent multiform PVCs, salvos, VT) are even more likely to be associated with CAD and a poor prognosis if they occur in the presence of significant ST ↓, ST ↑, angina pectoris, or combinations thereof.
Heart rate (HR):	The normal HR response to progressive exercise is a relatively linear increase, corresponding to 10 ± 2 beats/MET for inactive subjects. Chronotropic incompetence is signified by a peak exercise HR that is >2 SD (>20 beats/min) below the age-predicted maximal HR for subjects who are limited by volitional fatigue and are not taking beta-blockers.
Systolic blood pressure (SBP):	The normal response to exercise is a progressive increase in SBP, typically 10 ± 2 mmHg/MET, with a possible plateau at peak exercise. Exercise testing should be discontinued with SBP values >250 mmHg. Exertional hypotension (SBP that fails to rise or falls [>20 mmHg]) may signify myocardial ischemia and/or LV dysfunction. Maximal exercise SBP <140 mmHg suggests a poor prognosis.
Diastolic blood pressure (DBP):	The normal response to exercise is no change or a decrease in DBP. A DBP > 120 mmHg is considered an endpoint for exercise testing. An increase of >15 mmHg in DBP during treadmill testing may suggest severe CAD, even in the absence of ischemic ST ↓.
Anginal symptoms:	Can be graded on a scale of 1 to 4, corresponding to perceptible but mild, moderate, moderately severe, and severe, respectively. Ratings >2 (moderate) should generally be used as endpoints for exercise testing.
Aerobic fitness:	Average values of $\dot{V}O_{2max}$, expressed as METs, expected in healthy sedentary men and women can be predicted from the following regressions: Men = (57.8 − .445 [age])/3.5; Women = (42.3 − .356 [age])/3.5. The FAI can be calculated as: % FAI = ([Predicted $\dot{V}O_{2max}$ − Observed $\dot{V}O_{2max}$]/Predicted $\dot{V}O_{2max}$) × 100.

ECG = electrocardiographic; ST↓ = ST segment depression; ST ↑ = ST segment elevation; MI = myocardial infarction; SVT = supraventricular tachycardia; PVCs = premature ventricular contractions; CAD = coronary artery disease; VT = ventricular tachycardia; HR = heart rate; MET = metabolic equivalent; SD = standard deviation; LV = left ventricular; SBP = systolic blood pressure; DBP = diastolic blood pressure; $\dot{V}O_{2max}$ = aerobic capacity; FAI = functional aerobic impairment.

warm-up serves to decrease the susceptibility to injury and the occurrence of ECG abnormalities that are suggestive of myocardial ischemia and/or ventricular electrical instability—abnormalities that may be elicited by sudden strenuous exertion (17). Thus, warm-up has preventive value and enhances performance capacity.

Warm-up exercises should include musculoskeletal and cardiorespiratory activities, respectively. The latter involve total body movement to an intensity sufficient to evoke a heart rate response within 20 beats/min of the prescribed heart rate for endurance training. This can be achieved by performing the same activity that will be used during the conditioning phase, but at a reduced intensity (e.g., brisk walking before slow jogging).

Cool-Down

The cool-down permits appropriate circulatory readjustments after vigorous activity; enhances venous return, thereby reducing the potential for postexercise lightheadedness; facilitates the dissipation of body heat; promotes more rapid removal of lactic acid than stationary recovery (18); and combats the potential deleterious effects of the postexercise rise in plasma catecholamines (19). Omission of a cool-down in the immediate postexercise period may result in a transient decrease in venous return, possibly reducing coronary blood flow when heart rate and myocardial oxygen demand may still be high. Of 61 cardiovascular events reported during the exercise training of cardiac patients, at least 44 (72%) occurred during either the warm-up or cool-down phases (20).

Conditioning Phase

The endurance or stimulus phase serves to directly stimulate the oxygen transport system and maximize caloric expenditure. This phase should be prescribed in specific terms of intensity, frequency, duration, and mode of exercise training (Fig. 5).

Intensity

The prescribed exercise intensity should be above a threshold level required to induce a "training effect," yet below the metabolic load that evokes abnormal signs or symptoms. For most deconditioned cardiac patients, the minimal intensity for exercise training is probably between 40 and 60% $\dot{V}O_{2max}$ (21); however, considerable evidence suggests that it increases in direct proportion to the baseline aerobic fitness or level of habitual physical activity.

The "sliding scale" method empirically estimates a relative exercise-training intensity that increases in direct proportion to the initial peak or symptom-

MD ________________________________

Name ______________ Age ______________ Starting Date ______________

Clinical Status: Normal
Arrhythmia Angina CABG CAD HTN MI PTCA VR

Note: This prescription is valid only if you remain on the same medications (type and dose), and you are in the same clinical status as on the day your exercise test was conducted.

Contraindications: Angina at rest, fever, illness
Temperature and weather extremes (below 30°F or more than 80° with high humidity)

Activities to avoid: Sudden strenuous lifting or carrying
Exertion that leads to holding your breath

Exercise Type: Aerobic types of exercise that are continuous, dynamic and repetitive in nature

Frequency: ________ times/day ________ days/week

Duration: Total duration of exercise session: ________ min

To be divided as follows:

Warm-up: (light flexibility/stretching routine) __________ min

Aerobic training activity: ________ to ________ min

Cool-down: (slow walking and stretching): __________ min

Intensity:

Target heart rate ________ to ________ beats/min

________ to ________ beats/10 sec

Perceived exertion should not exceed "somewhat hard"

Re-evaluation

Your next graded exercise test is due: ______________________
Call our office to schedule an appointment. Phone: ______________________

Exercise Physiologist ______________________

Figure 5 Prescription form for standardizing the recommended exercise dosage.

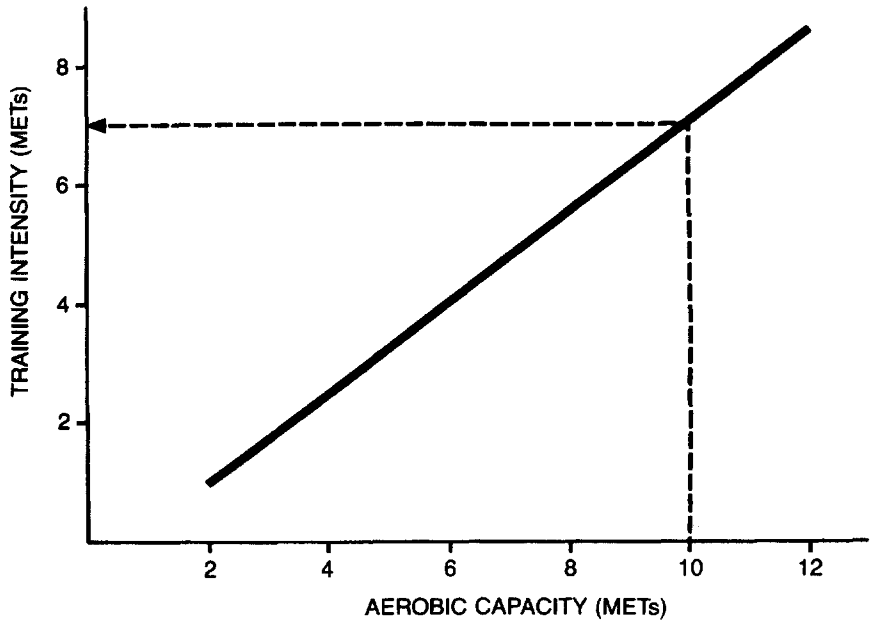

Figure 6 Sliding scale method for estimating relative exercise-training intensity (METs) from the peak or symptom-limited aerobic capacity (METs). For example, a cardiac patient with an aerobic capacity of 10 METs would use a training intensity of 7 METs.

limited aerobic capacity (5). The baseline intensity, set at 60% $\dot{V}O_{2max}$, is added to the pretraining $\dot{V}O_{2max}$, expressed as METs, to obtain the percentage of $\dot{V}O_{2max}$ that should be used for physical conditioning. For example, a patient with a $\dot{V}O_{2max}$ of 35 mL/kg/min or 10 METs would train at 70% of his or her aerobic capacity (60 + 10), corresponding to an average training intensity of 7 METs. Figure 6 shows the prescribed training intensity (METs) for patients with initial aerobic capacities ranging from 2 to 12 METs. However, the intensity should be set about 1 MET lower for novice exercisers, until the participant has become accustomed to physical activity.

Heart Rate

Because heart rate and oxygen consumption are linearly related during dynamic exercise involving large muscle groups, a predetermined training or target heart rate (THR) has become widely used as an index of exercise intensity (22). The limitations of age-predicted maximal heart rates as indices of $\dot{V}O_{2max}$ and of training intensity are well documented, especially in patients with coronary disease and associated chronotropic impairment secondary to cardiac medications, autonomic dysfunction, or both. Prescribed heart rates for aerobic conditioning can be more accurately determined by one of three methods from data obtained during peak or symptom-limited exercise testing: (1) the heart rate versus $\dot{V}O_{2max}$ regression method (23), where THR = heart rate that occurred at a given oxygen uptake during exercise testing; (2) the maximal heart rate reserve method of Karvonen and associates (24), in which THR = (maximal heart rate − resting heart rate) × 50 to 80% + resting heart rate; and (3) the percentage of maximal heart rate method (5). The regression method requires steady-state heart rate and oxygen uptake determinations during at least two and preferably more submaximal work loads, whereas the Karvonen method (24), which closely approximates the percentage of $\dot{V}O_{2max}$, requires reliable measurements of resting (standing) and peak heart rate. The third method, which calculates a fixed percentage of the measured peak heart rate, has been shown to yield remarkably similar regressions of % $\dot{V}O_{2max}$ on % HR_{max} (i.e., 60 to 80% $\dot{V}O_{2max}$ ~ 70% to 85% HR_{max}), regardless of the subject's age, gender, medications, or clinical status.

Rating of Perceived Exertion

The rating of perceived exertion (RPE) is a useful and important adjunct to heart rate as an intensity guide for cardiac exercise training (Fig. 7) (25). Exercise rated as 11 to 13 (6–20 scale) or 3 to 4 (0–10 scale), between "fairly light" and "somewhat hard" (6–20 scale), or between "moderate" to "somewhat strong" (0–10 scale), generally corresponds to the upper limit of prescribed training heart rates during the early stages of outpatient cardiac rehabilitation (e.g., phase II). Later, for higher levels of training, ratings of 12 to 14 (6–20 scale) or 4 to 5 (0–10 scale) may be appropriate, corresponding to 70% to 85% of the HR_{max}, which is equivalent to ~60 to 80% $\dot{V}O_{2max}$. Although the RPE correlates well with exercise intensity, even in patients whose heart rates are attenuated by beta-blockade (26), ischemic ST segment depression and threatening ventricular dysrhythmias can occur at low levels of perceived or physical effort (27).

Frequency and Duration of Training

Improvement in $\dot{V}O_{2max}$ with low-to-moderate training intensities suggests that the interrelation among the training intensity, frequency, and duration may permit

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PERCEIVED EXERTION

Category Scale

6	
7	VERY, VERY LIGHT
8	
9	VERY LIGHT
10	
11	FAIRLY LIGHT
12	
13	SOMEWHAT HARD
14	
15	HARD
16	
17	VERY HARD
18	
19	VERY, VERY, HARD
20	

Category - ratio Scale

0	NOTHING AT ALL	
0.5	VERY, VERY WEAK	[just noticeable]
1	VERY WEAK	
2	WEAK	[light]
3	MODERATE	
4	SOMEWHAT STRONG	
5	STRONG	[heavy]
6		
7	VERY STRONG	
8		
9		
10	VERY, VERY STRONG	[almost max]
	MAXIMAL	

Figure 7 The Borg category and category-ratio perceived exertion scales consist of 15 grades from 6 to 20 or 10 grades from 0 to 10^+, respectively, with descriptive ''effort ratings.''

a decrease in the intensity to be partially or totally compensated for by increases in the exercise duration or frequency, or both. Regular exercise training for 10 to 15 min may improve cardiorespiratory fitness, and 30- to 45-min sessions are even more effective. Moreover, recent studies suggest that longer exercise sessions can be *accumulated* in shorter periods of activity (i.e., three 10- or 15-min exercise bouts) (28,29). Although cardiac patients may respond to slightly less than twice-weekly exercise, three or four evenly spaced workouts per week appear to represent the optimal training frequency (21). Thus, relative increases in functional capacity appear to depend more on the patient's initial fitness and total amount of exercise accomplished or calories expended than on the specific exercise frequency, intensity, or duration.

A recent American Heart Association consensus statement (30) on preventing heart attack and death in patients with coronary disease extolled the importance of a minimum of 30 to 60 min of moderate-intensity activity three or four times weekly supplemented by an increase in daily lifestyle activities (e.g., walk breaks at work, using stairs, gardening, household activities); 5 to 6 h a week was suggested for maximum cardioprotective benefits—an exercise dosage that has been associated with the regression of coronary artery disease (Fig. 8) (31). Increasing physical activity in daily living can be helpful in this regard (Fig. 9) (32).

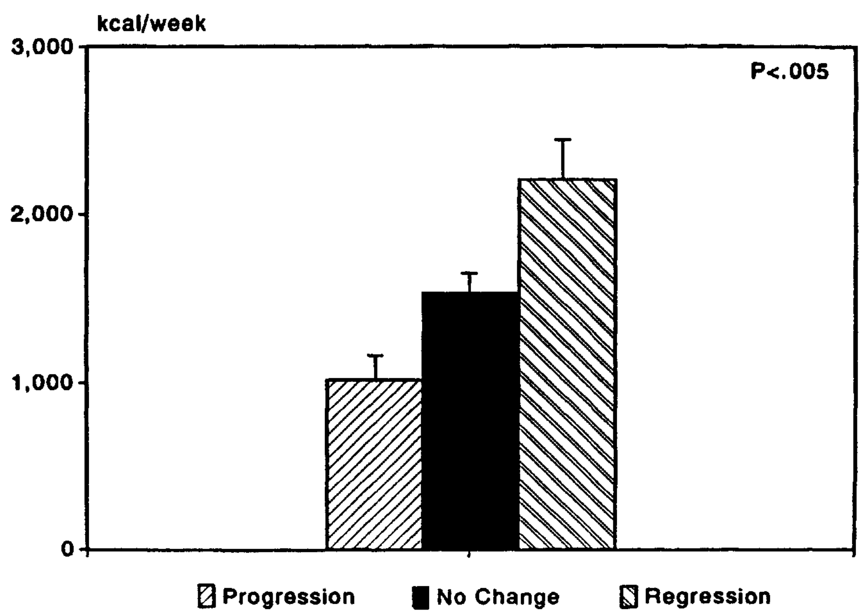

Figure 8 Effects of a low-fat diet and leisure-time physical activity in patients with baseline coronary angiography and stable angina pectoris. Higher levels of physical activity were associated with either no change or a reversal of coronary atherosclerotic lesions, corresponding to an energy expenditure of 1533 ± 122 kcal/week and 2204 ± 237 kcal/week, respectively. (Adapted from Ref. 31.)

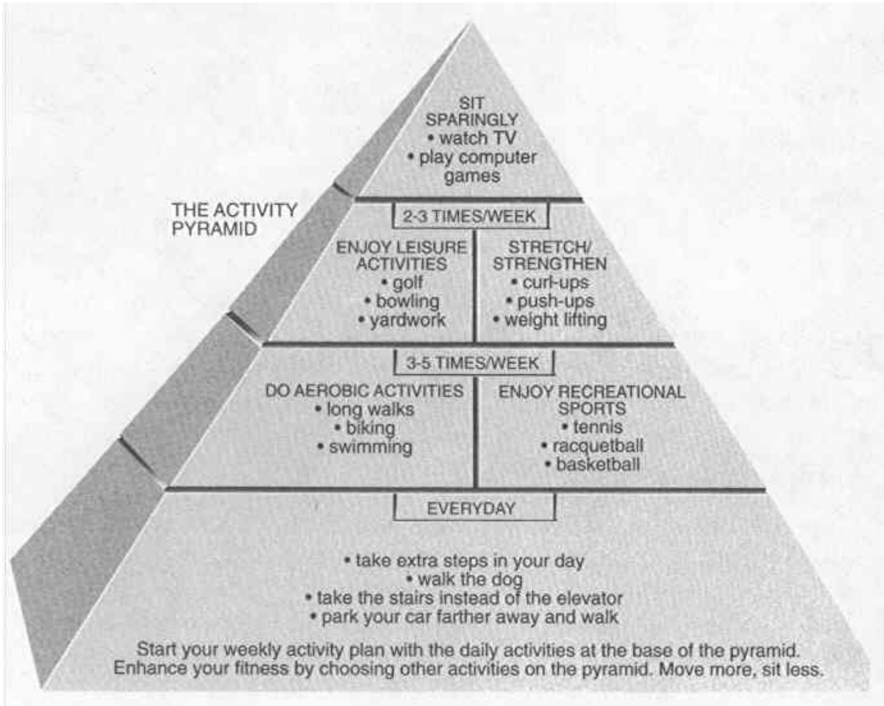

Figure 9 The Activity Pyramid, analogous to the USDA's Food Guide Pyramid, has been suggested as a model to facilitate public and patient education for adoption of a progressively more active lifestyle. (Copyright 1996 Park Nicollet Healthsource ® Institute for Research and Education. Reprinted by permission.)

Upper Body and Resistance Training

New to this decade has been the demonstration that upper body aerobic exercise and mild-to-moderate resistance training can safely and effectively improve muscular strength and endurance in healthy adults and clinically stable coronary patients (33,34). These adjunctive training techniques can also facilitate increased transfer of training benefits to occupational and recreational activities and provide greater diversity to the physical conditioning regimen, which may increase patient interest and adherence. Guidelines for dynamic arm exercise training should include recommendations regarding three variables (Table 3) (12): (1) the prescribed exercise heart rate; (2) the work rate or power output (kgm/min) that will elicit a sufficient stimulus for training; and (3) the appropriate training equipment and modalities. Single-set resistance training programs performed a minimum of

Table 3 Guidelines for Arm Exercise Prescription

Variable	Comment
Target heart rate	~10–15 beats/min lower than for leg training
Workrate	~50% of the power output (kgm/min) used for leg training
Equipment	Arm ergometer, combined arm-leg ergometer, rowing machine, wall pulleys, simulated cross-country skiing devices

two times per week are recommended over multiset programs because they are highly effective and less time consuming (35). Such regimens should include eight to ten different exercises at a load that permits 10 to 15 repetitions per set.

Special Considerations

When prescribing exercise, cardiovascular medication effects should also be considered (e.g., beta-blockers). If selected medications or dosages are discontinued or altered, the intensity prescription may no longer be valid (36). Special care should be taken for patients who, on their most recent exercise stress test, demonstrated signs and/or symptoms of myocardial ischemia that may be harbingers of malignant ventricular dysrhythmias (37). It is critical that such patients be restricted to training intensities that are ~10 to 15 beats/min below the heart rate heralding the ischemic ECG (≥1.0-mm ST segment displacement) or anginal thresholds during exercise testing (5). The professional staff, program participant, and significant others should also meet after the initial evaluation to clarify what the patient hopes to accomplish (i.e., to establish short- and long-range goals and objectives). By achieving their exercise-related goals, patients may be more motivated to become involved in other positive health behaviors. The combination of behavioral techniques and exercise science should result in the safest and most effective exercise prescriptions.

EXERCISE TESTING FOR RETURN TO WORK

Comprehensive cardiac rehabilitation programs offer patients many physiological and psychological benefits. By incorporating aggressive coronary risk factor modification, exercise training, behavioral counseling, and medical surveillance, most issues facing cardiac patients can be addressed and positively influenced. However, one area that remains difficult to impact is the rate of return to work. Numerous variables such as employer attitudes, prior employment status, economic incentives, age, educational level, occupational status, job type, medical prognosis, physician's advice, and patient's perceptions of their health and career

Figure 10 Levels of emotional distress (0–50 scale) for patients who did (shaded bars; $n = 90$) and did not (black bars; $n = 42$) return to work by 4 months after myocardial infarction and at 12-month follow-up. (Adapted from Ref. 39.)

can influence the return to work. Because automation and mechanization have eliminated many jobs requiring heavy physical effort, functional capacity has declined markedly as a determinant of employability after an acute coronary event. Accordingly, in the contemporary job market, coronary risk status is more important than functional capacity in determining occupational work potential (38). Focused vocational rehabilitation may have the greatest impact on hastening a patient's return to work, reducing the economic burden of an acute coronary event, and decreasing the associated level of emotional distress (Fig. 10) (39).

Vocational Demographics and Disability

The 138 billion dollar annual cost for coronary artery disease is the largest expenditure for a single disease entity in the U.S. (40). Treatment and hospitalization for acute MI is a major contributor to this staggering figure (41). One way to offset this burden is to safely return these patients to the work force as expeditiously as possible. According to the Framingham study, 5% of heart attacks occur in persons under age 40 and 45% occur in those under age 65. Therefore, about half of all MIs occur in potentially active members of the work force. Approximately 70 to 95% of young, previously employed patients return to work within 60 to 90 days of an uncomplicated MI (42). Despite these encouraging

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statistics, the economic burden to our society of even a 5 to 30% employee attrition rate has far-reaching effects. In the United States, coronary heart disease is the leading diagnosis for which patients receive premature disability benefits under the Social Security system (43). In 1985, approximately 350,000 persons were listed as disabled because of cardiovascular disease; these cases were about five times as expensive as the average claim (44).

Role of the Physician

Patients rely on guidance from their physician when contemplating their post-cardiac event return to occupational and leisure-time activities. Physicians should offer return-to-work recommendations that are based on the patient's cardiovascular status, the anticipated somatic, myocardial, and environmental demands of the job, and the associated risks (to the patient and those he or she serves). This is usually reasonably straightforward, as 55 to 75% of cardiac patients who sustain uncomplicated MIs are potential candidates for aggressive vocational rehabilitation.

Within the group of MI survivors, patients can be classified as either low, moderate, or high risk for future cardiac events, based on the degree of left ventricular dysfunction, residual myocardial ischemia, and electrical instability. Of these parameters, left ventricular dysfunction exerts the strongest effect on both short- and long-term prognosis. In a community hospital population, approximately 10 to 20% of acute MI patients demonstrate significant left ventricular dysfunction (45). These patients represent a special subgroup and will be discussed separately.

Timing for return to work and recreational activities has undergone considerable liberalization over the past 50 years. In the 1940s, post-MI patients were routinely placed on bed rest for 6 weeks before even modest physical activity was permitted (46). However, extended bed rest was shown to result in physiological deconditioning, a significant decrease in $\dot{V}O_{2max}$ (47), and other adverse sequelae, including: muscle atrophy, weakness, constipation, urinary retention, thrombophlebitis, pulmonary embolism, hypostatic pneumonia, orthostatic intolerance, and depression. Today, current practice guidelines advocate early ambulation and low-level activities for all uncomplicated acute MI patients, including interventions to simulate orthostatic or gravitational stress.

Accelerated Return to Work

Dennis et al. (42) conducted a randomized trial to assess the influence of symptom-limited exercise testing about 3 weeks after uncomplicated MI in facilitating an earlier return to work. The study population included previously employed men who were under 60 years of age. Screening yielded 201 men (49 ± 7 years); of these, 99 and 102 were randomized to intervention and usual-care groups, respectively. Patients in the intervention group who did not exhibit marked ischemic ST segment depression during symptom-limited treadmill testing ($n = 91$) were advised to return to work about 35 to 42 days post-MI. Patients in the usual-care group returned to work when they believed it was appropriate. On average, patients in the intervention group went back to work 3 weeks earlier than those who received usual care, 51 vs. 75 days, respectively. This earlier return to work was associated with $2102 of additional earned salary per intervention patient in the 6 months after MI, despite a comparable rate of recurrent cardiac events as compared with the usual-care control group.

Recently, Kovoor et al. (48) reported that low-risk patients could safely return to occupational and leisure-time activities soon after uncomplicated MI. All subjects were free of angina and congestive heart failure, had an ejection fraction >40%, and an exercise capacity ≥7 METs. One hundred forty low-risk MI survivors (mean age = 56 years) were randomized to return to normal activities at either 2 or 6 weeks after hospital discharge and an abbreviated rehabilitation program. At 6-month follow-up, there were no differences between groups in fatal or nonfatal cardiovascular events or need for coronary revascularization. These findings suggest that selected cardiac patients can safely return to work more promptly than previously believed.

Value of Exercise Test Data

A reduced exercise tolerance often characterizes the individual with cardiovascular disease. Indeed, most patients with heart disease have a subnormal level of aerobic fitness (50 to 70% age, gender-predicted). Physical work capacity may be spuriously low if submaximal or symptom-limited exercise testing is performed at or soon after hospital discharge (e.g., within 3 weeks). Deconditioning, fatigue, or fear of physical exertion may play a role. Nevertheless, post-MI patients who can achieve ≥ 7 METs during exercise testing without objective evidence of myocardial ischemia (>2-mm ST segment depression), have an annual risk of cardiac death, MI, or unstable angina that is <3% (49). This aerobic capacity is compatible with the performance of many common occupational tasks, with adequate cardiorespiratory reserve.

Other patients may demonstrate low aerobic fitness without anginal symptoms or ischemic ST segment depression. This subgroup should be referred for home-based or group exercise training to improve functional capacity. A significant increase in aerobic capacity, corresponding to 2 to 3 METs, generally occurs between 3 and 11 weeks after clinically uncomplicated MI, even in patients who

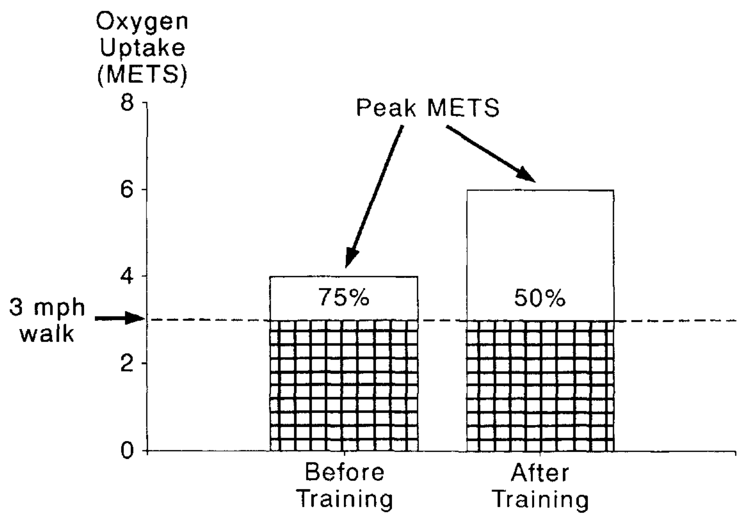

Figure 11 Effect of exercise training on peak oxygen uptake (METs) and relative oxygen cost (activity METs/peak METs) of walking at 3 miles per hour (mph) on a level grade. Following a physical conditioning program, peak oxygen uptake increased from 4 to 6 METs, decreasing the relative oxygen cost of a 3-mph walk from 75 to 50%.

undergo no formal exercise training (50,51). However, greater improvements may occur in patients who simultaneously undergo exercise training programs (50). Because a given submaximal task or work rate requires a relatively constant aerobic requirement, the physically conditioned patient finds that he or she is working at a lower percentage of their $\dot{V}O_{2max}$, with greater reserve (Fig. 11) (52).

When applying exercise test data to vocational counseling, the peak exercise workload that is compatible with the absence of myocardial ischemia should be at least twice the average aerobic requirement over an 8-h work day and 20% more than the peak somatic energy expenditure encountered on the job (53).

Identification of Patients at High Risk for Loss of Employment

Even with medical clearance for return to work, many patients still do not resume their previous employment (54). Unfortunately, this can be a self-perpetuating cycle; unemployment may result in depression and low self-esteem (55). The cardiac patient may suffer from depression because of his or her heightened awareness of their own mortality. One cause of depression may exacerbate another, resulting in a patient who is physically capable of work yet, from an emotional standpoint, is unable to do so. Return-to-work percentages also seem to be influenced by national and cultural customs and local economic conditions (56).

Myrtek and coworkers (57) compared the physiological and psychological profiles of 41 cardiac patients who retired after an acute coronary event to 41 matched patients (i.e., for age, gender, and diagnosis) who were working at 5-year follow-up. The former were characterized by lower work satisfaction, a greater perception of being handicapped by their disease, a higher propensity for pension, more frequent complaints regarding their general state of health, and a lower education level.

Mark and associates (58) studied medical and nonmedical factors to develop a multivariable model to identify patients with coronary artery disease who were at high risk of premature dropout from the work force and prospectively validated this model in an independent patient sample. Initially, 1252 coronary patients referred for diagnostic cardiac catheterization who were less than age 65, employed, and without previous CABGS or PTCA were followed for 1 year. Seven hundred sixty-one patients underwent coronary revascularization (312 PTCA, 449 CABGS) within 60 days of catheterization, whereas the remaining 491 were medically treated. Functional status as measured by the Duke Activity Survey Index was the single most important predictor of 1-year employment status, followed by older age, black race, presence of congestive heart failure, lower education level, presence of extracardiac vascular disease, poorer psychological status, and lower job classification. Standard clinical variables, functional measures, and demographic and socioeconomic characteristics provided 20%, 27%, and 45% of the total predictive information about follow-up work outcomes, respectively. These findings suggest that coronary patients who are at high risk for departure from the work force can be prospectively identified at a time when it may be possible to intervene to help preserve employment. Although PTCA patients who went back to work returned substantially earlier than their CABGS or medical counterparts, there was no evidence that coronary revascularization with either PTCA or CABGS provided any long-term employment benefit over initial medical therapy.

Pre-event job satisfaction plays a role in the rate of return to work. Patients who are working productively at the time of their acute cardiac event are more likely to resume work sooner and remain on the job (59). Kavanagh et al. (60) followed 1150 men who had survived an acute MI or who had undergone successful coronary bypass surgery; 71% and 29% were white and blue collar workers, respectively. Six months after the acute coronary event or revascularization, 14% of blue collar workers and 8% of white collar workers had failed to return to work. Of these, 55% suggested socioeconomic factors as the reason for their failure to resume employment, 35% reported negative medical advice, and 10% cited their employer's reluctance to rehire them. Overprotection and misinformation regarding cardiac risk are commonly reported among family members (56).

Self-efficacy has also been shown to be a strong predictor of return to work (54). This variable refers to the perceived confidence a person has in his or her ability to perform selected occupational and leisure-time activities. To promote a healthy return-to-work attitude among patients who are capable of resuming their former employment, dysfunctional perceptions, beliefs, and behavioral intentions must be identified early and changed. The Task Force I at the 20th Bethesda Conference recommended consideration of three factors in evaluating the patient's potential to return to work: (1) the capability of the individual to perform their job; (2) the risk to the individual to perform the job; and (3) the risk to society if the individual performs the job (49).

The High-Risk Patient

Patients following large anterior wall MIs with signs of left ventricular dysfunction are often discouraged from vigorous physical training programs and a return to heavy occupational work. Such perceptions may stem, at least in part, from the notion that left ventricular performance is a good predictor of exercise capacity. However, numerous studies have now shown that aerobic capacity correlates poorly with conventional indices of left ventricular function, including clinical classification by New York Heart Association criteria, resting ejection fraction, or resting hemodynamics (61–63).

One nonrandomized controlled study of patients with anterior MI and diminished ejection fraction suggested that exercise training leads to a significant exacerbation of left ventricular cavity distortion, an increase in asynergy, and a further decrease in ejection fraction as compared with a nonexercising control group (64). However, two reports of a randomized controlled multicenter trial showed no difference in left ventricular remodeling between exercise and control patients with Q-wave anterior MI and low baseline ejection fractions (65,66), with improved functional capacity in the exercise group.

Hedback et al. (67) examined the effects of a 2-year comprehensive cardiac rehabilitation program on high- and low-risk patients. There were no cardiovascular complications associated with exercise training. The high-risk group demonstrated a higher mortality, a lower physical work capacity at 4 months, and a lower rate of early return to work as compared with low-risk patients. However, at the end of the intervention, 63% of the surviving high-risk patients had returned to work vs. 59% of the low-risk group. These data suggest that a similar percentage of high-risk cardiac patients are able to return to work as compared with their low-risk counterparts.

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5

Exercise Prescription

Michael L. Pollock
University of Florida, Gainesville, Florida

Paulo Sergio Gomes
Universidade Gama Filho, Rio de Janeiro, Brazil

The benefits of exercise training and fundamentals of exercise testing for cardiac patients have been discussed in earlier chapters of this book. This chapter focuses on the exercise prescription for cardiac patients through their various stages of recovery. The exercise prescription has evolved from a narrow program mainly emphasizing exercise to improve cardiorespiratory fitness ($\dot{V}O_{2max}$) to a broader spectrum including resistance training and flexibility exercises (1,2). The exercise prescription has common guidelines for both healthy adults and cardiac patients but is quite variable in its application to the individual patient.

The exercise prescription is based on the patient's needs, goals, medical history, and current health status, initial level of fitness, available time, equipment and facilities, and personal preference. Patients vary greatly in their level of physical fitness, body composition, age, and motivation. The prescribed program will also vary depending on the patient's risk status and stage of recovery from a cardiovascular event or revascularization surgery. These factors should be considered in providing a safe and efficient program that progresses at the proper rate and promotes long-term adherence.

EXERCISE GUIDELINES

Since 1995, the American Heart Association (AHA) (3,4), American College of Sports Medicine (ACSM) (1), American Association for Cardiovascular and Pulmonary Rehabilitation (AACVPR) (5), Centers for Disease Control and Prevention (CDC)–ACSM (6), National Institutes of Health (NIH) (7), and Surgeon General (8) have provided exercise/physical activity guidelines that increase and

Table 1 Recent Standards, Guidelines, and Position Statements Regarding Physical Activity for Adults

	Frequency	Intensity	Duration	Mode	Weight training
1995 ACSM guidelines (1) Fitness/Health	3–5 days/wk	60–90% HR_{max}, or 50–85% VO_{2max}, or HR_{max} reserve	20–60 min continuous 20–30 min minimum	Aerobic activities (expanded)	1 set; 8–12 reps; 8–10 exercises; major muscles; 2 days/wk minimum
1995 AHA exercise standards (3) Health	Minimum 3 days/wk	50–60% VO_{2max} or HR_{max} reserve	Minimum 30 min	Fitness and health promotion activities	1 set; 10–15 reps; 8–10 exercises; 2–3 days/wk
1995 CDC/ACSM public health statement (6) Health	On most days Perferably all	Moderate	Accumulate 30 min/day	Health promotion/lifestyle activities	Addressed, not specified
1995 AACVPR (5) Cardiac Rehabilitation	3–5 days/wk	50/60% HR_{max} minimum	30–45 min	Variety of aerobic activities	1–3 sets; 10/12–15 reps; number not specified; 2–3 days/wk

1996 NIH (7) Consensus Health	On most days Preferably all	Moderate	Accumulate 30 min/day minimum	Health promotion/lifestyle activities	Addressed; not specified
1996 Surgeon General's Report (8) Health	On most days Preferably all	Moderate; Moderate–heavy better	15 min 75–90%[a] 30 min 60–75% 45 min 40–60%	Health promotion/lifestyle activities (run, walk, games)	1 or 2 sets; 8–12 reps; 8–10 exercises; major muscles; 2 days/wk
1996 AHA exercise statement (4) Health	3–6 days/wk	Moderate 40–60% minimum	30–60 min can accumulate	Health promotion and fitness activities	Sets not specified; 10–15 reps; 8–10 exercises; major muscles; 2 days/wk minimum

ACSM = American College of Sports Medicine; AHA = American Heart Association; CDC = Centers for Disease Control; NIH = National Institutes of Health; AACVPR = American Association of Cardiovascular and Pulmonary Rehabilitation. $\dot{V}O_{2max}$ = aerobic capacity; HR_{max} = maximum heart rate; reps = repetitions.

[a] Minimum 150 kcal/day.

Table 2 Guidelines for Exercise Prescription for Cardiac Patients

Component	Phase I inpatient	Phase II immediate outpatient	Phase III intermediate outpatient	Phase IV maintenance
Warm-Up				
Stretching, low-level calisthenics (ROM)	15–20 min	10–15 min	10–15 min	10–15 min
Muscular Conditioning				
Resistance exercise: all major muscle groups	None	ROM 10–20 min, 3 days/wk	20–30 min, 2–3 days/wk	20–30 min, 2–3 days/wk
Aerobic Endurance Exercise				
Frequency	1–3 ×/day, daily	1–2 ×/day, 5 days/wk	3–5 days/wk	3–5 days/wk
Duration	MI: 5–15 min CABG: 5–15 min	MI: 15–45 min CABG: 15–45 min	30–60 min	30–60 min
Intensity	RHR: +20 b/min	RHR: +20 b/min[a]	40/50–85% HRR_{max} ($\dot{V}O_{2max}$)	50–85% HRR_{max} ($\dot{V}O_{2max}$)
	RPE: 11–12	RPE: 12–13	55/65–90% HR_{max} RPE 12–16	65–90% HR_{max} RPE 12–16
Type of Activities	ROM, walk, cycle, stairs/steps	Walk, cycle, stairs, arm ergometer, ROM, wt. train	Walk, cycle, jog, swim, wt. train, endurance sports, lifestyle activity	Walk, cycle, jog, swim, wt. train, endurance sports, lifestyle activity
Cool-Down				
Low-level aerobic exercise, stretching	5–10 min	15 min	15 min	15 min

[a] After 3–6 weeks, intensity is set at 40–60% HRR_{max} (55/70% of peak HR_{max}) based on a symptom-limited graded exercise test.

MI = myocardial infarction; CABG = coronary artery bypass graft surgery; ROM = range of motion exercise; RHR = resting heart rate; b/min = beats per minute; HR_{max} = maximal heart rate; $\dot{V}O_{2max}$ = maximal oxygen uptake; wt. train = weight training; RPE = rating of perceived exertion.

Adapted from Ref. 14.

maintain cardiorespiratory and muscular fitness as well as various parameters of health in both healthy adults and cardiac patients (see Table 1). Although each guideline has a unique message, there are some commonalities depending on whether lifestyle or formal fitness approaches are recommended. The lifestyle approach was promulgated by the CDC/ACSM (6) and later by NIH (7) and the Surgeon General (8). The lifestyle guideline basically emphasizes that a more traditional formal regimen as prescribed by ACSM (1,2) may not always be necessary. The lifestyle approach encourages individuals to incorporate moderate intensity physical activity into their daily lives and to accumulate up to 30 min or more on most, if not all, days/week. Research has shown that three 10- to 15-min bouts of exercise accumulated throughout the day has similar benefit to one bout of continuous exercise (9–11). Also, participating in the activity at home or on the worksite appears to improve adherence (12,13). The Surgeon General proposes that a minimum goal of 150 kcal of physical activity should be accumulated on most days of the week and will elicit significant health benefits. Approximately 2000 kcal of weekly expenditure is even more beneficial (8). As health professionals, it would be prudent to recommend both approaches to our patient population as described by the Surgeon General (8), AHA (3), and ACSM (1).

Although the authors agree with the two-prong approach to exercise (i.e., lifestyle and formal ACSM-type programs), this chapter is devoted to the more formal approach. Pollock et al. (14) provide more detailed information on exercise prescription for the various stages of rehabilitation (Table 2).

EXERCISE PRESCRIPTION FOR CARDIAC PATIENTS

In prescribing an exercise program the clinician should take into account the frequency, intensity, and duration of training, mode (type) of activity, patient risk status, and initial level of fitness (1). Of these factors the intensity of training is the most critical and difficult to determine (14,15). Too high an intensity is related to an increased rate of cardiac events and too little stimulus will not provide an adequate training effect (14,15). In general, it is best to err on the moderate side.

The minimal level necessary to elicit a significant training effect is quite variable and ranges from 40 to 60% of maximum heart rate reserve (HRR_{max}) (55 to 70% of peak HR) depending on the initial level of fitness (2). There is an approximate 15% difference in training HR at the lower end of the training zone estimated from the two most common methods (HRR_{max} and $\%HR_{peak}$) (2,16). Either method can be used, but the HRR_{max} method relates better to the metabolic maximum reserve ($\dot{V}O_2R$) and the rating of perceived exertion scale (RPE) than the HR_{max} method, particularly at the lower end of the training zone (16,17). As the intensity of effort increases toward 85% to maximum, these HR curves converge (2,15).

Techniques for Determining Exercise Training Intensity

Several techniques have been developed to prescribe the proper exercise intensity for cardiac patients. Some techniques are more accurate, but may be invasive, expensive, time consuming, and impractical. Others, although not as precise, are efficient and practical for use in the clinical setting. The reader should refer to other sources for a more detailed description of these techniques (1,14)

Among all techniques, HR has been the most common parameter used to determine exercise intensity. The exercise intensity can be determined at a specific HR, at a specified % of HR_{max}, or at a percentage of the individual's $\%HRR_{max}$ (18). In cardiac patients, HR_{max} should be determined by a symptom-limited graded exercise test (SL-GXT) (1,3). The use of prediction equations (e.g., 220 − age) should be avoided due to the variability (standard deviation ~12.5 beats/min) (15). Abnormal HR responses are also found in many cardiac patients (chronotropic incompetence) and the common use of beta-blockers and other HR-limiting drugs further invalidates the prediction of HR_{max} (1,15).

The Borg RPE scales (19) (see Table 3) have been widely used to prescribe exercise intensity. The RPE provides subjective information related to the amount

Table 3 Borg Scales for Rating of Perceived Exertion (RPE)[a]

10-Grade scale		15-Grade scale	
0	Nothing	6	
0.5	Very, very weak (just noticeable)	7	Very, very light
1	Very weak	8	
2	Weak (light)	9	Very light
3	Moderate	10	
4	Somewhat strong	11	Fairly light
5	Strong (heavy)	12	
6		13	Somewhat hard
7	Very strong	14	
8		15	Hard
9		16	
10	Very, very strong (almost maximum)	17	Very hard
		18	
	Maximum	19	Very, very hard
		20	

[a] Scales for rating perceived exertion. The original scale 6–20 is given on the right, and 10-point scale on the left (19). The 10-point scale has ratio properties. The RPE scale is used as an adjunct to HR in the exercise prescription. It correlates highly with a variety of physiological parameters (e.g., HR, $\dot{V}O_2$, pulmonary ventilation, and blood lactate). *Source*: Refs. 15, 19.

of strain or fatigue the patient experiences during an activity. The RPE is highly related to other physiological indicators such as HR, pulmonary ventilation (V_E), and blood lactate concentration. In the early 1980s, the scale was adapted into a 10-grade category scale with ratio properties (19). Either scale is acceptable for use with cardiac patients.

To a lesser extent, oxygen consumption ($\dot{V}O_2$) has also been used in the clinical setting for prescribing exercise intensity. $\dot{V}O_2$ usually is measured by computerized open circuit-spirometry or estimated using standard prediction equations, during a maximal or submaximal GXT. Exercise intensity is then prescribed at a specified absolute $\dot{V}O_2$ value or at a percentage of maximum or peak $\dot{V}O_2$. The MET unit (metabolic equivalent in multiples of the resting rate of $\dot{V}O_2$) is also used as a means for determining intensity. The exercise intensity can be prescribed at a specified MET value, a percentage of MET_{max}, or by choosing an activity that elicits a known MET requirement. A list of various activities and their MET cost can be found elsewhere (1,15). One MET is equivalent to $\dot{V}O_2$ at rest (i.e., 200 and 250 mL of O_2 per minute for an average female and male, respectively).

Other techniques include parameters such as blood pressure, rate pressure product, dyspnea ratings and the anaerobic threshold—determined either by gas exchange measurements (ventilatory threshold) or blood lactate, sodium bicarbonate, and pH concentrations (lactate threshold or onset of blood lactate accumulation). The latter methods are generally not practical for use in the clinical setting.

Phase I Inpatient Prescription

The purpose of inpatient exercise is for stabilization and maintenance (i.e., to maintain range of motion (ROM) and avoid the detrimental problems associated with bed rest and immobilization). Exercise should begin early in the recovery period; usually day 1 or 2 after coronary bypass graft surgery (CABG) or percutaneous transluminal coronary angioplasty (PTCA) and day 2 or 3 for uncomplicated myocardial infarction (MI) patients (5,1,14). Since hospital stays average only 5 to 7 days for most patients, it is important for the rehabilitation team to have referrals as a part of their standing orders (20). Exercise prescription guidelines are shown in Table 2. The warm-up period includes standard ROM activities for both the upper and lower extremities. ROM exercise in the intensive care units for the surgery patient typically includes shoulder flexion, abduction, and internal and external rotation; elbow flexion, hip flexion, abduction, and internal and external rotation; and ankle plantar and dorsal flexion, inversion and eversion (14,15). Initially, five to eight repetitions of each exercise should be performed with a gradual progression to 10 to 15 repetitions. Early upper extremity ROM exercise for CABG patients is safe and aids in preventing adhesions, atrophy, and muscle weakness, and helps maintain ROM and good posture. Patients who

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experience sternal movement or clicking or have postsurgical wound complications should refrain from these activities until they are medically stable. Less than 5% of CABG patients cannot do upper extremity exercise during phase I (21).

Slow ambulation of 50 to 100 ft can be initiated as soon as the patient is stable. This activity is progressed approximately 100 ft/day as tolerated. During the inpatient program emphasis is placed on progression by increasing duration and to a lesser extent intensity. The frequency and duration of training guidelines are shown in Table 2. Usually, time only permits one ROM exercise session per day, but ambulation or stationary cycling is recommended two to three times/day as tolerated. Stair climbing or stepping may be introduced just prior to discharge (approximately day 6 or 7), particularly for patients who will have to climb stairs at home. For more detailed information on daily activities and guide for progression in an inpatient program, see the daily eight-step programs for both MI and CABG patients recommended by Pollock et al. (14).

Intensity of exercise usually begins at the 1.5 MET level and slowly progresses to 2 to 3 METs by hospital discharge. These levels of activity are associated with an increase in HR and systolic blood pressure (SBP) of 5 to 10 beats/min and 5 to 10 mmHg, respectively (22). These HR and SBP responses are also associated with an RPE rating of 11 to 12 (fairly light) (15-grade scale, Table 3) (21,22). The upper limit HR of 20 beats/min above standing rest is based on predischarge or early exercise testing results where this HR value related to ~13 (somewhat hard) on the RPE scale (23). While HR values usually remain below 15 beats/min above standing HR_{rest} at discharge, patients begin to reach the 20 beats/min limit by 3 to 4 weeks postevent or postsurgery. These HR and RPE guidelines are also appropriate for patients on beta-blockers (14,15). Prior to hospital discharge, it is important to provide the patient with a written home program. Patients should be taught the skills necessary to conduct their exercise including signs of intolerance (1,3,5). Often, the spouse may be needed to assist in the implementation of this program.

Phase II, Immediate Outpatient

The purpose of the phase II program is to provide patients with exercise guidelines and a progressive activity regimen to assist them through the convalescence period of rehabilitation. Also, guidelines for return to home activities, work, and secondary prevention are emphasized. The outpatient supervised program should begin shortly after the patient is discharged from the hospital. The immediate outpatient phase should begin where the inpatient program ended. Table 2 lists the components of the program and prescription guidelines used. The ROM exercises are continued and 1- to 3-lb dumbbells can be used with upper extremity exercise. The resistance training exercise can progress by 1- to 2-lb increments when the patient can complete a 15-repetition set at an RPE of 13 or less. Good form and technique are required: slow, controlled movements, good posture, and no breath holding (1,15). It is recommended that a patient breathe "out" during the lift and "in" while the weight is let down.

Prior to the low-level GXT, the frequency of training is one to two times/day, 5 days/week. During the first 4 to 6 weeks of the program (convalescence period—stage I; Fig. 1), the duration of training is shorter and multiple aerobic sessions per day may be more tolerable. The goal is to slowly increase duration (5–10 min/week) up to 45 min. Intensity will gradually increase with the upper limit target HR remaining at 20 beats/min above standing rest (RPE = 12 to 13). If a low-level GXT (usually up to 5 METs) is administered within 3 weeks of an MI, the HR and RPE found on this test should be used for the upper limit intensity target values. Once a SL-GXT is performed (approximately 3 to 6 weeks postevent or postsurgery) the intensity is set at 50% HHR_{max}. This should increase the target HR by approximately 10 to 15 beats/min (RPE = 13). Progres-

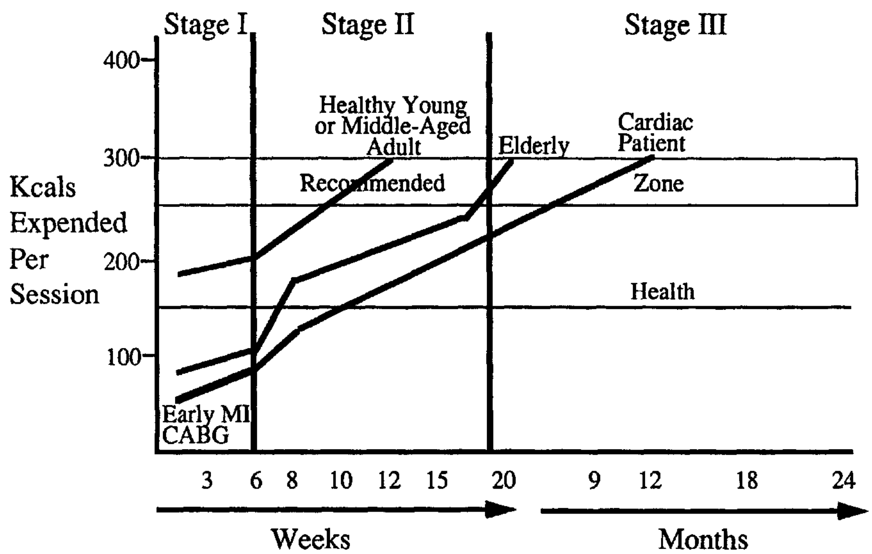

Figure 1 Comparison of relative progression of training volume among populations of healthy young and middle-aged adults, cardiac patients, and the elderly. Note: The minimal estmated kilocalorie (kcal) expenditure for health is approximately 150 kcal/day with 250–300 kcal/day, 3 to 5 days/wk being recommended for a higher level of benefit (Refs. 2,8). Stage I is the stabilization and convalescence period of rehabilitation and incorporates phases I and II; stage II is the development period (phase III); and stage III further development and maintenance.

sion of training depends on the patient's risk status, level of fitness, and rate of recovery. Since the MET level is still low (2.5 to 4 METs), the kcal expenditure will range from 100-150/day (Fig. 1). The figure denotes kcal expenditure for one aerobic session/day, thus two times/day will give the kcals mentioned at the early stage of training (22). The goal is to gradually progress to a minimum of 150 kcal/day by the time the patient reaches phase III (stage II; Fig. 1). Since daily exercise sessions are recommended, a combination of clinic visits (2 to 3 days/week) and home program (2 to 3 days/week) are necessary. The intensity prescription is more conservative in early home programs, until safety is determined.

The modes of activity remain conservative during phase II, emphasizing moderate intensity training and slowly building up stamina, ROM, and strength. Jogging, vigorous game-type activities, and weight training usually can begin in the intermediate outpatient or maintenance phases of rehabilitation (14). The SL-GXT is used to further define risk status, level of fitness, refine the exercise prescription, and make decisions concerning adding more vigorous activities (1,3,5).

Phase III, Intermediate Outpatient

The purpose of the phase III exercise program is further physical development; emphasizing return to normal activities and secondary prevention. Patients enter the Phase III program at variable rates depending on risk status; low risk, 5 to 6 weeks, moderate risk, 7 to 8 weeks, and high risk, 10 to 12 weeks (24). Once through the convalescent stage of rehabilitation, the low-risk patient's exercise prescription and training program becomes similar to what is recommended in adult fitness programs (Tables 1 and 2). Frequency and duration of training are usually greater for cardiac patients since most training is conducted at the lower end of the intensity target range (i.e., 50 to 70% of HRR_{max}). Intensity and duration of exercise are interrelated, with the total volume of training accomplished being an important factor (2,8). As long as the participant is above the minimal intensity threshold, the total volume of training (kcal) is the key to the development and maintenance of fitness/health (2,8). This total kcal concept appears acceptable, whether the exercise program is continuous or intermittent (9–11).

For stable patients who develop anginal symptoms and other abnormal cardiac signs, the target training HR should be prescribed at 5 to 10 beats/min below the point that the clinical manifestations occurred (1,3,5). Patients on beta-blocking agents, which significantly lower HR values, can determine their training HR by use of the HR method (1,15). This applies to patients with a GXT on the same dose of beta-blockade. If short-acting drugs are used, it is important that the GXT be performed at the time of day in which the patient will be normally exercising or at a similar time from which the drug was administered, to assure similar HR responses (14).

During stage II of recovery (Fig. 1), the patient can be progressed more rigorously. The moderate- to high-risk patient should continue a more conservative program that includes lower intensity exercise and moderate resistance training activities. Low-risk patients can progress their training program as age-matched healthy adults of similar levels of fitness.

More rigorous upper body exercise (e.g., arm and arm–leg ergometer, rowers, and weight training with free weights or machines) can be introduced. All major health organization guidelines mention the importance of a well-rounded program, including strength training for cardiac patients (Table 1). A brief review of the fitness/health benefits of resistance training have been provided by Pollock and Vincent (25). Using one set of eight to ten different exercises can be accomplished in the 20- to 30-min time frame shown in Table 2. The exercises should include the major muscle groups (i.e., the arms, shoulders, chest, trunk, abdomen, back, hips and legs). For older patients, special exercises designed to improve and maintain balance are appropriate (i.e., rise on toes, and abduction and adduction of hip/thigh). Exercises should be performed for 10 to 15 repetitions (reps), 2 to 3 days/week. Although an increased volume of resistance training (3 days/week, using multiple sets) may elicit a greater increase in strength and muscular endurance, most of the benefit can be attained with the minimal dose. Since the amount of time needed to complete a program is inversely related to adherence, more time-efficient protocols are recommended for most patients (1–3,5).

The 10- to 15-rep scheme produces a balanced effect on developing muscular strength and endurance; higher weight/lower rep programs elicit greater strength gains than the recommended protocol, but may be less safe and produce more orthopedic injuries (2). Injuries related to resistance training are most related to previous injury, heavier weights lifted, and balance problems (26). The latter may be avoided by the use of weight machines that give the patient more stability for the lower back and generally avoid balance problems and the potential for falling and dropping weights on self. Also, many weight machines provide an accommodating resistance cam and the ability to double-pin the weight stack to limit ROM. The former provides a better full-range stimulus to the muscle and the latter assists patients with joint problems to exercise in their pain-free ROM. Finally, exercises should be executed in a slow, controlled movement. Most recommend 2 s up and 4 s down (15).

Traditionally, one rep maximum (1-RM) strength testing was recommended prior to initiating a weight training program; to start the program, a 30 to 40% of 1-RM was recommended for arms and 50 to 60% of 1-RM for the legs. The weight was then adjusted in accordance with the number of reps that could be performed (~12 to 15) and the RPE (~13). The most popular current method is to have patients use the lightest weight or estimated light weight so that a set of 10 to 15 reps to an RPE of 13 or lower can be completed (14). Weight is progressed slowly as the patient adapts to the program (~2 to 5 lbs/week for arms and 5 to 10 lbs/week for legs). Although 10 to 15 reps are recommended for all patients, higher risk patients should remain at a moderate endpoint (e.g., an RPE of 15 or less), while low-risk patients can progress to volitional fatigue after an ~6-week adaptation period (1,14).

Swimming can be introduced once the patient is beyond the convalescent stage. Advantages of swimming are that it is an excellent aerobic activity that uses both arms and legs (14). The buoyancy of the water aids in venous return and can be therapeutic for patients with musculoskeletal problems. A major disadvantage is the varied skill level of patients. The HR response in water, in the prone position, is lower for a given workload than measured on a GXT out of the water. Thus, if using treadmill or cycle ergometer HR values for calculating the exercise target HR in the water, lower the estimate by 5 to 10 beats/min (27). Walking in water (upright chest deep) is a popular activity and does not adversely affect the HR response.

Arm Exercise

Patients with physical disabilities, unable to perform lower body aerobic activity should be exercised on an arm cranking or similar device. The exercise prescription as well as the physiological benefits for arm training are similar to those of leg training or a combination of arm and leg training (28–30). Exercise intensity should be prescribed based on heart rates or RPE values obtained during an arm cycle ergometer GXT; THR prescribed based on treadmill or cycle ergometer GXT may result in inappropriately higher exercise heart rates (29). At any given submaximal workload, the physiological response (HR,BP, RPP, and $\dot{V}O_2$) during arm exercise is higher when compared to either treadmill or leg cycle exercise, with absolute workloads being higher for the latter type of activities.

Phase IV, Further Development and Maintenance

The exercise training goal of the phase IV program is long-term development and maintenance (stage III; Fig. 1). Kavanagh et al. (31) have shown that cardiac patients continue to improve in aerobic capacity for up to 2 years. The low-risk, younger, more fit patient will progress much faster than the less fit older patient. Williams et al. (32) found that elderly patients made modest increases in MET capacity (2.9 to 4.3 METs) after 3 months of training compared to younger patients (3.3 to 7.0 METs). The older subjects who continued to train for an additional 3-month period improved to 6.9 METs. Since the progression of training is slower for cardiac patients, the developmental aspects of the exercise regimen

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can continue into the phase IV program. When the exercise program shifts from a developmental program to one of maintenance depends on the individual patient.

The guidelines for exercise prescription for phase IV are shown in Table 2. The recommendation is to continue to progress patients to the maintenance stage. Within this framework, the patient should exercise at a prescribed frequency, intensity, and duration of training that provides an energy expenditure of 150 kcal (minimum) to 300 kcal per exercise session for a minimum total kcal expenditure of 1000 kcal/wk. This level of activity provides significant long-term health and fitness benefits (2,8). A higher energy expenditure of up to 2000 kcal/wk gives added benefits (Fig. 1) (8). A weekly prescription of aerobic exercise of 30 to 60 min, 3 to 5 days/week at a moderate intensity will easily meet the kcal recommendation and is easily attainable by most patients.

At this stage (III) of training, a greater variety of activities may be recommended and desirable. Mixing activities (cross training) allows for a greater number of muscles to be trained and may make training more interesting and improve long-term adherence (2). For example, patients doing aerobic exercise for 45 min may walk, cycle, and stair-step for 15 min each. Some have considered this method a form of circuit training and it has been used by some clinicians as early as phase II rehabilitation. More rigorous game activities can also be recommended during phase IV.

Lifestyle Versus the Formal Fitness

As described earlier, many persons do not adhere to long-term formal rehabilitation programs, thus alternative approaches are most likely necessary (also see Chap. 5). The authors recommend a two-prong approach to the exercise prescription implementation. First is the formal program as outlined in Table 2, Figure 1. Patients in their formal program must be taught the skills necessary to conduct their exercise program at home/worksite and/or in less supervised environments. Second, the lifestyle approach to increasing physical activity should be taught and emphasized. The volume of kcal/wk expended concept (1000 to 2000 kcal/wk) should be taught and implemented as early as possible (2,8). Thus, both forms of the program become important for long-term adherence and kcal expenditure becomes the focal point for secondary prevention.

Prescribing Exercise Without an Exercise Test

Guidelines for exercise prescription for cardiac patients recommend a low-level or SL-GXT prior to program entry or shortly thereafter (1,3,5,33). Most often the low-level GXT is administered at patient discharge or shortly thereafter for risk stratification and the SL-GXT from 3 to 6 weeks postevent or postsurgery (see Chap. 4 concerning details on GXT). Even so, many early outpatient participants enter a program without a GXT, but these programs use telemetry monitoring at this phase of cardiac rehabilitation. The GXT may be performed later as described above. The progression of the exercise prescription prior to having their low-level or SL-GXT has been described and discussed earlier in this chapter (phase II).

The question arises whether a GXT should be required for program continuation or progression to higher intensities (i.e., 70 to 85% of estimated HRR_{max} and/or an RPE of 13–16). What is the safety and efficacy of such a program? McConnell (34) suggests that four types of patients may be referred to a cardiac rehabilitation program without a GXT: (1) patients with extreme debilitation (general muscular weakness and low endurance) may not be able to perform an adequate GXT; (2) patients with orthopedic limitations (e.g., arthritis, amputation, or neuromuscular dysfunction); (3) patients limited by shortness of breath; and (4) patients whose entry test may not provide any new information of diagnostic and prognostic value. These patients are known to be stable and their functional and disease status are well documented.

The safety and efficacy of cardiac rehabilitation exercise programs have been well-established (35). These programs were conducted with SL-GXTs so that the outcomes could be adequately compared and prescriptions appropriately recommended and followed. Also, these investigators were following the recommended guidelines provided by major health organizations (1,3,5). More recently, insurance carriers have questioned if everyone needs a GXT. Currently no published data establish the safety and efficacy of programs that do not require a GXT for program entry (or shortly thereafter).

McConnell et al. (unpublished data, personal communication) compared 229 MI and CABG patients who had a SL-GXT with 271 MI and CABG patients who did not have a GXT upon entering or during a 12-week outpatient cardiac rehabilitation program. The concerns were whether the no-GXT group would start at a lower intensity and progress at a slower rate than patients who had a GXT. Also, would there be a difference in safety and physiological outcomes between the two groups? All patients were telemetry monitored for the first 3 to 6 weeks of the program. Program prescription and progression for the GXT group were similar to that described earlier in this chapter (70 to 85% HR_{max} and RPE 11 to 14). The no-GXT group began at an approximated 2 to 3 MET level and progression was determined by HR and the RPE between 11 to 14 and the absence of abnormal signs and symptoms. There were similar increases in total kcal expenditure and no incidents required emergency medical management.

The initial exercise prescription for patients without a GXT is the same as described for the immediate outpatient cardiac rehabilitation program (see Table 2). The program will be progressed slowly by HR and RPE with close observation of symptomatology. Once the patient can attain a HR of 20 beats/min above standing rest, an RPE of 13, and duration of 30 to 45 min, alternative methods of prescription may be considered. First, an approximation of HR_{max} can be estimated (the limitations of this technique have been described earlier under Techniques for Determining Exercise Training Intensity). Using the estimated HR_{max} value determine the 50% of HRR_{max}. Use this HR value for the exercise prescription and titrate the prescription by RPE and symptoms of fatigue and exercise intolerance. Being more conservative than with patients who have had a GXT, use an RPE range of 12 to 14 rather than 12 to 16. Second, knowledge of the estimated MET level of the various activities on which the patient participates can be used as a guide for the proper prescription. For example, patients in the outpatient program usually begin activities at the 2 to 3 MET range and slowly progress by 0.5 to 1.0 MET increments (1,14).

Since the AHA, American College of Cardiology, and the ACSM all recommend yearly GXTs for cardiac patients, the exercise prescription can be further adjusted at that time (1,3,33). Although most guidelines are less stringent in regard to requiring a SL-GXT for a moderate intensity exercise program (<50% of HRR_{max}), all recommend one for entry into a vigorous physical activity regimen. Future research will provide information as to the safety, efficacy, and guidelines for exercise prescription for cardiac patients who do not have a GXT.

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6

Assessment for Exercise Training: Contraindications, Risk Stratification, and Safety Issues

Neil F. Gordon
St. Joseph's/Candler Health System, Savannah, Georgia

Appropriately prescribed and conducted exercise training is recommended as an integral component of cardiac rehabilitation services (1). Although habitual physical activity is associated with an overall reduction in the risk of sudden cardiac death, it is well established that an acute bout of exercise is associated with a transient increase in the risk for sudden cardiac death (2). Moreover, several studies have shown that, in adults, the transiently increased risk of cardiac arrest that occurs during exercise results primarily from the presence of preexisting coronary artery disease (3,4).

The recommendation that individuals with coronary artery disease and other cardiac disorders participate in exercise training is based on the premise that the benefits outweigh the risks. Therefore, the foremost priority when prescribing and conducting exercise training for these patients is to pay careful attention to minimizing potential adverse consequences via appropriate screening, program design, monitoring, and patient education. An initial step in facilitating exercise safety while fostering the cost-effective use of health care resources is to carefully evaluate patients and subsequently stratify them on the basis of likelihood of untoward exercise-related cardiac events (5).

PREPARTICIPATION EVALUATION

A careful medical evaluation is essential to establish a safe and effective exercise program for patients with cardiac disease (5). This initial evaluation should be

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performed by a physician or other appropriate health care professional. At the very least, the initial evaluation should include a medical history and physical examination. Key components of the medical history are outlined in Table 1 and include cardiovascular and other medical diagnoses; symptoms; risk factors for atherosclerosis progression; recent illnesses, hospitalizations, or surgical procedures; medications; exercise history; work history; other health habits; and psychosocial history. As outlined in Table 1, the physical examination should focus primarily on the cardiovascular system and, as indicated on an individual basis, other medical conditions such as musculoskeletal disorders which might limit exercise participation.

If available, measurements of left ventricular systolic function and coronary anatomy should be reviewed and noted as part of the initial evaluation. A current resting standard 12-lead electrocardiogram serves as an important reference standard for future comparison and should be recorded at the initial evaluation if unavailable (5).

Ideally, patients with cardiovascular disease should perform a graded exercise test with electrocardiographic monitoring prior to participation in exercise training. The exercise test is considered a key component of the initial assessment because it helps provide essential information on the participant's initial exercise capacity, hemodynamic and symptomatic responses to exercise, and the occurrence of exercise-induced ischemia and arrhythmias. Exercise testing should be performed in accordance with previously published authoritative guidelines, and repeated when warranted by clinical changes or to assess adaptations to exercise training and revise the exercise prescription (5).

STRATIFICATION FOR RISK OF EXERCISE-RELATED CARDIAC EVENTS

Information from the initial evaluation should be used to identify contraindications to exercise training and design a safe and effective exercise prescription. As we approach the next millennium, it is anticipated that cardiac rehabilitation programs will characteristically encompass comprehensive cardiovascular disease risk reduction programs (6). In view of this, data gathered from the initial evaluation should also be used to compile a multifaceted secondary prevention program.

There are certain individuals for whom the risks of exercise training may outweigh the potential benefits. Contraindications to participation in outpatient cardiac rehabilitation exercise training are listed in Table 2. Exceptions should be considered based on sound clinical judgment.

In addition to the contraindications listed in Table 2, certain clinical characteristics appear to increase the risk of exercise-related cardiac complications. De-

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Table 1 Key Components of the Preparticipation Medical History and Physical Exam

A. Medical History

1. Medical diagnoses—a variety of diagnoses should be reviewed including, but not limited to, cardiovascular disease including existing coronary artery disease, previous myocardial infarction, angioplasty, cardiac surgery, angina and hypertension; pulmonary disease including asthma, emphysema, and bronchitis; cerebral vascular disease including stroke; diabetes; peripheral vascular disease; anemia; phlebitis or emboli; cancer; pregnancy; musculoskeletal deficiencies, neuromuscular and joint disease; osteoporosis; emotional disorders; eating disorders.
2. Symptoms—angina: discomfort (pressure, tingling, pain, heaviness, burning, numbness) in the chest, jaw, neck, or arms; atypical angina; lightheadedness, dizziness, or fainting; shortness of breath; rapid heart beats or palpitations, especially if associated with physical activity, eating a large meal, emotional upset, or exposure to cold.
3. Risk factors for atherosclerotic disease progression—hypertension; diabetes; obesity; dyslipidemia; smoking; stress; and physical inactivity.
4. Recent illness, hospitalization, or surgical procedures.
5. Medication dose and schedule, drug allergies.
6. Other habits—including alcohol or illicit drug use.
7. Exercise history—information on habitual level of activity: type of exercise, frequency, duration, and intensity.
8. Work history—with emphasis on current or expected physical/mental demands, noting upper and lower extremity requirements; estimated time to return to work.
9. Psychosocial history—including living conditions; marital and family status; transportation needs; family needs; domestic and emtional problems; depression, anxiety, or other psychological disorders.

B. Physical Exam

1. Body weight; height; body mass index; waist-hip ratio.
2. Pulse rate and regularity.
3. Resting blood pressure.
4. Auscultation of the lungs with specific attention to uniformity of breath sounds in all areas (absence of rales, wheezes, and other abnormal breath sounds).
5. Auscultation of the heart with specific attention to murmurs, gallops, clicks, and rubs.
6. Palpation and auscultation of carotid, abdominal, and femoral arteries.
7. Palpation and inspection of lower extremities for edema and the presence of arterial pulses, skin integrity (particularly in diabetics).
8. Absence of presence of xanthoma and xanthelasma.
9. Examination related to orthopedic, neurological, or other medical conditions which might limit exercise testing or training.
10. Examination of the chest and leg wounds and vascular access areas in patients after coronary bypass surgery or percutaneous coronary revascularization.

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Table 2 Contraindications to Outpatient Cardiac Rehabilitation Exercise Training

1.	Unstable angina
2.	Resting SBP > 200 mmHg or resting DPB > 110 mmHg should be evaluated on a case-by-case basis
3.	Orthostatic blood pressure drop of > 20 mmHg with symptoms
4.	Critical aortic stenosis (peak systolic pressure gradient > 50 mmHg with aortic valve orifice area <0.75 cm^2 in average size adult)
5.	Acute systemic illness or fever
6.	Uncontrolled atrial or ventricular arrhythmias
7.	Uncontrolled sinus tachycardia (> 120 beats/min)
8.	Uncompensated CHF
9.	3° AV block (without pacemaker)
10.	Active pericarditis or myocarditis
11.	Recent embolism
12.	Thrombophlebitis
13.	Resting ST segment displacement (>2mm)
14.	Uncontrolled diabetes (resting blood glucose > 400 mg/dL)
15.	Severe orthopedic problems that would prohibit exercise
16.	Other metabolic problems, such as acute thyroiditis, hypo- or hyperkalemia, hypovolemia, etc.

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scriptive information regarding risk factors for cardiac arrest during outpatient cardiac rehabilitation in the United States can be ascertained from an analysis of questionnaire-based information on cardiac arrest occurring between January 1980 and December 1984 at 142 randomly selected programs (7). In this aggregate analysis, data were provided for 51,303 patients who collectively exercised for 2,351,916 hours. Cardiac arrest occurred in 20 patients for whom descriptive information was available and risk stratification status could be determined by various measures. Based on medical history alone, 11 patients could be categorized as "high risk." Of these patients, five had a previous cardiac arrest, four had heart failure, five had ventricular tachycardia, and two had a history of both heart failure and ventricular tachycardia. Of the 18 patients who performed a baseline exercise test, 10 had high-risk exercise test data which included an exercise capacity of <5 METs (five patients); ST segment depression at a heart rate <120 beats per minute (two patients); peak systolic blood pressure <130 mmHg (two patients); exertional hypotension (one patient); and ventricular tachycardia (three patients). Of the nine patients with adequate data from cardiac catheterization performed prior to their cardiac arrest, six patients had high-risk findings (specifically, four had triple-vessel coronary artery disease; one had left main coronary artery disease; three had a left ventricular ejection fraction <40%; and

Table 3 American Association for Cardiovascular and Pulmonary Rehabilitation Risk Stratification Model: Stratification for Risk of Event[a]

Lowest Risk
- No significant LV dysfunction (EF > 50%)
- No resting or exercise-induced complex dysrhythmias
- Uncomplicated MI, CABG, angioplasty, atherectomy, or stent: absence of CHF, absence of signs/symptoms indicating postevent ischemia
- Normal hemodynamics with exercise or recovery
- Asymptomatic including absence of angina with exertion
- Functional capacity ≥ 7.0 METs
- Absence of clinical depression
- Lowest risk classification is assumed when each of the risk factors in the category is present.

Moderate Risk
- Moderately impaired left ventricular function (EF = 40–49%)
- Signs/symptoms including angina at moderate levels of exercise (5–6.9 METs) or in recovery
- Moderate risk is assumed for patients who do not meet the classification of either highest risk or lowest risk.

Highest Risk
- Decreased LV function (EF < 40%)
- Survivor of cardiac arrest or sudden death
- Complex ventricular dysrhythmia at rest or with exercise
- MI or cardiac surgery complicated by cardiogenic shock, CHF and/or signs/symptoms of postprocedure ischemia
- Abnormal hemodynamics with exercise (especially flat or decreasing systolic blood pressure or chronotropic incompetence with increasing workload)
- Signs/symptoms including angina pectoris at low levels of exercise (<5.0 METs) or in recovery
- Functional capacity < 5.0 METs
- Clinically significant depression
- Highest risk classification is assumed with the presence of any one of the risk factors included in this category.

Abbreviations: CABG = coronary artery bypass graft surgery; CHF = congestive heart failure; EF = ejection fraction; LV = left ventricular; MI = myocardial infarction.
Note: If measured functional capacity is not available, this variable is not considered in the risk stratification process.
[a] Not specific solely to exercise.
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two had both triple-vessel coronary artery disease and a left ventricular ejection fraction <40%). Classic criteria for high-risk status were not noted for 4 of the 20 cardiac arrest patients.

Established models for risk stratification have been derived from research on factors associated with an accentuated overall risk of cardiac mortality and morbidity rather than the specific risk for exercise-related events. However, the above data clearly demonstrate a correlation between risk stratification status as determined using established models and the risk for exercise-related cardiac events. Thus, although other factors (such as exercise intensity and noncompliance with the exercise prescription) undoubtedly contribute to the precise risk for exercise-related cardiac events, risk stratification is believed to be an important clinical tool to assist in determining the appropriate level of supervision for individual patients.

Although not solely specific to exercise, the American Association for Cardiovascular and Pulmonary Rehabilitation (AACVPR) has recently developed a model that uses variables common to established models but has the advantage of categorizing patients into a single-risk class (5). Using this model, which is shown in Table 3, ''lowest risk'' patients are required to have all characteristics listed, ''highest risk''patients are required to have any one of the characteristics listed, and those who do not fit into either of these categories are classified as being at ''moderate risk.'' Subsequent decisions regarding extent of electrocardiographic monitoring and supervision are facilitated, in part, using this risk stratification process.

Established models for risk stratification, including the AACVPR model presented above, are limited by the fact that not all patients can be adequately categorized. This limitation is particularly relevant for patients with nondiagnostic exercise tests. Additional limitations that require remediation include the fact that many patients now enter cardiac rehabilitation programs without a recent exercise test and the failure to consider significant comorbid conditions.

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7

Components of Exercise Training

Ray W. Squires
Mayo Clinic and Foundation, Rochester, Minnesota

Long-term, consistent participation in exercise training is necessary for attainment of the benefits described in Chapter 2. This chapter provides practical information on how to apply the principles of exercise prescription and risk stratification for both inpatient and outpatient exercise programs for patients with cardiovascular disease. Specific suggestions for implementation, progression, and long-term follow-up of both aerobic and resistance exercise components will be presented.

INPATIENT EXERCISE TRAINING

The trend during the past three decades has been to reduce the average hospital length of stay for patients with acute myocardial infarction, coronary bypass surgery, and percutaneous transluminal coronary angioplasty with or without concurrent stent deployment. With the exception of a few categories of high-risk patients, such as those with unstable angina pectoris, severe congestive heart failure, malignant ventricular arrhythmias, other postevent serious complications, patients with multiple comorbidities, and the frail elderly, average hospitalization after a cardiac event now ranges from 1 to 5 days. The result, from a cardiac rehabilitation perspective, is that there is little opportunity for formal exercise training during hospitalization after a cardiac event.

COMPONENTS OF INPATIENT PHYSICAL ACTIVITY, STAFFING, AND FACILITIES

The components of physical activity for most hospitalized cardiac patients include rapid mobilization, a predischarge graded exercise test in some patient

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groups, prescription of a home exercise program, and transition into, or referral to, an outpatient cardiac rehabilitation program, if available (1).

Cardiac rehabilitation exercise may be supervised by one of several allied health professionals: registered nurse, physical therapist, exercise physiologist or exercise specialist, occupational therapist, etc. Specific training in cardiac rehabilitation is a requirement for cardiac rehabilitation professionals working with cardiac inpatients.

Facilities for the inpatient exercise program may consist of the patient's room, adjacent hallways, or an exercise center. Specific equipment includes a stethoscope and sphygmomanometer, ECG telemetry, 1- to 2-lb handweights or elastic bands for mild resistive activities, stairs (portable or a hospital stairway), cycle ergometer (in the patient's room or exercise center), and a treadmill (in exercise center) with a slowest speed of <1.0 mph.

The inpatient physical activity program begins with a review of the medical record and an assessment and patient interview by the cardiac rehabilitation professional. This evaluation and patient interview may include the components listed in Table 1. In addition to patients with acute myocardial infarction or revascularization via coronary angioplasty or bypass surgery, patients hospitalized with angina pectoris, valvular surgery, cardiac transplantation, surgical correction of congenital cardiac abnormalities, malignant ventricular arrhythmias, and chronic heart failure benefit from supervised physical activity. The patient should be risk stratified, as discussed in Chapter 6. High-risk patients should be carefully supervised in both the inpatient and outpatient phases of exercise training.

Table 1 Components of the Inpatient Interview Prior to Commencing Physical Activity

1.	Social history including marital status, social support system, employment history, educational attainment.
2.	Past medical history with emphasis on the cardiovascular system, peripheral, and/or cerebrovascular disease, musculoskeletal system, metabolic diseases, previous surgeries, balance/coordination/gait, cognition.
3.	Preevent physical activity patterns, disability status, physically demanding occupational/avocational activities.
4.	Current clinical event.
5.	Procedures/tests performed during the hospitalization.
6.	Laboratory data: coronary anatomy, left ventricular ejection fraction, cardiac valvular function, hemoglobin concentration, serum potassium concentration, blood glucose concentration in diabetics, electrocardiogram.
7.	Current heart rate, rhythm, and blood pressure (sitting and standing).
8.	Coronary risk factors.
9.	Hospital course, plans for further evaluation and treatment.
10.	Sleeping, eating patterns prior to and during this hospitalization.

The patient with an acute myocardial infarction may be mobilized as soon as symptoms have abated and electrical and hemodynamic stability has been demonstrated. After coronary bypass or other cardiac surgery, mobilization begins at the time of extubation. With catheter-based treatments, mobilization may begin when the risk of bleeding from the vascular access site has sufficiently diminished (2).

Mobilization may begin with sitting on the bedside with legs dangling for 2 or more minutes, as tolerated, and progresses to standing and walking in the patient's room. Range-of-motion exercises to each major joint, either passive, active, or mildly resistive (1- to 2-lb handweights), depending upon the patient's ability, are also performed. These activities may be performed multiple times during the day, as tolerated by the patient. Patients who have undergone a sternotomy benefit from specific upper extremity stretching exercises as described in Table 2. For inpatient physical activities, an increase in heart rate of 10 to 30

Table 2 Examples of Upper Extremity Range-of-Motion Exercises[a] for Inpatients and Outpatients After a Sternotomy

1. Stick behind head
   Starting position: Stand erect with feet shoulder-width apart and hold stick in front of body.
   Movement: Hold the stick out and raise it straight up over your head. Lower stick behind head, then raise up over head. Keeping arms straight, return stick to starting position. Work up to 10 to 15 repetitions.
2. Swinging stick
   Starting position: Stand erect with feet shoulder-width apart. Hold stick in front of body, arms extended.
   Movement: Holding stick, push one arm out to side and the other arm above head. Repeat to the other side. Work up to 10 to 15 repetitions.
3. Stick sliding up back
   Starting position: Stand erect with feet shoulder-width apart with stick behind back, hands trunk-width apart with arms extended.
   Movement: Raise elbows and slide stick up the back as high as possible. Return to starting position. Work up to 10 to 15 repetitions
4. Stick behind back
   Starting position: Stand erect with feet shoulder-width apart. Hold stick behind back with hands shoulder-distance apart.
   Movement: Move stick backwards keeping arms straight. All movement should come from the shoulders. Do not lean forward from the waist. Return to starting position. Work up to 10 to 15 repetitions.

[a] Performed with 3-ft piece of wooden dowel (the "stick"). These exercises are helpful when performed once or twice daily for approximately the first month after surgery. The movements should be performed smoothly and slowly and should not result in pain.
Adapted from Ref. 14.

6	
7	Very, very light
8	
9	Very light
10	
11	Fairly light
12	
13	Somewhat hard
14	
15	Hard
16	
17	Very hard
18	
19	Very, very hard
20	

Figure 1 Borg perceived exertion scale. (From Ref. 2a.)

beats above the standing heart rate at rest and Borg Perceived Exertion Scale ratings between 11 to 13 (fairly light to somewhat hard) (Fig. 1) are appropriate means of controlling exercise intensity.

Ambulation time may be gradually increased, as tolerated, from 2 or 3 min to approximately 20 min per session, with a frequency of two to three sessions per day. For extremely deconditioned patients, intermittent exercise involving several short walks (30 s to 2 min in duration), interspersed with short periods of rest (1 to 2 min), may be necessary. Walking may be accomplished in the halls of the hospital or on a motorized treadmill in an exercise center, if available. Cycle ergometry may be performed as an alternative to walking. During inpatient supervised exercise sessions, it may be desirable to monitor continuously the patient's electrocardiogram as a means of assessing cardiac rhythm and keeping

Table 3 Adverse Signs and Symptoms Used to Terminate an Exercise Session

Angina pectoris
New or increased dyspnea
Excessive or unusual fatigue
Lightheadedness/dizziness
Pallor/cyanosis/cold sweat
Syncope/near-syncope
Inappropriate bradycardia
Nausea
Hypotension (systolic BP <90 mmHg)/hypertension (systolic BP >240 mmHg, diastolic BP >110 mmHg)
Ventricular tachycardia/sustained supraventricular tachycardia
Peripheral edema/pulmonary congestion
Electrocardiographic ST segment displacement >1 mm from baseline (in leads without pathological Q waves)
Rate-related left bundle-branch block
High-grade AV block

Adapted from Refs. 15–17.

the heart rate within the recommended range, particularly for high-risk patients. Blood pressure should be measured before, during, and after exercise. The heart rate, blood pressure, amount of exercise, and any symptoms should be documented. Adverse signs to consider in prematurely terminating an inpatient exercise session are given in Table 3.

Patients hospitalized for evaluation and treatment of malignant ventricular arrhythmias are candidates for supervised and ECG-monitored exercise (3). Mobilization and low-level ambulation and/or cycle ergometry are useful in decreasing the deconditioning effects of hospitalization.

GOALS OF INPATIENT EXERCISE TRAINING

The goals of inpatient exercise training are to prevent potential deconditioning (reduced physical work capacity) and other adverse effects of bedrest, such as orthostatic hypotension, thromboembolism, reduced joint range of motion, and hypoventilation (1). Physical activity can assist in maintenance of neuromuscular relaxation and potentially reduce feelings of invalidism, increasing the confidence of both patient and significant others. Exercise during hospitalization may result in an earlier return to pre-event activities, provides medical surveillance (heart rate, blood pressure, symptoms, physical ability, etc.), and potentially may reduce hospital length of stay.

PREDISCHARGE GRADED EXERCISE TESTING

After acute myocardial infarction, predischarge graded exercise testing with submaximal endpoints may be performed at approximately 4 days in selected patients who have not undergone emergent coronary angiography. The results are useful for the assessment of prognosis and in the decision for subsequent diagnostic tests as well as for providing the basis for a home exercise program and the initial exercise prescription for outpatient cardiac rehabilitation (4). Pharmacological stress testing may be performed in patients who are unable to exercise adequately. In general, patients who have undergone successful revascularization with either catheter-based treatment or bypass surgery do not perform predischarge graded exercise testing (5).

HOME EXERCISE PRESCRIPTION AND TRANSITION TO OUTPATIENT CARDIAC REHABILITATION

The home exercise prescription details the types of exercise recommended for the patient (usually walking and/or cycle ergometry), the intensity of effort (mild to moderate), duration of exercise (gradual progression to 30 to 45 min per session), and frequency of participation (4+ sessions per week). An example of an exercise prescription for a patient with an uncomplicated myocardial infarction is shown in Figure 2.

A supervised or home-based outpatient cardiac rehabilitation program is recommended for essentially all patients after a cardiac event (6). Hospital discharge plans can include referral to an outpatient cardiac rehabilitation program, if available, or independent or home exercise may be undertaken. Many different options for outpatient supervision of patient exercise training are possible and are discussed subsequently.

OUTPATIENT EXERCISE TRAINING

Patient Population

Patients recently hospitalized with an acute cardiac event (myocardial infarction, coronary bypass surgery, diagnostic or therapeutic cardiac catheterization, other cardiothoracic surgery, etc.) should be referred for outpatient cardiac rehabilitation services. Additional patients with stable angina pectoris, remote history of a cardiac event, or chronic heart failure are also excellent candidates for regular exercise training. Unfortunately, insurance coverage of outpatient cardiac rehabilitation supervised exercise training may not be available for all cardiovascular diagnoses that can benefit from the service. The goals of outpatient exercise train-

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EXERCISE PRESCRIPTION

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The exercise prescription outlines the proper proportions of intensity, duration and frequency of participation on an individual basis which will result in a predictable improvement in performance. Age is not a barrier to improvement as numerous adult fitness programs have established that one can become healthier as one grows older.

Clinic Number 0-000-000 Date 12-19-97

Name Smith, John Age 55

Medication(s) aspirin 325 mg qd, metoprolol XL 100 mg qd, simvastatin 20 mg qhs

MODE (AEROBIC) Individual Preference

walk, treadmill, cycle

Resting heart rate 56

Peak exercise heart rate --

INTENSITY

Target heart rate (pulse) range rest heart rate + 10-20 beats/minute

Perceived exertion range 11-14

DURATION

Warm-up 5-10 minutes

Conditioning Exercise 10 minutes $\xrightarrow{*}$ 30-45 minutes

Cool-down 5-10 minutes

FREQUENCY

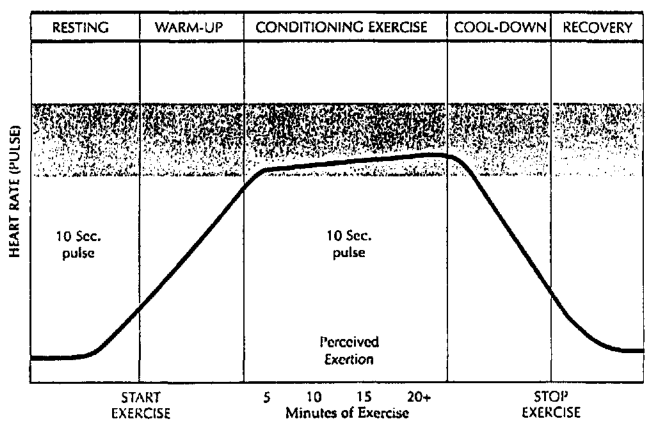
5-6 sessions/week

OTHER INSTRUCTIONS

* increase duration by 1-5 minutes each session, as tolerated

Perceived Exertion Scale	
6	
7	Very, very light
8	
9	Very light
10	
11	Fairly light
12	
13	Somewhat hard
14	
15	Hard
16	
17	Very hard
18	
19	Very, very hard
20	

THE EXERCISE TRAINING PATTERN



Conversion Table for 10 Second Pulse Count

Beats/10 sec.		Beats/min.
9	=	54
10	=	60
11	=	66
12	=	72
13	=	78
14	=	84
15	=	90
16	=	96
17	=	102
18	=	108
19	=	114
20	=	120
21	=	126
22	=	132
23	=	138
24	=	144
25	=	150
26	=	156

MC 1864-11/R494

Figure 2 Exercise prescription for a myocardial infarction patient with no predischarge graded exercise test.

ing are to improve exercise capacity, teach patients the skills to enable them to continue with lifelong physical activity and to provide additional benefits of secondary prevention.

INITIATING OUTPATIENT SUPERVISED EXERCISE TRAINING

For recently hospitalized patients, supervised outpatient exercise training may begin conservatively as soon as the patient is discharged and able to travel to the rehabilitation center, usually within 1 to 7 days after dismissal. For patients with cardiovascular disease who have not recently been hospitalized, an evaluation by a physician (preferably a cardiologist) should be performed prior to starting the exercise program.

The initial assessment, performed by a cardiac rehabilitation professional, is similar to the one described for inpatients (Table 1) and involves review of the medical records and consultation with the patient. In addition to the issues reviewed with inpatients, the following factors may be discussed:

1. Graded exercise test data (or pharmacological stress data), if available.
2. Anticipated return to work date.
3. Patient goals and expectations.
4. Explanation of the benefits of long-term participation in exercise training, amounts of exercise necessary for benefits to become operative.

If not done previously, the patient is risk stratified to determine the intensity of medical supervision required or desired at the beginning of the outpatient exercise training program. High-risk patients should receive more intensive medical supervision of their exercise program than lower risk patients (7).

DIFFERING INTENSITIES OF "SUPERVISION" OF EXERCISE TRAINING

Ideally, all cardiac patients should begin outpatient exercise training in a "supervised" program (i.e., in an outpatient exercise center with direct supervision by cardiac rehabilitation professionals). However, due to issues such as return to work within a few days of hospital dismissal, lack of insurance coverage of cardiac rehabilitation services for some patients, transportation barriers or travel distance, lack of an available program, or patient preference, many patients will not enter traditional "supervised" programs.

"Supervision" of exercise training for patients in a cardiac rehabilitation center, in the broad sense, includes the following:

1. Exercise prescription, including proper warm-up and cool-down procedures, knowledge of the target heart rate and ability to self-monitor heart rate, desired perceived exertion range, knowledge of symptoms of exertional intolerance and the recommended patient responses to symptoms, prudent progression in the amount of exercise, knowledge of the effect of environmental factors on exercise training, etc.
2. Familiarization with appropriate use of exercise equipment.
3. Direct instruction and supervision of exercise sessions by qualified personnel.
4. Monitoring of the heart rate and blood pressure during exercise training.
5. Periodic adjustment of the exercise prescription based on changes in the clinical status of the patient.
6. Medical intervention during serious exercise-related complications, such as prolonged angina pectoris, life-threatening ventricular arrhythmias, heart failure decompensation, etc.

Many cardiac patients are not able to attend traditional, directly "supervised" exercise programs. However, according to the broad definition of supervision outlined above, several potential models of differing intensities of supervision of exercise training follow:

Model A: Direct supervision of all exercise sessions (three or more per week, no unsupervised training) by qualified staff in a traditional cardiac rehabilitation program; ECG monitoring available on an individual, as-needed basis. This model is ideal for very high-risk patients.

Model B: Partial direct supervision of exercise training with one to three supervised sessions per week, with additional unsupervised sessions (at home or at a community exercise facility).

Model C: Initial direct medical supervision for days to weeks with a subsequent unsupervised long-term program.

Model D: Initial direct medical supervision for days to weeks with a subsequent unsupervised long-term program with periodic, directly supervised exercise sessions (every 1 to 3 months).

Model E: Initial direct supervision with a subsequent home exercise program monitored by telephone contact with an established cardiac rehabilitation program (with optional transtelephonic ECG monitoring capability).

Model F: Initial evaluation, followed by home-based exercise training for appropriately selected patients (see Chap. 9).

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PATIENTS WITH EXERCISE-INDUCED MYOCARDIAL ISCHEMIA

Exercise intensities above the ischemic threshold (the heart rate or double product that is associated with at least 1 mm of horizontal ST segment depression or imaging evidence of ischemia with nuclear or echocardiographic techniques) are not advised due to the risk of life-threatening ventricular arrhythmias. Target heart rates should be set at least 10 beats per min below the heart rate that corresponds to the ischemic threshold. Anginal symptoms should be avoided and pre-exercise use of nitroglycerine should be encouraged if it enables patients to perform greater amounts of exercise with fewer symptoms. Patients with painless (silent) ischemia must be able to accurately self-monitor heart rate, if they are not using ECG telemetry of an electronic pulse monitor, and remain within their target heart rate range during exercise training.

The ischemic threshold may not always occur at a specific heart rate (8). Changes in coronary perfusion may occur from increased or decreased coronary vasoconstriction or transient blood platelet aggregation. Blood levels of anti-ischemic medications are not constant over the entire day. Therefore, ECG monitoring and careful assessment of patient symptoms is warranted for the first several exercise sessions. Careful education of patients regarding the taking medications properly is of critical importance.

CONTINUOUS ELECTROCARDIOGRAPHIC MONITORING

Continuous ECG monitoring during outpatient exercise training sessions should be based on the risk status and needs of the individual patient. For initial exercise sessions, routine ECG monitoring may assist patients in learning to self-monitor heart rate and to remain within their target heart rate zone. Longer term ECG monitoring should be restricted to high-risk patients or those who cannot self-monitor. Transtelephonic monitoring of an exercising patient's ECG is an option for patients who cannot attend a rehabilitation center (9).

FACILITIES, EQUIPMENT, AND STAFFING FOR SUPERVISED OUTPATIENT EXERCISE TRAINING

Medically supervised exercise programs for cardiac outpatients may be located in hospitals, outpatient clinic buildings, community exercise facilities, or workplace exercise facilities. These facilities must provide a clean, safe environment and adequate exercise space for each participant (40 to 50 square feet). Emergency equipment (defibrillator, crash cart, portable oxygen supply) and protocols for handling emergent medical events must be in place. Stethoscopes and sphygmomanometers, as well as ECG monitoring equipment, are required. Basic first aid supplies should be available. A drinking fountain or other water supply for patient hydration is mandatory. Infection control policies and hand-washing facilities are also needed. Exit signs must be clearly marked and the facility must meet local fire code regulations. Temperature (between 62 to 72°F) and relative humidity (<65%) should be maintained. Procedures to maintain confidentiality of patient medical records must be in place (7).

Cardiac rehabilitation staff who directly supervise outpatient exercise sessions may have diverse professional training. Exercise specialists or exercise physiologists, registered nurses, and physical, occupational, or recreational therapists are examples of such allied health professionals. Specific training in cardiac rehabilitation, either through academic preparation, an internship or preceptorship, or on-the-job training with experienced professionals is required. Certification by the American College of Sports Medicine at the exercise specialist or exercise program director level is desirable. Advanced Cardiac Life Support certification with extensive experience in critical care medicine for at least one staff member is a requirement for most programs. A medical director must be identified to give medical direction to the program. Ideally, this person should be a fully trained cardiologist with expertise in preventive and rehabilitative cardiology. The risk status of the patients and the experience of the patients in performing exercise training will determine the exact staff-to-patient ratio for each group of patients.

The types of exercise equipment used for outpatient cardiac exercise programs are given in Table 4. Equipment must be properly maintained

Table 4 Various Types of Exercise Equipment Used in Outpatient Cardiac Rehabilitation Exercise Programs

Cycle ergometer
Semirecumbent cycle ergometer
Combination arm/leg ergometer
Motorized treadmill
Stairclimbing machine, portable stairs, step benches
Rowing ergometer
Arm ergometer
Pool for swimming, water exercise
Walk/jog track
Cross-country ski simulator
Sport balls
Hand weights (1 to 20 lb)
Large elastic bands
Weight training machines
Floor mats

and calibrated periodically. The staff must be experienced in the use of all exercise equipment. Additional equipment, such as a pulse oximeter for measuring arterial oxygen saturation for selected patients with pulmonary or congenital heart disease and a glucometer for capillary blood glucose measurement (as well as a glucose source) in diabetic patients should be available. Patients should wear loose-fitting, light-weight exercise clothing and good quality athletic shoes.

INDEPENDENT EXERCISE TRAINING

Patients who exercise in an unsupervised environment (independent exercise training) may do so at home (indoor or outdoor exercise) or at a community exercise center. A medical emergency plan should be part of the preparation for unsupervised exercise. Having a person able to provide basic cardiopulmonary resuscitation available in the exercise area is prudent. In the event of cardiac collapse, cardiopulmonary resuscitation is effective only if promptly followed by defibrillation. Activation of the emergency medical system and the response time of the emergency team is of critical importance. External semiautomatic cardioverter defibrillators, in the future, may become commonplace in community exercise facilities. For patients who exercise out-of-doors without a partner, the chances of successful resuscitation are extremely small. Fortunately, the risk of an exercise-related serious cardiac complication is minimal, even for properly screened high-risk patients (10). Factors believed to reduce exercise-related cardiovascular complications are given in Table 5.

Table 5 Program Factors to Reduce Exercise-Related Cardiovascular Complications

Medical clearance prior to beginning exercise training
Serial graded exercise testing
Risk stratification with medical supervision of exercise training for high-risk patients
Emergency equipment and experienced staff in the exercise area
Availability of ECG monitoring
Proper warm-up and cool-down procedures
Patient education regarding warning signs and symptoms
Patient adherence to the prescribed target heart rate range
Moderate exercise intensity
Minimize competition
Adapt exercise to environmental conditions

Adapted from Refs. 6 and 18.

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PATIENT EDUCATION AND SKILL DEVELOPMENT

Whether patients exercise in a supervised environment or independently, they must obtain certain basic exercise knowledge and skills. Self-monitoring skills, such as pulse taking, use of the Borg Perceived Exertion Scale, symptom recognition and the appropriate response, and environmental issues (for outdoor exercise), are examples. Patients should understand what specific circumstances should result in deferring exercise training for a day or more.

Most patients must learn to accurately monitor their pulse rate. Due to potential problems with the carotid sinus reflex and the high prevalence of carotid artery atherosclerosis in patients with coronary artery disease, the radial pulse, rather than the carotid pulse, is usually palpated. Patients may count the pulse for 10 s and multiply by 6 to convert to beats per minute. Patients unable to self-monitor pulse should generally use an electronic heart monitor (with torso rather than finger or earlobe leads) during independent exercise. Patients with extremely irregular heart rates, for example, atrial fibrillation, often do not self-monitor exercise pulse rates.

Patient symptoms of angina pectoris, dyspnea, and claudication may be quantified by use of the scales in Table 6. Patients should not continue exercise if perceptible anginal pain is present. Preexercise sublingual or spray nitroglycerin should be used for patients with a low anginal threshold. Moderate dyspnea during exercise training is acceptable if it is determined that the symptom is not an anginal equivalent or a sign of heart failure decompensation. Patients should be

Table 6 Scales for Grading Symptom Severity

	Angina Scale
1.	Light, barely noticeable
2.	Moderate, bothersome
3.	Severe, very uncomfortable
4.	Most severe pain ever experienced
	Dyspnea Scale
1.	Mild, noticeable
2.	Mild, some difficulty
3.	Moderate difficulty, but can continue
4.	Severe difficulty, cannot continue
	Claudication Scale
1.	Initial, minimal pain
2.	Moderate pain
3.	Intense pain
4.	Maximal pain, cannot continue

From Ref. 6.

Table 7 Reasons to Temporarily Defer Exercise Training

Acute illness, fever
Unusual fatigue, lightheadedness
Uncontrolled hypertension (resting systolic BP >200 mmHg, resting diastolic BP >110 mmHg), hypotension (resting systolic BP <90 mmHg)
Worsening angina pectoris (unstable angina)
Dehydration
Poorly controlled diabetes mellitus (fasting blood glucose >300 mg/dl)
Emotional crisis
Adverse environmental conditions (defer outdoor exercise)

Adapted from Ref. 16.

able to talk during exercise training (''talk test''). Patients should also stop exercise if musculoskeletal pain increases during physical activity.

Reasons to temporarily defer exercise training are shown in Table 7. After a period of several days to weeks of not exercising due to clinical reasons or poor patient compliance, the program should resume at a lower intensity and duration with a gradual progression to the previous exercise amount.

COMPONENTS OF OUTPATIENT EXERCISE TRAINING

The initial exercise prescription for outpatient exercise training must be individualized (see Chap. 4). The intensity of exercise is set at approximately 50 to 60% of exercise capacity, using either a target heart rate based on a symptom-limited graded exercise test or with perceived exertion levels of 11 to 14. Table 8 gives

Table 8 Intensity of Exercise as a Function of the Percentage of Maximal Heart Rate and Maximal Oxygen Uptake, and Ratings of Perceived Exertion (RPE)

$\%HR_{max}$	$\%VO_{2max}$	RPE	Intensity classification
<35	<30	<10	Very light
35–59	30–49	10–11	Light
60–79	50–74	12–13	Moderate
80–89	75–84	14–16	Heavy
>90	>85	>16	Very heavy

From Ref. 17.

the relationship between perceived exertion ratings and the corresponding percentage of maximal heart rate and oxygen uptake. Most cardiac patients, with proper training, use the perceived exertion scale accurately to regulate exercise intensity. Without a symptom-limited graded exercise test, a target heart rate corresponding to perceived exertion scores of approximately 11 to 14 may be prescribed based on results of one or more ECG-monitored exercise sessions.

The duration of exercise begins conservatively, usually 10 to 15 min per session, with a gradual increase to 30 to 45 min by the third week. The exercise may be performed continuously for the desired duration using a single mode of activity (walking, for example), or multiple modes of activity (for instance, a combination of walking, cycling, arm ergometry). The exercise session may also employ interval training, which uses periods of higher intensity exercise alternated with periods of lower intensity activity. This approach is particularly effective in rapidly improving exercise capacity. Although not commonly employed in coronary patients, it has been demonstrated to be effective for patients with chronic heart failure (11). Some patients with extremely poor exercise capacities or those limited by symptoms of claudication cannot exercise for more than a few minutes initially. Intermittent exercise (i.e., short periods of exercise interspersed with periods of rest) is helpful for these patients. Table 9 provides an outline of an intermittent progressive exercise program for patients with exercise capacities of <3 METs.

Frequency of exercise is set at 4 to 6 days per week; up to three sessions per week may be in a supervised environment. Walking (treadmill, outdoors, track, shopping center, or school) and cycle ergometry are the most common modes of exercise during the first several weeks. Upper extremity exercise is important, because much of the improvement in exercise capacity is specific to the muscle groups undergoing exercise training. Such training allows daily activities requiring arm activity to be performed with less fatigue and at a lower myocardial oxygen requirement (lower heart rate and systolic blood pressure after

Table 9 Intermittent Exercise Progression Suggestions for Patients with Extremely Poor Exercise Capacities (EC, <3 METs)

Week	%EC	Total min @ %EC	Min Exercise	Min Rest	Reps
1.	40–50	10–15	3–5	3–5	3–4
2.	40–50	12–20	5–7	3–5	3
3.	50–60	15–25	7–10	3–5	3
4.	50–60	20–30	10–15	2–3	2
5.	60–70	25–40	12–20	2	2

Adapted from Ref. 15.

training). Upper extremity aerobic exercise may be performed with an arm ergometer, a combination arm/leg ergometer, or a rowing ergometer.

The exercise sessions must begin with a series of warm-up activities to prepare the musculoskeletal system for the conditioning exercise phase and to increase cardiac output as well as blood flow to the myocardium. This is accomplished by a combination of static stretches for the major muscle groups, dynamic range of motion activities, and several minutes of low-level aerobic exercise. At the end of the conditioning period, a cool-down routine that consists of lower level aerobic activity, static stretching, and dynamic range of motion movements is performed. The stretching activities, especially when performed after a period of aerobic activity when the skeletal muscle temperature is elevated, are helpful in improving flexibility.

Resistance Exercise Training

Although aerobic exercise training constitutes the most important form of physical activity for cardiac patients, improving muscular strength and local muscle endurance is also a vital component of a comprehensive fitness program. Increased muscular strength and endurance results in an improved ability to perform many routine tasks and potentially increases patient confidence and quality of life (12). It is an important component of rehabilitation of patients who will return to occupations or avocational pursuits that require musculoskeletal strength and endurance.

Prior to beginning a resistance exercise program, the patient's musculoskeletal system should be reviewed with emphasis on old injuries, surgery, arthritis, or other causes of joint pain. During the performance of resistance exercise, patients must not experience limiting joint or muscle pain. Low-level resistance exercise using light hand weights is appropriate for any cardiac patient. However, using resistance training machines with more than minimal resistance should be restricted to patients with normal exercise capacities. During the first few resistance training sessions, the heart rate and blood pressure should be assessed to determine the appropriateness of the responses.

Traditionally, resistance exercise was not deemed appropriate for cardiac patients due to the concerns of a potential excessive heart rate and blood pressure response resulting in myocardial ischemia or left ventricular overload. However, data over the past decade have demonstrated the safety and efficacy of this type of exercise. In one study, patients progressed to performing multiple repetitions of machine-based weight training using approximately 40- and 130-lb weights with the arms and legs, respectively (13). The mean heart rate and systolic blood pressure increase, relative to resting conditions, was a modest 20 beats/min and 21 mmHg, respectively. No clinical deterioration occurred. The cohort of 13 cardiac patients involved in the study included four with left ventricular ejection fractions of <40%.

Equipment for resistance exercise may include: (1) hand weights; (2) wrist or ankle wrap-around weights; (3) large elastic bands; (4); weight training machines with adjustable resistance; and (5) free barbell weights.

Low-level resistance exercises may begin during hospitalization. However, patients with a sternotomy should restrict resistance to <10 lb with the upper extremities for approximately the first 6 weeks after surgery to minimize the chances of sternal nonunion. In general, patients after myocardial infarction and cardiac surgery do not begin using weight training machines until at least 4 weeks into the outpatient exercise program.

Beginning resistance may be set by having the patient begin with minimal resistance and find a weight that can be lifted 10 to 20 repetitions without undue straining. Before using weight training machine exercise, a few weeks of using hand weights should be performed. One to three sets of exercises for the major muscle groups should be performed two or three times per week. Patients must be carefully supervised and instructed initially in proper lifting technique and avoidance of the valsalva maneuver. Lifting technique should be slow and deliberate. Patients may be instructed to count aloud ''one, two,'' while lifting the resistance and ''one, two, three, four'' when lowering the weight.

For patients who are at least 6 weeks after myocardial infarction or are well healed after cardiac surgery, a one-repetition maximum may be determined for each exercise by having the patient perform one repetition with gradually increasing amounts of resistance with adequate rest periods interspersed between lifts. The training resistance may then be set at approximately 70% of the one-repetition maximum for each exercise. Having middle-aged or more elderly patients perform maximal lifting greatly increases the risk of musculoskeletal injury. Once the patient can perform 15 to 20 repetitions of an exercise without straining, the resistance may be increased and the number of repetitions decreased to approximately 10 per set. During the next several resistance exercise sessions, the patient is instructed to gradually increase the number of repetitions.

Assessment of the changes in skeletal muscle strength resulting from resistance training may be accomplished by repeat one-repetition maximum testing. However, it is this author's opinion that this practice is unnecessary unless it is a component of a formal research project. Patient advances in strength may be easily assessed by comparing the amounts of resistance used and the total number of repetitions performed at the beginning of the program to the present.

PATIENT-KEPT EXERCISE RECORDS

Activity logs or other patient-kept records of exercise training sessions are helpful. These forms of ''self-report'' can assist patients in charting their progress and compliance with their exercise prescription. They can serve as a motivator for the patient and significant others.

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PERIODIC REVIEW OF EXERCISE PROGRAM

At intervals of 1, 3, or 6 months, a formal review of the patient's exercise program by a cardiac rehabilitation professional is recommended. This is a one-on-one consultation to review the current program, any problems or patient questions, and to make appropriate adjustments in the exercise prescription. This encounter may be face-to-face in a private office or via the telephone. This type of review should take place after each graded exercise test. These visits may be crucial to the long-term compliance with exercise for many cardiac patients.

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8

Life-Long Exercise: Counseling for Exercise Maintenance

Linda K. Hall
Health and Disease Management Sevice Line, BMHCC, Memphis, Tennessee

> All parts of the body which have function, if used in moderation and exercised in labors in which each is accustomed, become thereby healthy, and age more slowly; but if unused and left idle they become liable to disease, defective in growth and age quickly.
>
> *Hippocrates* circa 1400 BC (1)

As long as 3400 years ago, Hippocrates knew and espoused what we have studied for years and now have scientific evidence to corroborate. Exercise reduces the risk of incurring chronic illness, slows the aging process, reduces the risk of premature death, and prolongs life. We live in a country where huge sums are spent on health care that is the most advanced and sophisticated in the world, and medical and health care science bring forth new discoveries daily (2).

There is increasing evidence that prevention is the best approach, and may be applied in two ways to intercede in the disease continuum: primary and secondary prevention. Primary prevention is the appropriate course and action to modify risk factors and stop the disease before it begins to develop. Secondary prevention is utilizing preventive behaviors and changes in lifestyle or health habits to lessen, arrest, or reverse the progress of the disease (3). The scientific benefits of physical activity and exercise training in primary and secondary prevention are elucidated elsewhere in this text.

Physical inactivity is characteristic of most of the American population. The mechanization of the twentieth century has provided us with elevators, moving walkways, escalators, cars, buses, trains, motorized bicycles, etc., such that physical activity and exertion have virtually been removed from everyday occupation and lifestyle (4). According to the Surgeon General's report, over 60% of

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Americans are not active regularly and 25% are not active at all (5). Moreover, research by Oldridge demonstrated a dropout rate of 25 to 30% at 3 months, 40% at 6 months, and 50% at 12 months from a secondary prevention exercise program for patients with coronary heart disease (6).

If physical activity benefits could be encapsulated in a pill that could be taken each day, there would be fewer dollars spent on health care, and especially notable would be the impact on the chronic disease spectrum. Since there is no such pill, benefits must be accrued from participation in some form of regular daily physical activity. The question remains, what has to be done to actualize the reality of regular daily exercise across the lifespan, including the continuum of health through disease.

There has been much research and study of human behavior with regard to motivating and counseling patients in the process of adoption of a healthy lifestyle to slow, arrest, or reverse the progression of coronary artery disease. The most successful people who become compliant with habitual exercise are those who have exercised beginning in childhood. For those for whom exercise is not a usual way of life, no one theory has demonstrated conclusive and positive outcomes in converting these people to lifetime exercise habits. Several methods have been found to produce positive results.

PROCESSES OF MOTIVATING PEOPLE TO EXERCISE FOR A LIFETIME

Prochaska and DiClementi have proposed different stages through which people progress as they prepare to change their behavior: precontemplation, contemplation, and action (7). The precontemplation stage may be the most important in establishing a basis for lifetime compliance to exercise. It is also the one stage for which health professionals involved in behavior change and therapeutic exercise programs fail to spend adequate time with the patient. A patient who has been a nonexerciser for 20 to 30 years does not decide to become an exerciser overnight.

In the precontemplation: We rethink who we are, where we are going, how we will do things, and what we want to do. In this stage, the educator/exercise leader helps patients to examine their beliefs, values, and rules.

Beliefs: Patients are helped to examine what they believe about the benefits of exercise in their disease process (e.g., exercise will not prevent or stop the progress of the disease, or I am too old and too sick to be able to exercise). What has been experienced before is the framework for shaping current beliefs. At this time, negative beliefs must be changed into positive ones and targeted at a specific objective (e.g., I will find a way to exercise at least 30 min a day, 4 days a week, because it is a positive way of slowing the progress of my heart disease).

Values: A value is an internal belief or concept (e.g., what a person believes is right or worthwhile). Many people do not know what their values are until confronted with a list (e.g., challenge, independence, achievement, family, health, leadership, expertise, friendship, wealth) or with the question (e.g., list the most important thing in your life, job, and relationships). Examine health as a value in patients' lives and their perception of what health is and how to achieve it. What have the patients done thus far to contribute to good health? What do they have to do now to reverse the disease process?

Rules: Rules are the internal laws that govern the way we behave. There are things we must do, things we should do, and things we can do. The objective is to work with patients so they move from the statement, "I can or should exercise 30 min a day, 4 days a week," to "I must exercise 30 min a day, 4 days a week." This may be done by questioning how the current behavior has produced negative results and what must be done to produce positive results.

Additionally, in the precontemplative stage, patients examine what they have done in the past, what made them fail, and whether they can see themselves exercising in the future. Again, the process involved in the precontemplation stage is to help patients change from the external, "My doctor says..." to the internal, "I have to . . . and know that I can" (8).

Patients are in the contemplation stage when they are willing to make the change and in the action stage they are highly committed to making the change (7). A problem in working with cardiac patients is that they may reverse these stages or move in and out of them; counselors and educators must be aware of the stages at different times. Patients following coronary artery bypass surgery or myocardial infarction, or who have heart failure may be in the contemplation stage immediately after the medical event when they first enter cardiac rehabilita-

Table 1 Personal Variables that Predict Exercise Dropout

Smoker
Overweight, overfat
Inactive during leisure
Sedentary occupation
Hourly employee
External locus of control
Low self-esteem
Type A personality
Hypochondriacal
Anxious
No social support
Depressed
Financial difficulties

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tion. Patients are receptive to change because they have been frightened. As they feel better, they move into the action stage. Six months later, when they feel better, have forgotten the pain, and are no longer frightened the thought that "just one week without exercise won't hurt me" initiates noncompliance and a return to old habits. Numerous personal factors and variables are causative and predictive of exercise dropout over time (see Table 1) (9). Patients who exhibit these personal factors are major targets for interventions on beliefs, values, and rules, with special attention to changing negatives into positives.

CONTINUING EDUCATION AND MOTIVATION TO ACHIEVE EXERCISE COMPLIANCE

Cardiac rehabilitation programs must establish and continue a follow-up program with patients, either by face-to-face visits or telephone contact every 3 months for as much as 2 years or more. Evidence supports that follow-up over time improves compliance and adherence (10–12). According to Haskell et al., patients assigned a level of importance to their continuing behavioral interventions because of the continued follow-up (11).

Patients completing an initial outpatient cardiac rehabilitation program should have continued contact with the rehabilitation program through education by community events, periodic support group meetings, newsletters, video rentals, a lending library, and continued exercise programming in a phase III, IV, or wellness program. The following strategies can assist patients in maintaining lifetime exercise.

1. *Encourage participation in a structured program.* As patients are discharged from an outpatient phase II program, interview them as to how, where, and how often they plan on continuing exercise. Ensure that they have a current exercise prescription, that they have appropriate warm-up and cool-down exercises, that they have a plan for continuing exercise, and that you have scheduled a follow-up appointment with them within 3 months.
2. *If they are not going to join a club, fitness center, or stay with your program, assist them in finding a "buddy."* There is evidence that exercise with a group or even with just one other person provides an improved impetus to continued exercise adherence. Patients can exercise by walking in their neighborhood, using equipment in their homes, or in a park with exercise trails. It is pivotal to have someone to whom the patient is accountable for showing up. This may be accomplished by weaving the family into the rehabilitation program and activity matrix (9).

3. *Discuss with the patient the multitude of activities that provide variation in the exercise commitment.* If patients join a wellness or exercise center, counsel them about the necessity of variety in regard to equipment, such as bicycles, treadmills, rowing machines, and stair climbers; activities such as outdoor walking, bicycling, golf, tennis, and even skiing; and, finally, choosing activities that are fun and enjoyable. When a behavior change is regarded as punitive, it is not continued.
4. *Establish a regular "exercise appointment" with patients and help them regard it as a "million dollar health hour," equal in importance to an appointment with a boss, a stock broker, or a doctor.* This helps patients establish health as a "number one value." This is a critical step in the compliance continuum.
5. *Establish a program to reward individual accomplishments, to celebrate regularity, fitness achievement, zero days in the hospital, numbers of pounds lost, etc.* Recognition for accomplishments is a powerful motivator.
6. *Hire excellent, high-quality, enthusiastic, innovative, compassionate, interested staff.* There is no fancy facility nor exciting piece of equipment that can ensure patient compliance better than excellent staff. Not only should the staff have good educational background as an exercise leader, they should also like helping people, be interested in the patients enough to know them by name, and by remembering special days in their lives, such as birthdays (9).

LAPSE, RELAPSE, AND COLLAPSE PREVENTION

The onset of *lapse* (a single slip) continuing on to relapse (three or four slips) occurs within the first 3 months of a maintenance program (8,13,14). It begins by missing exercise once a week for 2 weeks, then twice a week for 2 weeks, and soon the patient is exercising 1 day a week—relapse. Collapse occurs when there is no exercise for 2 to 3 months and the patient has not made plans to return to exercise. The longer the lapse and collapse, the harder the return.

The exercise staff and counselors have to teach lapse, relapse, and collapse prevention. Patients must be able to identify high-risk situations (e.g., those emergencies, last-minute events, work, life situations, and interruptions that cause them to miss an exercise session). In teaching patients about these high-risk situations, a practice firedrill is appropriate. This practice involves having patients list alternatives to missing the exercise session and may include: rescheduling it at another time during the day, making reservations in hotels that have exercise rooms, rescheduling the exercise session at another club, or substituting a neighborhood walk in the evening for a workout at the club. Patients who have developed preplanned coping mechanisms, when challenged with potential failure, will meet with success and feel good, thereby reinforcing the improbability of relapse (8).

CONCLUSION

Many things can contribute to patient adherence to lifetime exercise. Most important are the combination of an excellent staff who are able to educate and counsel patients, imbuing them with a strong set of supportive beliefs, values, and goals to help them establish an achievable lifetime program. It is also important to provide a long-term follow-up program, where patients know they will be assessed for continued health and the potential for arresting the disease. Finally, the family should be woven into the activity matrix of patients' daily rehabilitative regimen, thus extending the ''family'' with health professionals who are role models for exercise and good health behaviors.

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9

Supervised Versus Unsupervised Exercise Training: Risks and Benefits

Robert F. DeBusk
Stanford University School of Medicine, Palo Alto, California

"Supervision" of exercise training has had various meanings during the past 30 years. The original distinction contrasted exercise performed in a formal or group setting as part of a therapeutic regimen for coronary heart disease with that performed spontaneously in an individual setting without therapeutic intent. While the original connotation of "supervised" endures, "unsupervised" exercise training is increasingly associated with formal exercise training with therapeutic intent that is performed in an individual or home-based setting.

The original rationale for exercise training in either setting has changed greatly during the past 30 years. In the 1960s and thereafter, exercise training was commonly used to mitigate the psychological and physiological effects of bedrest following acute myocardial infarction. Beginning in the 1970s, exercise training was increasingly used to reverse the effects of bedrest following coronary artery bypass surgery. Studies conducted in the 1970s and 1980s established that exercise training improved the prognosis of patients with coronary heart disease (1,2) and ameliorated some of the metabolic abnormalities leading to coronary artery disease. The latter include improvement of glucose homeostasis, reduction of body weight and systemic blood pressure, and normalization of plasma lipoproteins.

Beginning in the 1970s, exercise training or cardiac rehabilitation programs proliferated on the strength of their benefits to patients with established coronary heart disease or at risk for coronary heart disease. However, the original rationale for cardiac rehabilitation programs and the need for supervision have been greatly

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altered by the increasing effectiveness of newer treatments for coronary heart disease. Treatments provided at the onset of acute myocardial infarction (MI), including thrombolysis and adjunctive drug therapy and percutaneous transluminal coronary angioplasty (PTCA), stenting, etc., have substantially reduced both short-term and long-term mortality (3,4). Functional capacity has been preserved by limiting the degree of myocardial necrosis and residual myocardial ischemia. These treatments have transformed the nature of coronary heart disease and, coincidentally, the rationale and methods for exercise training. Specifically, these improvements in therapy have eclipsed exercise training as a means to enhance prognosis and, to a lesser extent, the potential of exercise training to enhance functional capacity in patients with coronary heart disease. The focus of contemporary exercise training is increasingly on enhancing the physiological and psychological status of patients with coronary heart disease and other cardiac disorders and mitigating the effects of the metabolic disorders that predispose to coronary artery disease.

The original rationale for supervised exercise training was twofold: to enhance the safety of therapeutic exercise and adherence to it. The safety argument was based on three premises: (1) that only high-intensity training produced clinical benefits; (2) that such exercise training was potentially dangerous in patients with coronary heart disease; and (3) that participation in a group exercise training program, with or without continuous electrocardiographic (ECG) monitoring was required to surmount this danger. However, the recent therapeutic advances cited above have substantially undercut this rationale. First, moderate intensity exercise training in patients with and without coronary heart disease produces physiological and metabolic effects similar to those associated with high-intensity exercise training. Second, the risks of moderate exercise training are almost certainly less than those of high-intensity exercise training. Third, patients at high risk of training-induced cardiac events on the basis of major cardiac ischemia can and do undergo coronary revascularization procedures that alleviate myocardial ischemia. Fourth, patients treated for coronary heart disease in the late 1990s receive more intensive prophylaxis and therapy [aspirin, beta-blockers, lipid-lowering drugs, and angiotensin converting enzyme (ACE) inhibitors] and have a better prognosis than their counterparts in the 1970s.

The adherence argument was based on the observation that attrition rates were high (50% or more) after 6 or fewer months of participation in group programs. The premise was that attrition would be diminished by the peer support provided by group-based programs. However, as with the safety argument, further developments have substantially undercut the broad adherence rationale for group-based exercise training. Several studies have demonstrated that the physiological effects of home-based and group-based exercise training are virtually identical in patients with coronary heart disease (5,6). Continuous measurements of heart rate during home-based exercise training in patients without coronary heart disease have shown close adherence to the prescribed regimen (7). Although direct corroboration of adherence is lacking for patients with coronary heart disease undergoing home training, the magnitude of the increase in their functional capacity suggests that they adhere closely to the prescribed regimen.

These developments have substantially altered the indications and the methodology for exercise training. In particular, they have broadened the availability of exercise training for patients with coronary heart disease, enabling participation in "unsupervised" as well as "supervised" settings. For patients with coronary heart disease, the choice between these two alternatives is still influenced by considerations of safety. The risk of acute cardiac events in group-based exercise training programs is quite low: 21 cardiac arrests and 8 nonfatal myocardial infarctions in 51,303 patients exercising for more than 2 million hours (8), whether or not continuous ECG monitoring is used. As noted previously, these rates will probably decrease further under the influence of further advances in medical and surgical treatments for coronary heart disease.

DETERMINANTS OF SAFETY

The safety of exercise training in any venue reflects not only the methods used to regulate the intensity of exercise training and to monitor patients for exercise-induced abnormalities, but the attributes of the patients themselves. Of these factors, patient selection is paramount. The risk of exercise training in patients with coronary heart disease is determined by the magnitude of myocardial ischemia and/or left ventricular (LV) dysfunction (9). Patients with marked myocardial ischemia are generally identified by treadmill testing, often performed as soon as 7 to 14 days after acute MI. Such patients exhibit marked ischemic ST segment depression and/or angina at a low peak treadmill workload, equal to or less than 6 METs or peak heart rate equal to or less than 130 beats per minute. They often fail to increase their blood pressure during exercise. These patients, who comprise 10 to 20% of post-MI patients, should be referred for coronary angiography and consideration for mechanical revascularization. Indeed, most such patients undergo these procedures before they are referred for cardiac rehabilitation.

The other major pathophysiological abnormality that determines the risk of exercise training is myocardial dysfunction. In patients with coronary heart disease, this abnormality results primarily from one or more previous acute myocardial infarctions. A decrease in left ventricular ejection fraction (LVEF) below 40% and especially below 30% is associated with a poor prognosis. Between 10 to 20% of post-MI patients exhibit LV dysfunction of this magnitude (9). However, ACE inhibitors and adjunctive medical treatment has substantially improved the prognosis of patients with LV dysfunction and heart failure, about half of whom have underlying coronary heart disease. Although exercise training increases the functional capacity of patients with heart failure (10), its effects on the prognosis of such patients are not well-established. Patients with clinically significant LV dysfunction as defined above probably should not undertake high-level exercise training in any venue.

Patients with coronary heart disease who lack clinically significant myocardial ischemia or LV dysfunction as defined above comprise about 50% of the post-MI population. Among these low-risk patients, the risks of training-induced cardiac events is so low that they can train safely in either a group or home environment.

Guidelines for stratifying the risk of patients with coronary heart disease developed by the American College of Physicians (11), the American Association of Cardiovascular and Pulmonary Rehabilitation (12), and the American Heart Association (13) are based on the extent of myocardial ischemia and left ventricular dysfunction. Although these guidelines are widely used to assess the risks associated with exercise training, few data are available concerning their sensitivity and specificity for predicting severe exercise-induced cardiac events.

Regulation of the intensity of exercise training is perhaps the next most important safeguard for exercise training among patients with coronary heart disease. High-intensity exercise training (70 to 85% of age-predicted maximum) has been shown to enhance functional capacity promptly in healthy individuals. However, extrapolation of high-intensity training to patients with coronary heart disease is of dubious merit, for it increases the risks of exercise training among these individuals. In fact, moderate exercise training (peak heart rate 60 to 75% of age-predicted maximum) produces up to 75% of the increase in functional capacity achieved with high-intensity training over a 3-month period (14). With more prolonged training, the gap in functional capacity narrows further.

Experience with home-based exercise training suggests that most of the benefits can be achieved without the use of elaborate methodology. In the MULTIFIT study of post-MI risk factor modification (6), trans-telephonic ECG monitoring was not considered because the yield of new exercise-induced abnormalities (ischemic ST segment depression or ventricular arrhythmias) observed in our previous studies was very low (5). A total of 78% of patients randomized to the MULTIFIT intervention actually underwent exercise training, about one-quarter following coronary revascularization procedures. This suggests that, in the future, most patients with coronary heart disease who are free of marked myocardial ischemia or LV dysfunction can be provided individualized exercise training prescriptions based largely on peak treadmill heart rate. A simple heart rate monitor can be used to regulate their training intensity within prescribed (and moderate) limits.

The next most important safeguard of exercise training is instruction of patients to recognize and respond appropriately to symptoms that reflect exercise-induced myocardial ischemia and/or LV dysfunction. Patients should be cau-

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tioned to avoid exertion that produces these symptoms, especially when the treadmill test ECG has shown evidence of marked myocardial ischemia.

SUMMARY

Among patients with coronary heart disease, experience with home-based exercise training is too limited to permit a meaningful comparison with the risks of training in cardiac rehabilitation programs. Moreover, this issue may never be resolved. This is because the risks of exercise training and the need for supervision have forever been altered by the impact of powerful prophylactic and therapeutic modalities. Quite independently of exercise training, these modalities have enhanced the prognosis, functional capacity, and metabolic state of patients with coronary heart disease.

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10

Exercise Training in Special Populations: The Elderly

Philip A. Ades
University of Vermont College of Medicine, Burlington, Vermont

BACKGROUND

More than one-half of patients eligible for cardiac rehabilitation services are now over the age of 65. Based in part upon the successes of primary prevention which have rendered coronary artery disease more a disease of the later years, and the aging of the general population, it is predicted that the proportion of older patients in cardiac rehabilitation programs will continue to increase well into the twenty-first century.

The Framingham Disability Study defined disability by work and mobility limitations, and found that disability rates in older coronary patients are far higher than in the general population (1). For patients over the age of 70 years, 79% of women and 49% of men with coronary heart disease were considered to be disabled compared with 49% of women and 27% of men in an age-matched noncoronary population (Table 1). The presence of angina pectoris or chronic heart failure further increased the likelihood of disability. The direct causes of disability in older coronary patients have received little study, although preliminary investigation suggests that they are both physiological and perceptual in nature (2). It appears that the best predictors of poor physical functioning in this population are the presence of mental depression and a low aerobic fitness level, both treatable disorders. Other important factors include the presence of angina, low skeletal muscle mass, low strength, and the presence of noncardiac comorbidities. Despite the fact that fitness levels and psychological factors play an important role in preventing disability in older coronary patients, older patients are far less likely than younger patients to participate in organized cardiac rehabilitation (3). Older

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Table 1 Framingham Study Disability Rates: Age 70–88

	Men	Women
No CAD or CHF	27%	49%
CAD	39%	61%
Angina	56%	84%
CHF	57%	88%

Source: Ref. 1.

women, in particular, are the least likely patients to participate (4). The primary reason for nonparticipation in the elderly is a low rate of physician referral (3).

Exercise is also indicated in the treatment of older coronary patients due to its favorable effects on other coronary risk factors including blood lipid levels (5), obesity (6), body fat distribution (7), and blood pressure. It is, however, not clear if exercise training improves mortality rates in the elderly as very few older coronary patients were included in the meta-analyses of randomized trials of exercise training that demonstrated a 25% decrease in total mortality over a 3-year follow-up period after cardiac rehabilitation in primarily middle-aged patients after myocardial infarction (8,9). In addition to physiological benefits, participation in cardiac rehabilitation confers psychological benefits that include diminished levels of social isolation, higher levels of self-efficacy, and possibly lower rates of mental depression (10).

The goals, then, of exercise training in older coronary populations are to decrease cardiac disability and to extend disability-free survival. This is accomplished by a program that can increase aerobic capacity, muscle strength, and flexibility as well as provide associated psychosocial and perceptual benefits. Exercise training programs also have to take into account the frequently associated comorbidities that can alter the modalities and intensities of the exercise stimulus that is required. These include, but are not limited to, chronic lung disease, diabetes, arthritis, osteoporosis, and peripheral and cerebrovascular disease. Exercise regimens also have to consider social issues such as difficulties in transportation and the frequent presence of a dependent spouse at home.

EXERCISE SCREENING AND TRAINING

Optimally, older coronary patients will enter cardiac rehabilitation only after a careful screening process, which should include an electrocardiographically monitored exercise tolerance test, strength measures, and a clinical review that should include an analysis of disease severity and questionnaire or interview-derived data regarding physical functioning and psychosocial function. With careful observation, even patients who use canes and walkers can be exercise tested and trained on a treadmill with surround bars. Exercise modalities should include options for aerobic exercise, resistance exercise and flexibility. Aerobic choices include treadmills, a walking course, cycles, airdynes, rowers, etc. Aerobic exercise is often guided by an exercise heart rate range and/or scales of perceived exertion such as the Borg scale (11). A gradual increment of exercise heart rate from 60 to 65% of maximal attained heart rate to higher levels of up to 85% is balanced against the greater risk of injury at higher exercise intensities and past demonstration of measurable benefits even with low levels of exercise. Older coronary patients are less likely to exercise to a physiological maximum at their baseline exercise test than are younger patients; therefore, a strict adherence to an exercise heart rate range is often inappropriate (12). As mentioned above, utilization of a perceived exertion scale is often a useful guide to exercise intensity in older patients. Duration of the exercise stimulus can begin with very brief, intermittent bouts of exercise, gradually increasing to 20 to 25 min or longer. Special considerations in the elderly include that training regimens often have to be adjusted to accommodate the frequent presence of comorbidities. For example, patients with hip arthritis may do better with cycling or rowing exercise to avoid the weight bearing of treadmill walking.

Resistance training often begins with the use of elastic tubing and stretching and progresses to include dumbbells and stationary weights. Resistance training protocols are often quantified by the measurement of the single-repetition maximal (1-RM) lift for a given exercise (13), with subjects performing an 8- to 10-set repetition of a given exercise at 40 to 60% of the 1-RM (13,14). The presence of osteoarthritis does not contraindicate resistance exercise unless a specific motion is limited by pain. Upper body resistance exercise is often delayed for at least 3 months after coronary artery bypass surgery to allow for sternal healing.

Finally, for many elders, flexibility, or lack thereof, can be an exercise-limiting factor. Flexibility exercises can be as simple as 5 to 10 min of stretching per day to more complex protocols of yoga and tai-chi.

EXERCISE TRAINING STUDIES

Even in the absence of coronary heart disease, physical fitness decreases by approximately 10% per decade after the age of 25 years (15). Wth the superimposition of chronic heart disease and other comorbidities, older coronary patients, as a group, present with extremely low fitness levels. This is often compounded by a fear of exercise and physical activities often derived from inappropriate advice of family and physicians (16).

The cardiac rehabilitation literature clearly supports the safety and efficacy of exercise-training regimens in older patients, with relative training benefits documented to be similar to younger patients (17) (Fig. 1). In the studies of Williams, Ades, and Lavie, increases in peak exercise intensity of 34 to 53% were demonstrated over a 3-month training period in response to an aerobic conditioning protocol with no apparent increase in exercise-related morbidity (5,18–20). Some researchers recommend longer training regimens in the elderly due to lower absolute training intensities and to the briefer training sessions often performed early in the training program (21).

Resistance-training regimens have been less well studied in elderly coronary populations despite the obvious attraction of a training modality that can increase strength and endurance in a population that is frail and sarcopenic. In a recently published study, older coronary patients (68 ± 3 years) improved their strength to a similar degree as did younger coronary patients (48 ± 7 years) after 11 weeks of resistance training (13). In this study, single-repetition maximal lift for leg extension and bench press increased by 35 and 14%, respectively, in the older group, with a tendency for older women to attain relatively greater increases in strength than older men. The training protocol involved one set of 8 to 10 repetitions of seven separate exercises at an intensity of 50% of 1-RM, with 1-RMs updated monthly. In a study of healthy, although deconditioned elders, mean age 70 ± 4 years (range 65 to 79) resistance training not only resulted in an increase in strength and muscle mass of the trained limb, but in an improved

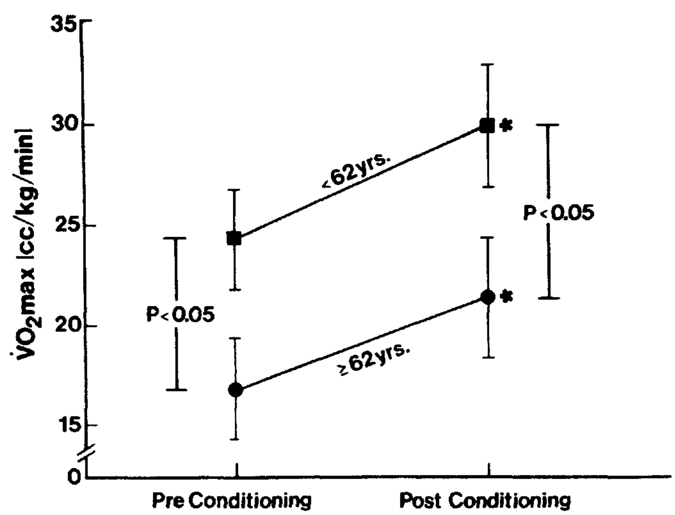

Figure 1 Peak aerobic capacity ($\dot{V}O_{2max}$) before and after conditioning in the older and younger patient groups. * = $p < 0.001$ vs. preconditioning. (Reprinted from Ref. 12.)

walking endurance (22). This suggests that, even in healthy elders, activities such as walking, which are classically considered to be aerobic, are in fact limited by the decreased strength of the older individual required for lifting the leg, making a compelling case for resistance training to treat or prevent disability in more disabled older coronary populations (Fig. 2).

For cardiac rehabilitation programs to attract more older patients for participation, programs have to become more attractive and accessible to individuals in this age group and physicians have to learn the benefits of rehabilitation. Seemingly minor issues such as transportation, parking, and ease of access are frequently major barriers to the elderly. The expansion of programs to include home- or community-based regimens will also expand utilization. In many cases, an intermittent visit to the rehabilitation program can be combined with a home-based or aging-center-based program.

The needs of older female coronary patients should be particularly emphasized (see Chap. 11). As a group they are the most disabled, deconditioned, and sarcopenic and have the greatest need for exercise rehabilitation. Yet as a group they are the least likely of all demographic and gender groups to be referred for exercise rehabilitation (4).

FUTURE DIRECTIONS AND SUMMARY

As the older cardiac population continues to grow in size and complexity, much research remains to be done. The effects of aerobic and resistance training proto-

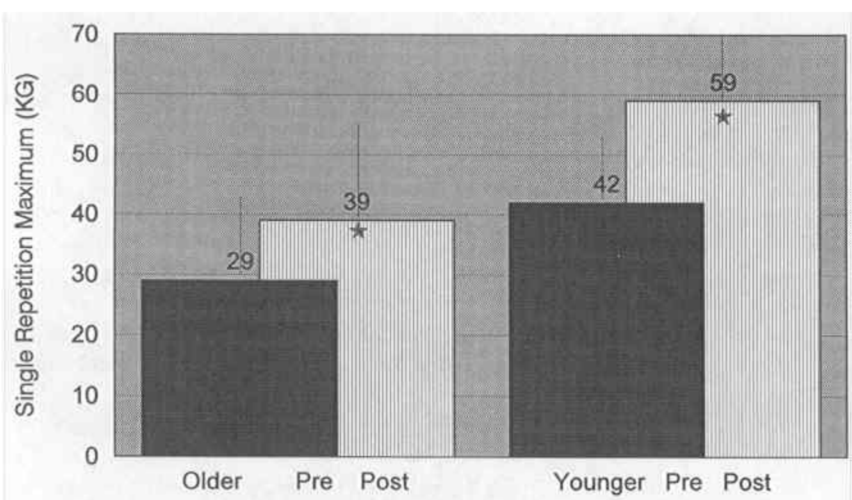

Figure 2 Leg strength before and after resistance-aerobic conditioning in older vs. younger coronary patients. (Reprinted from Ref. 13.)

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cols on measures of physical functioning have to be better studied in older coronary populations, with the inclusion of older patients disabled by angina or chronic heart failure. Whether training regimens can improve physical functioning in the most severely disabled patients is of particular importance, although *preventing* disability in the less severely affected ''younger-old'' is also a priority. Effects of cardiac rehabilitation regimens on other important outcomes, including lipid levels, blood pressure measures, insulin levels, body composition, and body fat distribution, have to be better studied to better define expected benefits of rehabilitation. The effects of estrogen and other hormone replacement therapy in women and of anabolic agents, such as growth hormone in men, on the maintenance of muscle mass and physical functioning will be of interest. Finally, whether training regimens can favorably affect the economics of health care is crucial, especially if costly hospitalization and/or home care services can be minimized.

In summary, the older coronary population is a highly disabled group yet quite heterogeneous as to physical functioning and disease severity. Exercise rehabilitation programs have been demonstrated to be safe and to improve aerobic fitness capacity and muscular strength. It remains to be determined whether exercise training can reverse or prevent cardiac disability. If so, it would be expected that cardiac rehabilitation programs would pay great medical, social, and economic dividends in the older coronary population.

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11

Exercise Training in Special Populations: Women

Lauralyn B. Cannistra
Brown University School of Medicine and Memorial Hospital of Rhode Island, Pawtucket, Rhode Island

Gary J. Balady
Boston University Medical Center, Boston, Massachusetts

Cardiovascular disease accounts for more than 51% of all deaths in women and, since 1984, the number of cardiovascular-related deaths in women has exceeded that of men. Similarly, coronary artery disease remains the leading cause of death among women and accounts for nearly 250,000 deaths annually (1). The death rate due to atherosclerotic coronary artery disease is even higher among black women (85 per 100,000) than white women (64.1 per 100,000). Compared to men, myocardial infarction in women is associated with a higher in-hospital mortality, a higher incidence of recurrent angina, reinfarction, and congestive heart failure within 6 months, and a greater 48-month mortality (2,3). Women have a high prevalence of cardiovascular risk factors that are potentially modifiable through a multidisciplinary cardiac rehabilitation program. It is estimated that nearly one-third of adult women are classified as obese and that 60% of women have no regular physical activity (4,5). Among U.S. women over age 45, 60% of whites and 79% of African American women have hypertension (defined as taking antihypertensive medication or having a systolic BP $\geq$ 140 mmHg or diastolic BP $\geq$ 90 mmHg) (6). In addition, from 1980 to 1991, more than 55% of women over age 55 had serum cholesterol levels over 240 mg/dL (7). In patients with established coronary heart disease, women are generally older, are more likely to have hypertension and diabetes, and have higher cholesterol levels

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than men (3,8,9). These factors may, in part, explain the worse prognosis among women with coronary heart disease. Exercise training and risk factor modification are therefore vital as primary and secondary prevention measures in women.

EXERCISE BENEFITS IN WOMEN

Cardiovascular Morbidity and Mortality

Several population-based studies show that incremental levels of regular physical activity are inversely proportional to long-term cardiovascular mortality when controlled for the presence of other risk factors in both women and men (10–12). Specifically in older women, a study of over 32,000 postmenopausal women found a graded inverse relationship between leisure physical activity and cardiovascular mortality over 7 years of follow-up (13). Moreover, higher levels of physical fitness, when measured with an exercise tolerance test, are associated with significantly reduced subsequent cardiovascular mortality among women and men (14). For exercise as secondary prevention in women, the data are very limited. In a meta-analysis of the 4500 patients enrolled in the randomized trials of cardiac rehabilitation after MI, only 3% were women (15). This meta-analysis showed a 20% reduction in overall mortality, but the small number of women precludes generalizing these results.

Physical Fitness

Physical fitness is a set of attributes that enables an individual to perform physical activity (16), and is best assessed by measures of maximal (or peak) oxygen consumption (VO_2). There are no known differences between women and men with regard to the cardiovascular adaptations to exercise training, but, after puberty, women have a lower aerobic capacity, greater percent body fat, decreased oxygen-carrying capacity, and a smaller muscle fiber area when compared to men (17). Generally, improvements in maximal oxygen uptake ($\dot{V}O_{2max}$) of 15 to 30% are achieved when exercise training is performed at least 3 to 5 times per week for 12 or more weeks, at an intensity of approximately 60% maximal heart rate or 50% $\dot{V}O_{2max}$, for 20 to 60 min (18). The few studies available on healthy women suggest similar benefits (19–22).

In women with established coronary artery disease, a limited number of studies with small numbers of women show similar results of exercise training on physical fitness (9,23–25). Table 1 summarizes selected data from these studies of women in cardiac rehabilitation programs. The study with the largest number of women is from the Massachusetts cardiac rehabilitation database (25), which represents the combined outcome from 13 programs. Despite some heterogeneity in the exercise training, these studies demonstrate a 30 to 41% increase in esti-

Table 1 Change in Exercise Capacity After Training

Study (Ref.)	Duration	Number of Women	Results
9	10 weeks	26	↑ METs 35%
23	12 weeks	17	↑ VO_2 19%
24	12 weeks	83	↑ METs 33%
25	10 weeks	126	↑ METs 41%

mated METS after 10 to 12 weeks of exercise training. Ades et al. measured peak VO_2 before and after exercise training in women ≥62 years and found a 19% improvement in peak VO_2. Each of these studies found that women had a lower exercise capacity than men at baseline, but showed similar improvements after exercise training. These results suggest that women with coronary artery disease may derive a greater benefit from exercise training than men, as they start from a lower baseline exercise capacity. Ades et al. showed a more efficient response to submaximal exercise in older women as the heart rate–blood pressure product during an exercise intensity of 3 METS was lower following 12 weeks of regular exercise.

Lipids

Beneficial effects of exercise on blood lipids have been suggested in studies of both women and men (26). However, there is much variability in the results of these exercise/lipid-lowering studies. This is at least in part due to the heterogeneity of the study methods, study populations, exercise interventions, and the use of adjunctive interventions such as diet or pharmacological lipid-lowering agents. A meta-analysis (27) of 95 studies, most of which were not randomized, controlled trials, concluded that exercise leads to a reduction of 6.3% in total cholesterol, 10.1% in LDL-C, and 13.4% in cholesterol/HDL-C, and a 5% increase in HDL-C. The greatest change in lipids was noted in those patients who also lost weight during their exercise programs (total cholesterol decreased by 13.2 mg/dL, LDL-C decreased by 11.1 mg/dL).

Few investigations of the effect of exercise on lipid and lipoproteins have been performed in women. A recent cross-sectional study examined the effects of vigorous exercise on HDL cholesterol in women runners (28). HDL cholesterol levels were higher, with increasing amounts of exercise, and continued to rise further in women who ran more than 64 km per week. For every additional kilometer run, the HDL cholesterol increased by 0.133 ± 0.20 mg/dL. Available prospective studies on this subject are contradictory (28a–30). Some of this confusion may arise from the lack of control in these studies for menopausal status

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and estrogen use. Since estrogen is associated with an increase in HDL and triglyceride levels and a decrease in LDL cholesterol (31,32), hormonal status must be taken into account in such studies. Some data suggest that premenopausal women may derive less beneficial lipid effects from exercise than postmenopausal women (26).

For women with coronary artery disease, there are limited data regarding the effect of multidisciplinary cardiac rehabilitation programs on lipid profiles. Two studies that evaluated 12 weeks of cardiac rehabilitation showed no major improvements in lipid profiles among women (9,24). This finding was also seen in the men in the programs. One potential reason for the negative results is the short duration of the intervention. In support of this explanation is a study by Warner et al., which showed a 20% increase in HDL cholesterol levels among women after 5 years of cardiac rehabilitation. In contrast, the men in the group increased their HDL levels only after the first year, but then showed no further improvement, resulting in a 5-year increase of only 5% (33). Given that low HDL cholesterol levels may be a stronger predictor of CHD mortality in women, these results from long-term exercise training studies are promising (34).

Weight/Body Composition

Exercise training appears to be an important component for weight loss and the development of a more favorable body composition and fat distribution with regard to coronary heart disease risk. The effect of exercise, however, is quite variable, and data for women are limited. A well-controlled, 1-year randomized trial (35), which included 112 women, demonstrated a significant 5.1 kg weight loss, most of which was body fat, in women who received both the exercise and the diet intervention. Those in the control group increased their weight by an average of 1.3 kg. Exercise programs reduce body fat by approximately 1.6% after 6 months to 1 year of training (36). Physically active women and men have a more favorable waist–hip ratio than do sedentary individuals (37–40). Men and women differ with respect to the distribution of body fat with men generally having a central pattern of obesity and women having a more peripheral fat distribution. The effect of exercise training on body composition may also differ between women and men, and between pre- and postmenopausal women. Except for women with truncal obesity, premenopausal women may not lose body fat with exercise training due to a sparing of gluteal-femoral fat deposits (41).

ENROLLMENT AND COMPLIANCE IN EXERCISE PROGRAMS AMONG WOMEN

The long-term success of any prevention program is directly related to patient compliance. Adherence rates (i.e., the number of persons who remain active in

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a program at a given time compared with the total number of persons who began the program) for exercise training programs generally exceed 80% for the first 3 months (42,43), fall to 60 to 71% at 6 months (44,45), 45 to 60% at 12 months (43), and 30 to 50% at 2 to 4 years (45). For women with coronary artery disease, enrollment in cardiac rehabilitation programs is much less than expected based on their prevalence of coronary events. In a national survey of cardiac rehabilitation programs by Thomas and colleagues (46), only a minority of survivors of myocardial infarction (10.8%), coronary angioplasty (10.3%), or coronary artery bypass surgery (23.4%) enrolled in cardiac rehabilitation programs. Even more striking, however, is that women who are postinfarction or postcoronary bypass surgery have significantly lower enrollment rates than men (6.9% vs. 13.3% and 20.2% vs. 24.6%, respectively). The reason for this gender difference in participation rates is not clear. Recent studies have begun to investigate the potential barriers to women's participation in cardiac rehabilitation. Women candidates for cardiac rehabilitation are more often unmarried, may have less social support, are more likely to have a dependent spouse at home, and are less likely to own and drive a car (9,23). In addition, women have more noncardiac morbidity, such as arthritis and low back pain (23,47). These patient-related factors certainly may play a role in the low participation rates. In addition, Ades et al. found that the strength of the physicians' referral to cardiac rehabilitation was the most powerful predictor of participation among older coronary patients. In this study, physicians did not recommend cardiac rehabilitation as strongly to their women patients (23).

Once women enroll in cardiac rehabilitation, it is not clear if their compliance and attendance rates differ from those of the men since the limited data in this area are conflicting (9,23,48). Cannistra et al. (9) demonstrated no significant difference in compliance rates between women and men, and no difference with respect to the reasons given for lack of program completion. By univariate analysis, younger women and those who smoked were less likely to be compliant. Other patient-related factors associated with noncompliance include physically inactive leisure time, blue-collar employment, and sedentary occupations (49). Preferences for program features may differ between women and men as well (50).

CONCLUSION

Information is now beginning to emerge about exercise training in women, but clearly more data are needed. Women improve their exercise tolerance to a similar degree as men after exercise training. Programs of weight loss and diet appear to favorably alter lipids, body composition, and fat distribution in women, but there is much variability due to potential confounding factors such as menopausal status and estrogen use. Cardiac rehabilitation may be even more important in women than men, since their morbidity and mortality from the disease appear to be higher and they have both a lower functional capacity and a higher prevalence of modifiable risk factors at baseline. Improving referral and compliance of women to cardiac rehabilitation is therefore crucial to achieving these secondary prevention goals.

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Exercise Training in Special Populations: Heart Failure and Post-Transplantation Patients

Ileana L. Piña
Temple University, Philadelphia, Pennsylvania

EXERCISE TRAINING IN PATIENTS WITH HEART FAILURE

Rationale and Review of Studies

In the 1970s, cardiac rehabilitation was accepted as beneficial for the patient following a myocardial infarction or coronary bypass surgery (1,2). Patients with significant left ventricular dysfunction were usually excluded based on the concern of excess risk (3,4). In 1979, Lee et al. (5) and in 1982, Conn et al. (6) reported that exercise training was safe in patients with impaired ventricular function and demonstrated significantly improved work capacity after training. Both investigators noted no improvements in ventricular function but no deterioration either. Weber and Janicki classified patients with chronic heart failure according to the maximum VO_2 achieved as well as by the anaerobic (ventilatory) threshold (7). This classification is presented in Table 1.

Since heart failure patients with abnormal exercise VO_2 may have preserved hemodynamics and simply reflect extreme deconditioning, it is reasonable to recommend exercise rehabilitation programs to this group of patients. However, cardiac rehabilitation programs are rarely recommended in the community for patients with heart failure due to traditional fear of worsening cardiac function with exercise (8). When applied, rehabilitation programs usually include interval aerobic training with very light resistive training, if any at all. Isometric training has been traditionally avoided due to implied concern over elevation of peripheral

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Table 1 Functional Impairment During Incremental Treadmill Testing: The Weber Classification

Class	Severity	Peak VO_2 (mL/kg/min)	AT	$C.I._{max}$ ($L/min/m^2$)
A	Mild to none	>20	>14	>8
B	Mild to moderate	16–20	11–14	6–8
C	Moderate to severe	10–16	8–11	4–6
D	Severe	6–10	5–8	2–4
E	Very severe	<6	<4	<2

AT = anaerobic threshold; C.I. = cardiac index.

vascular resistance and the occurrence of ischemia, overt heart failure, and/or arrhythmias. Although currently there is ample evidence in the literature for the safety of resistive training in patients with coronary heart disease, resistive training applied to heart failure patients is less well studied (9).

The effects of exercise training in heart failure were examined by Sullivan and colleagues (10) in 12 patients who underwent a 4- to 6-month conditioning program consisting of approximately 4 h per week at 75% of $\dot{V}O_{2max}$. Training reduced heart rate at rest and submaximal exercise with a 23% increase in peak VO_2. Central hemodynamics were not significantly altered after training. Training, however, resulted in significant peripheral changes, such as an increase in systemic arteriovenous oxygen difference with improved leg blood flow and reduction in arterial and venous lactate levels.

A controlled cross-over trial of 8 weeks of bicycle training at home in 17 heart failure patients supported the previous findings of improvements in functional capacity. In contrast to the study by Sullivan, this study by Coats et al. (11) reported an increase in cardiac output during both submaximal and maximal exercise. In addition, for the first time, some of the neurohormonal abnormalities prevalent in the heart failure patients were shown to improve after training. In parallel to changes in normals after exercise conditioning, the heart failure patients demonstrated enhanced vagal tone supported by overall reductions in heart rate, increased heart rate variability as well as declines in sympathetic nervous system activity with decreases in resting norepinephrine spillover.

Shemesh and colleagues supported the findings of Coats et al. in reporting decreases in norepinephrine and atrial natriuretic peptide levels both at rest and during exercise in patients with ejection fractions <25% who had survived a myocardial infarction and participated in long-term cardiac rehabilitation (12).

That training can also have an impact on peripheral oxidative capacity was shown by Minotti et al., (13) who performed isolated forearm training in a group of heart failure patients and found that improved endurance was associated with a reduction in the ratio of inorganic phosphate to phosphocreatine, or an indirect

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measure of improved oxidative capacity. This shift occurred without a concomitant increase in blood flow.

The complexity and variability of patients with moderate to advanced heart failure are not only evident in their response to exercise testing, but also in their response to training. This fact was recently underscored by Wilson and coworkers, who reported that as many as 44% of a group of heart failure patients with VO_2 values of $\leq$ 14 mL/min/kg had mild or moderate hemodynamic compromise (using wedge pressure and cardiac output) and, in contrast, 25% of those with VO_2 of >14 mL/min/kg had severe hemodynamic abnormalities (14). Since VO_2 of <14 mL/min/kg have been associated with a poor prognosis, some of these patients with low function but preserved hemodynamics could ordinarily be referred for cardiac transplant evaluation. These findings emphasize the complexity of exercise dysfunction in this population. As a follow-up to their initial study, Wilson and colleagues undertook a training program for 32 patients who had an average peak VO_2 of 12.9 $\pm$ 2.3 mL/min/kg (15). Of the 27 patients who successfully completed the program, only nine demonstrated a >10% improvement in functional capacity. These nine patients had a normal cardiac output response to exercise. Of 11 patients who had an abnormal or low cardiac output response to exercise, only one had an improvement in functional capacity while three stopped the program due to severe exhaustion.

The responses to exercise training noted above may appear at first glance somewhat disparate. However, the differences in training protocols, in both intensity and duration, as well as the inclusion of resistive exercise have to be considered. Table 2 summarizes the training protocols used and the results obtained in several studies. The number of patients in each series is small and the overall results may represent intragroup variability. In addition, patients with a better baseline functional capacity may be able to comply with a more rigorous program and take it to completion in contrast to patients who are more debilitated at baseline and may have intercurrent absences due to decompensation and hospital admissions. Moreover, the derivation of an exercise prescription based on heart rate may not adequately address the true percent of maximum if insufficient effort is expended by the patient. For example, a heart-rate-derived prescription based on an effort level corresponding to a respiratory exchange ratio (RER = VCO_2/VO_2) of <1 will not adequately identify a true maximum heart rate as was present in two of Wilson's patients with a normal cardiac output response (15). If the patient were so debilitated that an accurate maximum heart rate could not be determined, the test should be repeated after a few training/conditioning sessions and the exercise prescription rewritten to reflect a new maximum heart rate.

The Exercise Prescription

As can be noted from the previous discussion, the minimum amount of exercise necessary to produce functional improvement in heart failure patients is uncer-

Table 2 Exercise Training Protocols and Results in Patients with Heart Failure

Study (Ref.)	Intensity	Duration	Results
5	75% max HR	6–8 weeks	Decrease in FAI from 32% to 23%
6	70% max HR, 30 min daily	8 weeks	Increase from average of 7.0 METS to 8.5 METS
10	75% VO_2 peak, 1 h daily	6 weeks	23% increase in peak VO_2
11	60–80% max HR, 20 min, 5×/week	8 weeks with 8 weeks of rest	18% increase in peak VO_2
15	60–70% max HR, 45 min, 3×/week	12 weeks	23% increase in VO_2 in responders
19	50–60% peak VO_2, 30 min, 3×/week	3 months	18% increase in workload

FAI = functional aerobic impairment; 1 MET = approximately 3.5 mL/min/kg of oxygen uptake at rest; VO_2 = oxygen uptake; HR = heart rate.

tain. Belardinelli and colleagues (16) set out to answer this question by applying low-level training (40% of peak VO_2) to a group of heart failure patients and compared their responses to a control group without exercise. Peak VO_2 and the anaerobic threshold increased significantly by 17% and 20%, respectively. Although the increase in cardiac output was minimal, the changes in VO_2 and anaerobic threshold correlated highly with increases in mitochondrial density. Increases in the cross-sectional area of both type I and type II fibers were also noted without a change in the percent distribution of each. The patients enrolled in the exercise arm of this trial had mild chronic heart failure and a baseline VO_2 of 16.1 $\pm$ 2 mL/min/kg and had, therefore, a higher functional capacity at baseline.

Since there is no agreement on a universal exercise prescription for this population, an individualized approach is recommended. Gas exchange measurements offer an objective assessment of true functional capacity and are strongly advised. If gas exchange is not available, baseline exercise testing should be performed using protocols that optimize the estimation of a true functional capacity by approaching a true maximum heart rate. Heart-rate-derived exercise prescriptions may be inaccurate in patients with more advanced disease. In these patients, chronotropic reserve may be limited (e.g., Weber functional class D). The most frequently used intensity range has been 70 to 75% of peak VO_2 determined in a symptom-limited, but sufficient effort, exercise test. Very debilitated patients, or those who are not accustomed to aerobic activity, may have to initiate exercise at a lower intensity (e.g., 60% or 65% of peak VO_2). It is essential that progression be built into the prescription to allow the rehabilitation staff to adjust the exercise intensity as the patient becomes better conditioned. The Borg scale can also be useful in prescribing exercise intensity. The ventilatory or anaerobic threshold generally occurs at a rate of perceived exertion (RPE) of 15 to 16. Intensities of 12 to 13 RPE are usually well tolerated.

Duration of exercise should include an adequate warm-up period, which can consist of stretching or aerobic exercise at a very low intensity. The warm-up may have to be longer in patients with the lowest functional capacity. Usually 10 to 15 min is recommended. The exercise duration most frequently used is 20 to 30 min at the desired intensity. A period of cool-down is also advised. Cool-down could consist of stretching as well.

Most studies have used three to five times per week as the optimal training frequency. Patients who develop exhaustion after training may need a day of rest between sessions. Walking, as a minimum, should be encouraged on the "off" days. Other routine precautions should include avoiding extremes of temperature or humidity. Many shopping malls offer walking programs in a controlled environment prior to the opening of stores.

Since the skeletal muscle changes in heart failure are well described, resistive training offers the opportunity to strengthen individual muscle groups.

Table 3 Listing of Exercise Training Studies in Heart Failure

Ref.	Patients Analyzed (No.)	Patient Type	Design	Outcome
33	11 males	ICM	Crossover	17% increase in peak VO_2
34	18 males	ICM	Randomized controlled	22% increase in VO_2 in group with EF <30%
11	17 males	ICM	Crossover	18% increase in VO_2
35	14 males, 6 females	ICM/DCM	Randomized controlled	37% increase in exercise time
36	47 males, 8 females	ICM/DCM	Randomized controlled	15% increase in VO_2 in group with abnormal diastolic relaxation
37	29 males	ICM/DCM	Randomized controlled	Recovery of skeletal muscle is normal beyond the first 5–10 min after exercise
38	18 males	ICM/DCM	Randomized controlled	31% increase in peak VO_2
19	20 males	ICM/DCM	Randomized controlled	18% increase in workload
39	29 males	ICM/DCM	Randomized controlled	16.3% increase in peak VO_2
40	76 males, 4 females	ICM, post-MI	Randomized controlled	28% increase in work capacity
41	25 males	ICM, post-MI	Randomized controlled	26% increase in peak VO_2

Values in the outcome column are given as results in the training group compared to the control group. DCM = dilated cardiomyopathy; ICM = ischemic cardiomyopathy; VO_2 = oxygen uptake; EF = ejection fraction.

Although less well studied than aerobic training, resistive exercise can be safely performed using small free weights (1, 2, 5 lbs), elastic bands, or repetitive isolated muscle training (17). Upper body exercise should not be ignored since many activities of daily living require arm work. These muscle groups are often neglected in exercise training.

Table 3 presents some of the current evidence-based studies of exercise training in heart failure in which data have been prospectively collected and patients have been randomized. All the studies in Table 3 enrolled patients with ejection fractions <40%.

In summary, there is now ample evidence of the benefits of exercise training in patients with heart failure. Although this recommendation is logical for class I to III patients, the role of exercise in the most advanced heart failure patient is less well studied. Nonetheless, a low-intensity program may be beneficial even in the most clinically impaired group of heart failure patients. The effects of immobilization may impact the chronic heart failure patient to a greater degree than patients who have undergone a revascularization procedure or sustained a myocardial infarction. With the underlying muscle changes that accompany the syndrome of heart failure, inactivity can only worsen muscle function and should be avoided (18). Studies are eagerly awaited that will address the impact of exercise conditioning on long-term outcomes, including mortality.

EXERCISE TRAINING AFTER CARDIAC TRANSPLANTATION

In spite of dramatic advances in survival of cardiac transplant recipients, published studies have consistently shown abnormal levels of functional capacity. Even if patients return to their normal activities and feel well without evidence of rejection, exercise function remains 30 to 40% below normal (20,21). Studies describing persistently abnormal exercise capacity early after transplant suggested marked deconditioning prior to transplant due to heart failure, surgical denervation, skeletal muscle weakness and corticosteroid use among others as possible explanations (22–24).

Exercise Capacity Early Post-Transplantation

Subsequent reports of rehabilitation programs after transplantation showed improvements in peak VO_2 from 16.7 to 20 mL/kg/min after 10 weeks of outpatient exercise training (25). Patients following coronary bypass surgery show similar levels of functional capacity to cardiac transplant recipients after an early outpatient program of exercise conditioning (<3 months after surgery). However, coronary bypass patients who continue to exercise can further increase exercise capacity by 25% while transplant recipients with the same program increase function by only 8% (21). The results of an exercise program, however, may depend on the motivation of the individual as shown by Kavanagh and colleagues (26). After 16 months, a significant difference in the VO_{2max} was achieved in the more compliant transplant recipients. Using a peak VO_2 at baseline of 21.8 mL/kg/min and 21.3 mL/kg/min in the less compliant and more compliant groups respectively, the more compliant group achieved an improvement in VO_2 to 32.3 mL/kg/min compared to 24.5 mL/kg/min in the less compliant group. In spite of this improvement, the combined group overall had an exercise capacity of 70% of normal.

Long-Term Exercise Capacity

Until recently, information concerning the long-term assessment of functional capacity post-transplant was limited. Data have now emerged for up to 5 years post-transplant and show that peak VO_2 may decrease with time (27). However, if measured as an absolute value rather than normalized to body weight, VO_2 (mL/min) remains unchanged and thus weight gain impacts negatively on exercise performance. Furthermore, there is some evidence that exercise capacity may be higher in those recipients who are not on maintenance corticosteroids (23). Patients with chronic heart failure have skeletal muscle histological abnormalities with an increase in type II muscle fibers relative to type I fibers. Post-transplant, the ratio of both fiber types remains unchanged (28). However, a significant increase in fiber size occurs associated with an increase in skeletal muscle oxidative capacity. Thus, although after transplantation some of the skeletal muscle abnormalities improve, complete normalization does not occur and may account in part for the continued abnormal exercise capacity. Progressive resistance training should be added to a conditioning program since a leg strength deficit persists up to 18 months after transplant (24).

Transplantation Cardiac Rehabilitation Program

Patients who have undergone cardiac transplantation pose a challenge. Not only have many of these patients been hospitalized repeatedly and for prolonged periods, leading to marked deconditioning, but also they are often cachectic and malnourished. Cardiac transplantation offers these patients a new source of central cardiovascular blood flow. The periphery, however, remains the same or perhaps worse due to anesthesia and further prolonged bed rest, in addition to corticosteroid use. After transplantation, heart rate cannot be used as a measure of work intensity due to denervation. Hence, the rehabilitation team must rely on clinical judgment and on perceived level of exertion (RPE) to guide exercise therapy (29).

Pretransplantation

Ideally, transplant candidates should initiate an exercise program as soon as possible after listing. The program should include both aerobic training and resistive exercise. If the program is instituted pretransplantation, the patient will be familiar with exercise modes such as range of motion and be able to reinitiate these with minimal reeducation shortly after transplantation. Inspiratory muscle training has also been shown to improve ventilatory muscle strength in a group of patients awaiting transplant (30). Moreover, if a patient is in a better conditioned state pretransplant, the few days of intubation and inactivity will do little to reverse this level of conditioning.

For patients who become dependent on inotropic therapy and are listed as status I, the same type of program can be instituted in the hospital. A set routine consisting of bicycle, treadmill, upper body ergometry and free weights can be carried out safely in the controlled intensive care setting. Walking can often dissipate boredom and add to the patient's functional capacity. The exercise intensity may have to be determined by patient symptomatology, rather than by heart rate or RPE. In accordance with the AHCPR Guidelines on Cardiac Rehabilitation, exercise training is recommended both pre- and post-transplantation (8).

Post-Transplantation

Prior to removal of the chest tubes and pacing wires, exercise consists mainly of passive and active range of motion accompanied by incentive spirometry to facilitate pulmonary toilet. Once out of bed in a chair, leg raising and hip girdle exercises become useful as a preparation to transfer weight from sitting to standing. Once the patient is able to stand, ambulation is initiated, initially in the patient room, progressing to the ward. It is assumed at this point that the patient is on telemetry monitoring. Intensity continues to be assessed by rate of perceived exertion more commonly using the Borg scale (29). Prior to discharge, if no rejection is encountered, the patient may be able to exercise on a stationary bicycle ergometer and/or treadmill. A predischarge exercise test to better define an exercise prescription for an out-patient program is strongly suggested.

Exercise Prescription for the Outpatient Program

The exercise prescription post-transplantation includes all the essentials of intensity, duration, frequency, and progression. The rehabilitation programs should also be instructed regarding specific exercise modalities such as upper body resistive training after the first 6 weeks post-transplantation to allow for healing of the sternal incision. The RPE at the anaerobic threshold serves to prescribe intensity since the heart rate will not be commensurate with effort. The anaerobic threshold or ventilatory threshold has been shown to correlate with the lactate threshold in transplant recipients (31). Other centers use fixed distance/ fixed speed intensities and use the Borg scale to ''fine tune'' the set prescription (32).

Warmup and cool-down is essential, with a minimum of 20-min of exercise at the prescribed intensity. Exercises should be performed in a supervised setting three times per week for a minimum of 6 to 8 weeks. Whether telemetry monitoring is essential has not been well established. A walking program is recommended for alternate days. An extension of this timetable is often necessary to take into account early episodes of rejection or infection that may preclude exercise for several days at a time. It is important to outline a progressive increase in exercise activity to account for improvement in function that may occur early in the program. An RPE of 11 to 13 will allow for early deconditioning. Every effort should be made to increase the intensity to at least RPE 13 to 15 to approach the ventilatory threshold, which may also improve with exercise. Although not well studied in transplant recipients, resistive exercise can be performed safely and increase strength and flexibility for tasks of daily living. One would hope for an alleviation of steroid-induced proximal myopathy. The exercise prescription should be adjusted as patients improve. Patients should be encouraged to adopt exercise and activity as a way of life. Adherence to physical activity should be monitored in a similar fashion to adherence to the medical regimen.

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Exercise Training in Special Populations: Diabetes

Donald A. Smith and Jill Crandall
Mount Sinai School of Medicine, New York, New York

Because diabetes mellitus is a risk factor for coronary heart disease, cardiac rehabilitation programs will see a disproportionate number of patients with diabetes compared with the general population. The philosophy of exercise for the diabetic patient should be to include all the types of exercise available to the patient without diabetes. This philosophy should be superseded only when such a policy would increase the risk of injury or harm to a specific individual. This requires evaluating each patient with diabetes for the level and stability of glucose control, the agents used to achieve this, and for the presence of diabetic complications.

Both Type 1 and Type 2 diabetes can eventually lead to the same complications. Type 1 diabetes is an autoimmune disease in which autoantibodies eventually result in complete destruction of the insulin-producing beta cells of the pancreas, leaving the patient chronically insulinopenic. This necessitates the administration of exogenous insulin to control underlying metabolic pathways of energy storage and utilization. Lack of proper insulinization can result in severe hyperglycemia and ketosis in the occasional patient, often worsened by the adrenergic response to exercise. Over-insulinization, on the other hand, can augment the hypoglycemic effect of exercise, resulting in severe hypoglycemia both during and within the 24 h after exercise.

Most patients with Type 2 diabetes, in contrast, have functioning beta cells with varying levels of insulin secretion based on the degree and duration of the insulin-resistant state. This endogenous insulin prevents ketogenesis during exercise, although hyperglycemia can occur. Only Type 2 patients on insulin or oral sulfonylurea therapy, which raise serum insulin levels, may experience hypogly-

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cemia during or after exercise. On the other hand, dietary therapy alone and the newer oral therapies that reduce insulin resistance, metformin (Glucophage) and troglitazone (Rezulin), will not cause hypoglycemia except in a rare case because the normal feedback mechanisms whereby falling blood glucose levels shut off insulin release remain intact. Acarbose (Precose), an oral agent that blocks alpha glucosidase in the intestine and thus decreases carbohydrate absorption, also should not cause hypoglycemia.

Although one should be familiar with the distinctions between Types 1 and 2 diabetes, from the cardiac rehabilitation point of view one needs mainly (1) to know the type of hypoglycemic agents being used in order to anticipate if hypoglycemia could be a problem and (2) to be aware of the presence and severity of complications to determine if certain types of exercise will have to be limited or excluded.

AMOUNT AND TYPE OF EXERCISE

One purpose of the exercise component of cardiac rehabilitation in the diabetic patient is to ameliorate coronary risk factors (e.g., intra-abdominal obesity with its attendant increased insulin resistance, dyslipidemias, hypertension, and hyperglycemia). This is in addition to increasing the cardiac aerobic capacity and producing a level of fitness that will protect from myocardial infarction triggered during unplanned sudden increases in physical activity (1). Cardiac aerobic capacity is a function of exercise duration and intensity and the prescription in diabetic patients should be the same as for nondiabetic persons. On the other hand, exercise-induced improvements in the coronary risk factors often associated with diabetes may be achieved with less vigorous exercise by simply increasing moderate activities whether done in one or several sessions throughout the day. One should aim during follow-up to maintain exercise intensity to sustain cardiac aerobic gains achieved earlier in the program. In case functional status deteriorates with time, one can minimally encourage 30 min of moderate exercise accumulated each day in order to improve insulin resistance and other coronary risk factors associated with it.

Resistance or strength training (2) (see Chap. 7) has been shown to be beneficial in persons with Type 1 diabetes and should prove useful in Type 2 diabetes in improving glycemic control, dyslipidemias, and other coronary risks associated with insulin resistance. Examples of such training include calisthenics using body weight as resistance, the use of elastic bands, free weights, and weight machines. This type of exercise can be combined with more traditional aerobic exercises in diabetic patients. When resistance exercises are done in a circuit fashion moving from one group of muscle exercises to the next, using relatively light weights and resistances allowing 15 to 20 repetitions, with 15 to 30 s between exercises, such training is in the low-to-moderate intensity range and can be associated with aerobic improvement.

In the performance of such exercises, patients must be taught to avoid breath-holding and Valsalva maneuvers which tend to raise blood pressure. This can be achieved by encouraging rhythmic breathing with exhalation during effort (e.g., during the lift). As in all types of exercise, a 5- to 10-min warmup and cool-down period is indicated. One begins slowly with low resistance or weight loads, allowing 10 to 15 repetitions for all muscle groups, and then slowly adds more sets and more resistance or weight. Blood pressure, heart rate, and monitoring for ischemia can be performed after the completion of a set to ensure safety. Two sessions or more per week with a rest of 36 to 48 h between sessions allows positive physiological effects. The only persons with diabetes for whom this type of exercise is prohibited are those with untreated and/or unstable proliferative retinopathy or severe preproliferative retinopathy. It may be allowed post laser therapy with stabilization of the retinopathy and with the consent of the treating ophthalmologist.

GLUCOSE CONTROL DURING EXERCISE IN THE PATIENT ON INSULIN OR SULFONYLUREAS

It is important for the cardiac rehabilitation program to help educate the patient with diabetes about changes in glucose associated with exercise (3). Since each patient's glycemic response to exercise differs, this requires monitoring each patient before and immediately after exercise at the facility and then having the patients monitor themselves later at home with results brought to the next rehabilitation session. The major concern is to be aware of and avoid hypoglycemia in those on insulin and/or sulfonylurea agents both during and in the 24 h postexercise; the risk increases with the intensity and duration of the exercise. If the preexercise fingerstick glucose is less than 100 mg/dL, a source of simple carbohydrate should be administered before starting. This could be 1 fruit or starch exchange or 2 to 3 glucose tablets containing 4 or 5 g of glucose each. Insulin preceding exercise should not be given in an extremity that will be used for exercise since this may increase insulin absorption during exercise. Abdominal sites are preferred. In addition to the fingerstick glucose monitor, the rehabilitation area should also have glucose tablets or gels to administer to patients with hypoglycemia during exercise, and glucagon emergency kits (1 g glucagon) if severe symptoms make oral administration of glucose impossible.

If the patient has repeated hypoglycemic episodes associated with exercise, one may decrease the preceding insulin or sulfonylurea dosage 10 to 20% or have the patient consume an extra serving of carbohydrate before or after the session, depending on the timing of the hypoglycemic episodes. Exercise per-

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formed in the evening can be especially problematic for some individuals by producing nocturnal hypoglycemia. Occasionally a patient may have to set the alarm for 3 AM to measure glucose to be sure that the level is normal. Others may have to reduce nocturnal intermediate insulin dosage, or take an extra serving of complex carbohydrate before going to bed. If nocturnal hypoglycemia becomes a repetitive problem after late afternoon or evening exercise, the exercise may have to be changed to earlier in the day.

Because poor glucose control can occasionally lead to severe hyperglycemia and ketosis in Type 1 patients and severe hyperglycemia in Type 2 patients, exercise should be avoided when the preexercise glucose level is greater than 250 mg/dL and the urine is positive for ketones, or if the glucose is greater than 300 mg/dL. For the enthusiastic participant, one may delay exercise 60 to 90 min while a small dose of rapid-acting Humalog insulin is given and then remeasure glucose in 1 h to see if it is in a more acceptable range. Or one may allow the person to exercise with glucose and ketone monitoring at 30, 60, 120, and 180 min to simply educate the patient to the effects of exercise in the hyperglycemic state.

If the patient is to continue to exercise after the formal rehabilitation program, its performance should be simple and enjoyable. Thus, for the usual diabetic individual, it should be unencumbered with the necessity of monitoring glucose before and after each exercise episode and be free of undue fear of hypo or hyperglycemia. Thus the goal of the cardiac rehabilitation program is to help the patient understand his or her glycemic response to exercise through monitoring while in the structured program. It should not make patients dependent on glucose monitoring when they leave the cardiac rehabilitation program nor make them unduly fearful of hypoglycemia. Teaching the following principles may be helpful in this regard.

1. Try to exercise at a similar time each day, since one is most familiar with the glycemic response in such a constant setting and time.
2. Be aware that changing the time or intensity or duration of exercise can influence glucose response; simply be more vigilant for hypoglycemic effects.
3. Always have a source of instant glucose in a pocket during exercise, especially when away from home or alone.
4. Wear a medical alert bracelet with the words ''Diabetic: if confused, give sugar,'' if the individual has frequent episodes where neuroglycopenia (loss of judgment, confusion, stupor) may occur in a setting where others are unaware of the diagnosis.
5. Be especially vigilant for hypoglycemia when exercise and alcohol are combined (e.g., baseball and beer, prolonged dancing at parties with delayed food intake, increased alcohol and exercise on vacation).

EXERCISE IN THE DIABETIC PATIENT WITH COMPLICATIONS

Peripheral Neuropathy

A diagnosis of peripheral neuropathy (4) is not uncommon after 5 years of Type I diabetes or even at the time of diagnosis in Type II diabetes. Symptoms occur mainly in the feet, with painful burning, tingling, or numbness. Neuropathy also can be silent, with the first symptom being development of a foot ulcer. Hence screening for loss of sensation is important in the initial diagnostic workup for a diabetic patient entering cardiac rehabilitation. One simple test that can identify diabetic patients who have lost protective sensation in their feet is to test for light touch using a 5.07-gauge nylon monofilament (NC 12757-14 [5.07]; North Coast Medical, San Jose, CA). The absence of sensation to this stimulus on the bottom of the foot suggests an increased risk for skin and joint injury to the feet (5) and requires self-examination of the feet before and after exercise, and proper shoes with shock-absorbing soles and ample room for the distal foot. Severe absence of sensation would suggest avoidance of weight-bearing exercises on the feet such as prolonged walking (on or off the treadmill), jogging, and step exercises. Nonweight-bearing exercises such as swimming, bicycling, rowing, or chair or arm exercises are recommended.

Retinopathy

A potential barrier to a diabetic patient's participation in an active cardiac rehabilitation program is the risk of precipitating vision loss in those patients with advanced (proliferative) retinopathy (6). Proliferative diabetic retinopathy is characterized by neovascularization, which is the growth of abnormal blood vessels in response to retinal ischemia. These new vessels are fragile and prone to hemorrhage. In addition, fibrous tissue may cause traction on the retina and lead to retinal detachment, which may be precipitated by serious jarring of the cranium. Proliferative retinopathy may be present in the absence of visual symptoms and can only be diagnosed by a dilated fundoscopic examination that ideally should have been done within the previous 12 months.

The risk of exercise aggravating proliferative retinopathy is not known. Most episodes of acute deterioration in vision due to hemorrhage or retinal detachment are not related to exertion and often occur during sleep (7). However, most clinicians feel that restricting selected high-risk activities is prudent with the goal of minimizing increases in systolic blood pressure and intraocular pressure (6). Activities involving a prolonged Valsalva maneuver and isometric exercises should be avoided. Weight-lifting with high resistance; vigorous bouncing such as jogging, boxing, heavy competitive sports; and high-impact aerobics are generally discouraged. Acceptable activities that involve a minimal risk to vision

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include swimming, walking, low-impact aerobics, stationary bicycling, and endurance exercises.

In a careful 6-year prospective study of diabetic patients with milder degrees of retinopathy (background, mild, moderate, and severe nonproliferative), no association was found between activity level and two-step progression of retinopathy or development of proliferative retinopathy (8). In a subset of 32 weightlifters in this study, there was no worsening of preproliferative retinopathy or progression to proliferative retinopathy when compared to nonweight-lifting diabetic patients. Thus patients with nonproliferative retinopathy (background or mild-moderate) probably require no restrictions on exercise. With severe nonproliferative retinopathy, current policy would limit activities with severe Valsalva or blood pressure responses and significant jarring, much like the recommendations for proliferative retinopathy (6,9). In any situation of uncertainty, more frequent ophthalmological follow-up should be encouraged (i.e., every 2 to 4 months).

Nephropathy

Nephropathy (10,11) usually begins 5 years or later after the diagnosis of Type I diabetes but may be coexistent with the diagnosis of Type II diabetes. Microalbuminuria, or incipient nephropathy, is a state preceding the decline in glomerular function in which the usual dipstick tests for proteinuria are negative but in which specific tests for albumin are increased. This state progresses over 10 to 20 years to clinical albuminuria, or overt nephropathy, at which time glomerular filtration rates start to decline. During this state of microalbuminuria, hypertension usually develops and the risk of coronary heart disease morbidity and mortality is doubled. Both systolic and diastolic hypertension have been shown to hasten the progression of diabetic nephropathy. This progression may be slowed and life expectancy may be increased with the control of blood pressure using many agents (diuretics, beta-blockers, and calcium channel blockers) but benefit is most pronounced using angiotensin converting enzyme inhibitors.

Exercise acutely increases systolic blood pressure and albumin excretion through the glomerulus. It has not been shown that these acute changes lead to more rapid progression of nephropathy. Thus, no recommendations have been made in persons with diabetic nephropathy concerning exercise. Perhaps the most helpful recommendation is to make sure that preexercise blood pressure is adequately controlled (systolic blood pressure $\leq$ 130 mmHg, diastolic blood pressure $\leq$ 85 mmHg). If preexercise blood pressure is not controlled in the presence of micro or clinical albuminuria, angiotensin converting enzyme inhibitor therapy must be considered and blood pressure control intensified, in consultation with the referring physician.

Cardiac Autonomic Neuropathy

Although infrequently found, cardiovascular autonomic neuropathy (12) is important because the changes in cardiovascular function that ensue may affect the exercise component of cardiac rehabilitation. The development of this syndrome first involves loss of parasympathetic function which increases resting heart rate (HR > 100 bpm) and decreases heart rate variability in the resting state and with deep breathing. Subsequently, sympathetic function may be decreased with associated decreases in left ventricular systolic and diastolic function when compared with nondiabetic control subjects. Such changes include measurable, but usually clinically insignificant, reductions in ejection fraction both at rest and with exercise (13) and in attained heart rate and blood pressure with exercise (14).

Loss of sympathetic function can eventually result in orthostatic hypotension, defined as a drop in systolic blood pressure >20 mmHg on standing, which is generally associated with a sense of dizziness, lightheadedness, or actual fainting. The symptoms may be worsened after eating when splanchnic blood flow increases, thus further decreasing blood supply to the central nervous system.

A simple practical baseline evaluation for cardiac autonomic neuropathy includes:

Resting heart rate >100 bpm
Drop of systolic blood pressure from supine to standing >20 mmHg at 2 min
QTc interval, calculated as $[QT/(R - R)^{1/2}]$, $\geq$ 440 ms (15).

If any of these are positive, further simple diagnostic baseline tests may be done (16), but these three items are sufficient to help in supervision of cardiac rehabilitation. Because of the resting tachycardia and depression of maximal expected heart rates using published tables, the target of exercise may be better determined using the rate of perceived exertion scale, aiming for a moderate range gradually over 2 to 4 weeks (12). Although the treatment of a diabetic patient with symptomatic orthostatic hypotension is beyond the scope of this chapter and may be found elsewhere (17), simple suggestions to lessen drops in blood pressure with exercise include:

1. Providing adequate hydration with fluids containing sodium chloride.
2. Postponing exercise to times when hypotension is less (e.g., 2 h after eating, afternoon rather than morning).
3. Avoiding situations that cause peripheral vasodilation (e.g., hot environments, hot showers, preexercise alcohol use).
4. Reducing medications (generally antihypertensives) that may increase postural hypotension.
5. Using support hose to the midthigh in those with large varicose veins, or body stockings to the umbilicus in those without.

Although a prolonged QTc interval >440 ms in the diabetic person increases the risk of sudden death even in the absence of other etiologies of cardiovascular disease (18), it is unclear how this should affect cardiac rehabilitation except to consider stopping or reducing medications that prolong the QTc interval and to monitor for serious arrhythmias during exercise.

CONCLUSIONS

1. The types and goals of exercise rehabilitation should be the same in the person with diabetes as in the person without it, as long as such a policy engenders no harm or injury.
2. The risk of hypoglycemia during and in the 24 h postexercise in those on insulin or sulfonylurea therapy will be the most common problem associated with glucose control. Education about the individual's own glycemic response to exercise during rehabilitation helps the person understand and manage it in the nonsupervised situation, and should be designed not to enslave the person to the glucose monitor before or during exercise.
3. Target heart rates for exercise can be the same as for persons without diabetes, except in the case of cardiac autonomic neuropathy where the loss of parasympathetic and sympathetic function alter normal cardiovascular responses to exercise. In this situation, a moderate rate of perceived exertion may be a better target than a percentage of maximum heart rate found in standard maximum heart rate tables.
4. When perception of pain and touch in the feet are significantly diminished with peripheral neuropathy; good shoes, frequent inspection of the feet for injury; and nonweight-bearing exercises should be encouraged.
5. When proliferative diabetic retinopathy or severe nonproliferative retinopathy is present, exercise with prolonged Valsalva such as with heavy resistance weight-lifting and jarring sports such as jogging and major body contact sports should be discouraged.
6. The rehabilitation program should ensure that blood pressure and dyslipidemias are well-controlled, that smoking cessation efforts are vigorous, and that glucose control is optimized in conjunction with the patient's primary care or referring physician.

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14

Exercise Training in Special Populations: Obesity

Carl J. Lavie and Richard V. Milani
Ochsner Heart and Vascular Institute, New Orleans, Louisiana

Recent data indicate that the prevalence of obesity has progressively increased over the past two decades in the United States, and now nearly 50 million adult Americans are considered to be overweight (1,2). Obesity is known to affect many of the well-known coronary artery disease (CAD) risk factors, increasing levels of systemic arterial pressure and the prevalence and severity of left ventricular hypertrophy (LVH), decreasing insulin sensitivity, adversely affecting plasma lipid profiles [particularly decreasing levels of the cardioprotective high-density lipoprotein (HDL) cholesterol and increasing triglycerides], and leading to a sedentary lifestyle (3–7). In addition to adversely affecting all these individual risk factors, data from both the Framingham Heart Study (8) and a large cohort of U.S. nurses (9) have indicated that obesity is an independent risk factor for major CAD events, particularly in women, and that it increases the risk for congestive heart failure from systolic and, in particular, diastolic, abnormalities (5,6,10). Previous data indicate that weight reduction from exercise training and/or dietary caloric restriction reduces arterial pressure, LVH, and insulin resistance and improves plasma lipid profiles (11,12). However, only very limited data are available on the impact of cardiac rehabilitation and exercise training programs in obese patients with CAD (2,13).

We recently reviewed data from 588 consecutive CAD patients who were referred to, attended, and completed outpatient phase II cardiac rehabilitation and exercise training programs (14). A subgroup of 235 patients (40% of this CAD cohort) was classified as being obese by body mass index (BMI) criteria: BMI $\geq$ 27.3 kg/m^2 in women and $\geq$ 27.8 kg/m^2 in men. These obese patients were compared to those not classified as obese. We also compared the effects of

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cardiac rehabilitation in 45 obese patients who had ≥ 5% weight reduction (average − 10%), with 81 obese patients who did not lose weight.

At baseline, obese patients were 4 years younger ($p < 0.0001$) and had a higher prevalence of hypertension (74% vs. 50%; $p < 0.01$) and diabetes (29% vs. 21%; $p < 0.05$). They had higher percent body fat (+17%; $p < 0.0001$), total cholesterol (+6%; $p = 0.02$), triglycerides (+23%; $p < 0.0001$), fasting glucose (+13%; $p = 0.04$), and low-density lipoprotein (LDL)/HDL ratio (+12%; $p < 0.001$), but had lower HDL cholesterol (−22%; $p < 0.01$) compared with nonobese patients.

After cardiac rehabilitation and exercise training programs, obese patients had statistically significant, although small, improvements in obesity indices (weight −2%, $p < 0.0001$; BMI − 2%, $p < 0.0001$; and percent body fat −5%, $p < 0.0001$). Exercise capacity (+27%, $p < 0.0001$), HDL cholesterol (+4%, $p < 0.01$), and LDL/HDL ratio (−6%, $p < 0.01$) also improved. Obese patients also had significant improvement in scores for anxiety, depression, and somatization, and total quality of life score improved by 13% ($p < 0.0001$), with significant improvements noted in all components studied.

Compared with nonobese CAD patients, obese patients had statistically greater reductions in BMI (−2% vs. 0%; $p < 0.0001$) and weight (−2% vs. 0%; $p < 0.0001$), but they also had less significant improvement in exercise capacity (+27% vs. 39%; $p < 0.0001$) than nonobese patients.

In the subgroup of obese patients with a ≥5% weight reduction (average −10%; 219 pounds to 200 pounds), statistically greater improvements were noted in obesity indices (BMI, $p < 0.001$ and percent fat, $p < 0.01$); exercise capacity (+34% vs. 26%; $p < 0.001$); total cholesterol (−7% vs. −2%; $p = 0.03$); triglycerides (−20% vs. +4%; $p < 0.01$); HDL cholesterol (+11% vs. +2%; $p < 0.001$); LDL cholesterol (−7% vs. −4%; $p = 0.02$); LDL/HDL ratio (−16% vs. −7%; $p < 0.0001$); and fasting glucose (−6% vs. +3%; $p = 0.09$) compared with obese who did not lose weight.

Overall fitness levels and exercise capacity may be important risk factors for CAD events, and improvements in exercise capacity and fitness may predict an improvement in all-cause mortality (2,15–17). In addition, the benefits of higher fitness levels have been demonstrated in overweight subjects. Although obese CAD patients improved their exercise capacity by 27% following rehabilitation, this was considerably less than the improvement noted in nonobese patients. Importantly, the improvement was considerably better (+34%) in obese patients with an average 10% reduction in weight, suggesting that greater weight reduction should be associated with both improvements in fitness levels and prognosis in obese CAD patients.

Although improvements in lipids were modest in obese patients, the improvements were less than desired, particularly since obese patients had more severe dyslipidemia at baseline. Importantly, however, obese patients with the

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greatest weight reduction had statistically greater improvements in most lipid fractions, again demonstrating the importance of weight reduction for these patients.

Obesity is extremely prevalent, and on the increase, in society, more so in the CAD population (40% in our study). Following comprehensive cardiac rehabilitation, obese patients, particularly those who are more successful with weight reduction, have significant improvements in obesity indices, exercise capacity, other CAD risk factors, as well as behavioral characteristics and quality of life, which should translate into a better prognosis and lower subsequent costs for these patients. Greater emphasis on more effective weight reduction strategies is needed to enhance the benefits of effective cardiac rehabilitation for the large number of obese CAD patients.

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Exercise Training in Special Populations: Valvular Heart Disease

Henry S. Miller
Wake Forest University School of Medicine, Winston-Salem, North Carolina

Acquired and congenital valvular heart disease may occur in any heart valve as stenosis or regurgitation, in a combination of valves as mitral regurgitation and tricuspid regurgitation or as a valvular abnormality associated with other congenital anomalies as aortic stenosis and ventricular septal defect. In evaluating the clinical significance of the valvular problem, obtaining a history to include exercise-induced symptoms and a physical examination to determine the presence and hemodynamic significance of a valvular abnormality is vitally important. Doppler echocardiography has proven to be a very reliable adjunctive test to identify aortic, mitral, and tricuspid disease and in distinguishing mild disease from severe disease. However, at times, it is difficult to evaluate the degree of severity by echocardiography, particularly in regurgitant valvular abnormalities. The sensitivity of echocardiography to detect valvular regurgitant jets is high. Reportedly, tricuspid regurgitation can be seen in 25 to 95%, mitral valve regurgitation in 10 to 40%, and aortic valvular regurgitation in 0 to 30% of the subjects who had an echocardiogram. In evaluating a group of healthy subjects, regurgitant jets were found in greater than 90%, with triple valve regurgitant jets in 20% (1). These regurgitant jets are usually trivial and do not represent significant valvular insufficiency. The addition of a graded exercise test and cardiac catheterization may be required to determine the symptomatic and anatomical significance of the valvular disease.

In the discussion of exercise training in this patient population, stenotic and regurgitant lesions of the aortic and mitral valve, tricuspid regurgitation, mitral valve prolapse, and multiple valve problems will be considered. Patients

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who have had valvular repair, replacement, and valvuloplasty will also be discussed.

MITRAL VALVE PROLAPSE

Mitral valve prolapse is relatively common, occurring in approximately 5% of the population, but is usually a benign disorder. However, certain characteristics of the prolapsed mitral valve such as an elongated myxomatous thickened leaflet are associated with the greatest risk of disabling and potentially fatal arrhythmias and severe mitral regurgitation. The valve that is mildly redundant during systole with a midsystolic click and short murmur is rarely associated with significant problems (2). In the absence of significant mitral regurgitation, normal activity and exercise training do not impose a significant risk. Sudden death is reported, but rare. In the absence of significant arrhythmias at rest and with exercise, a family history of sudden death associated with mitral valve prolapse, moderate-to-severe mitral regurgitation, or emboli or syncope due to arrhythmias, these patients will benefit from exercise training and need not be limited.

In developing an exercise program for these patients, it is important to remember that arrhythmias are always a concern and the frequency and significance may change with time. However, there is no evidence that exercise accentuates the arrhythmias unless the hemodynamics of the valvular disease change due to ruptured chordae tendineae or valve fracture. The increase in mitral regurgitation under these circumstances will usually markedly limit exercise tolerance. It is important that these patients are told that complications are a possibility and are instructed to report any change in symptoms, exercise capacity, sound of their murmur, or cardiac arrhythmias to the personnel directing the exercise training.

MITRAL REGURGITATION

In addition to mitral valve prolapse, mitral regurgitation may have other causes including rheumatic valvulitis, coronary artery disease resulting in papillary muscle infarction, bacterial endocarditis, poor valve support associated with dilated cardiomyopathy, and connective tissue disorders as the mucinous degeneration commonly associated with Marfan's syndrome. The intensity and duration of exercise training in patients with mitral regurgitation depends on the severity of the disease. The severity can be assessed by a careful history to determine the etiology and exercise-limiting symptoms, the classic cardiac physical signs of mitral regurgitation, the increased heart size, and left ventricular apex impulse, soft quality of the first sound, and quality, intensity, and location of the systolic murmur.

In patients who have relatively mild mitral regurgitation without any increase in left ventricular size, moderately intense aerobic exercise is well tolerated. There is some evidence, however, that the regurgitant jet is intensified and left atrial pressures are increased significantly with the use of intense static exercise, which may relate to the marked increase in arterial pressures generated with power lifting. Patients with moderate mitral regurgitation and mild left ventricular and left atrial enlargement can exercise in a more limited way, limiting themselves to an intensity of 50% of their maximal capacity for 20 to 40 min. As the disease worsens and the ventricular response rate with atrial fibrillation is more difficult to control, the exercise training should be limited to low- to moderate-level walking, biking, and other similar activities, carefully avoiding undue risk of trauma in patients on anticoagulant therapy.

MITRAL STENOSIS

Mitral stenosis of any significant degree usually limits the ability to exercise more than mitral regurgitation. The degree of mitral stenosis can frequently be assessed by asking patients questions regarding their symptoms associated with specific physical activity and by careful examination of the heart. Echocardiography is valuable in documenting valvular mobility and orifice size, left atrial size, and pulmonary artery pressures. When the mitral valve orifice size is greater than 1.5 cm^2, the stenosis is judged to be mild, and patients can participate in exercise training at a fairly normal level. The level of exercise intensity and duration may be modestly reduced, but conditioning can be significantly improved. As the valve becomes more stenotic (1 to 1.4 cm^2) exercise symptoms are usually evident and can easily be documented historically or by an exercise test. These subjects can frequently walk and do modest exercise to enhance peripheral adaptations, but moderate exercise both in intensity and duration may cause an increase in left atrial pressure and significant shortness of breath. Prior to echocardiography, exercise was used to evaluate mitral stenosis during cardiac catheterization. It was noted that pulmonary wedge pressure was markedly increased with upper or lower extremity exercise when the valve area was less than 1 cm^2. Pulmonary wedge pressures were easily elevated with modest exercise even with valves up to 1.5 cm^2, as measured at surgery.

The patients with mitral stenosis have to be carefully observed for rather intense shortness of breath during exercise training. Increasing left atrial pressure and size may cause atrial fibrillation. A graded exercise test with monitoring of blood pressure, heart rate, and rhythm, and increase in dyspnea is the best method of determining the maximal intensity at which a patient can comfortably and safely exercise. This test provides the best information for designing a safe and effective exercise prescription and program for the patient.

AORTIC STENOSIS

Aortic stenosis is most commonly caused by congenital bicuspid valve. This accounts for 4% of the sudden deaths in young athletes (3,4). Hemodynamic flow changes caused by the anatomical abnormalities of the valve cause thickening and calcific changes of the leaflets. Aortic stenosis secondary to rheumatic heart disease is usually associated with mitral and/or tricuspid valve disease. As with the other valve lesions, the severity of the disease can be estimated by a history and physical examination and ECG. Doppler echocardiography can determine the aortic valve orifice size, left ventricular contractility, and ascending aortic size. As the disease worsens and left ventricular decompensation occurs, the valve gradient measured during cardiac catheterization usually decreases; thus the severity of the aortic stenosis based on gradient can be misleading. However, observing the left ventricular contractility and valve orifice size by echocardiogram can clarify the severity of stenosis.

As is true in mitral stenosis, the degree of disease can be characterized as mild, moderate, and severe. This is best determined by estimating the gradient across the valve and the valve orifice size. Patients with mild disease can participate in exercise training at a moderate level of activity without problems. However, those who have symptoms of syncope, regardless of the degree of stenosis, should be carefully assessed for arrhythmias during activity. Here, as in other valvular abnormalities, a carefully performed exercise test before one embarks on exercise training is extremely important. In patients with aortic stenosis, the limit in the cardiac output may manifest itself by a decrease in blood pressure or ECG evidence of ischemia and/or arrhythmias with increasing exercise. The intensity of exercise training should be limited to a level below which these symptoms occur. Exercise training pulse rates and levels of perceived exertion should be provided to the patients to help them avoid reaching the level of intensity that may be detrimental.

The degree of aortic stenosis may worsen with time and patients should be reassessed every 6 to 12 months to assure that their exercise levels are safe, even if they have been instructed to continue at the same level of exercise training.

AORTIC REGURGITATION

Aortic regurgitation may have multiple causes. Again, the most common cause is a congenital bicuspid valve that may be thickened, shortened, and predominantly regurgitant as opposed to stenotic. Rheumatic heart disease, valve destruction associated with bacterial endocarditis, and proximal aortic medial necrosis, as in the Marfan syndrome, can also cause severe aortic regurgitation. Aortic regurgitation is variable in its intensity. When recognized only by echocardiography, with minimal or no auscultatory findings, the subjects can participate in exercise training without limitations. Those with mild-to-moderate aortic regurgitation usually tolerate physical activity quite well and will benefit from exercise training. They obviously have to be watched and reassessed after 3 to 6 months of exercise training to be sure that the condition remains stable. In most patients, the left ventricle will develop increased diastolic diameters as a compensatory mechanism for the regurgitant flow associated with aortic regurgitation. These subjects can usually tolerate exercise training without any difficulty, but should also be watched carefully for increased left ventricular size if exercise training continues over several months or increases in intensity. Again, the individual patient's level of exercise training is best determined by an exercise test. Exercise echocardiography adds valuable information as to the magnitude of left ventricular changes that occur during exercise. By using the information obtained from these exercise tests, the level at which these patients can train safely and effectively can be determined.

TRICUSPID REGURGITATION

Tricuspid regurgitation can be caused by rheumatic fever and usually associated with other valvular diseases. The regurgitation itself is most often caused by right heart dilatation and is commonly found in patients with severe mitral valve disease where increased pulmonary artery pressures can cause right ventricular failure.

Patients with tricuspid valve disease from rheumatic fever can usually participate in exercise training. Careful assessment of the right atrial and ventricular size is important in determining the degree of tricuspid valve disease and is necessary to determine the intensity level at which the patients can be trained. If the right ventricular size and estimated pulmonary pressure are within a normal range, these subjects can be trained quite actively without any significant limitation (5). Often associated valve lesions prove the determining factor for exercise recommendations.

MULTIVALVULAR DISEASE

Disease in more than one valve is usually related to rheumatic fever and most commonly involves the aortic and mitral valves. It can also be caused by myxomatous changes in the atrioventricular valves, infective endocarditis of the aortic and mitral valves or the tricuspid and pulmonary valves in intravenous drug users. As alluded to earlier, marked dilatation of the left and/or right ventricles can result in dilatation of the mitral or tricuspid ring producing severe valvular regurgitation. In determining the appropriate degree of exercise training for these patients, one should carefully look at the hemodynamics of each valve lesion. Exercise training programs should be developed related to the most severe valvular abnormality. However, it is necessary to consider the effects that the associated valvular abnormalities may have on the overall cardiac function. A patient may have predominant mitral stenosis and a less significant degree of aortic regurgitation; but the decreased cardiac output caused by the limited ventricular filling may be worsened by a significant aortic valve regurgitant flow. As one considers surgical correction, both valves usually have to be corrected to establish a stable cardiac output.

POSTOPERATIVE VALVULOPLASTY, VALVULAR REPAIR, AND VALVULAR REPLACEMENT

Cardiovascular changes associated with valve disease that occur over many years prior to correction of the valvular abnormalities are manifest primarily by an increased heart chamber size, changes in the contractility of the ventricles, and changes in the pulmonary vasculature. Thus, the postoperative valvular patients should not be expected to return to a good functional level of activity as quickly as do patients following coronary artery bypass graft surgery. In our experience, it has taken 3 to 6 months to recover maximally, even with exercise training of gradually increasing intensity throughout the time. The ball and tilted disc valve prostheses used from the early 1960s to the mid-1980s were associated with a reduction in the effective valve area. As valve design improved, this problem has become significantly less, as is noted in the current St. Jude valves. The replacement of valves with porcine valves and with human allografts has also enhanced the function and improved the level of exercise after complete recovery.

It is necessary to carefully assess these individuals. The graded exercise test or exercise echocardiography to assess valve motion, ventricular contractility and pulmonary artery pressures after exercise are invaluable in determining the intensity of exercise training that can be tolerated.

Again, it must be emphasized that after valve replacement or repair, patients take a significant time to recover. Therefore, they require careful observation in a rehabilitative setting for at least a 6-month period of time to evaluate medical management and allow the subjects enough time to recover sufficiently to return to work and normal lifestyle.

SUMMARY

Exercise training in patients with valvular disease is extremely important. The effect of specific valve disease on heart chamber size and pulmonary artery pres-

sures make careful assessment of these patients very important. A good history and physical examination and, at times, a carefully performed exercise test are essential to determine a safe and effective exercise training program for each individual patient. As noted, postoperative patients may take a significant period of time to regain good functional capacity because of the cardiopulmonary changes that frequently occurred prior to surgery. They seem to recover more rapidly in a rehabilitative exercise setting where their heart rates and blood pressures can be carefully recorded during the first few months. However, in a recent study (6), moderate exercise training in postoperative mitral and aortic valve surgical patients did not seem to add to the improvement in oxygen uptake of the subjects in a rehabilitation program compared to those exercising independently. The authors suggest that alternate strategies to improve exercise tolerance can be used, and suggest home-based rehabilitation. The subjects in this study were otherwise healthy individuals with valve disease, in their mid-50s, and would not be considered high-risk individuals. The authors state that exercise was emphasized for all these subjects. Many well-motivated patients without any arrhythmias or other problems may be able to exercise in a nonrehabilitation setting, but should have careful assessment, instructions, and a brief time in a rehabilitation program, as is usual for coronary disease patients.

The benefit of exercise training in enhancing return to work and decreasing rehospitalizations in patients with valve disease is not well documented in the literature. However, it has been the experience of many who work in cardiopulmonary rehabilitation programs that it is beneficial psychosocially and that quality of life is improved. Improvement in physical capacity has been noted in most patients and is more marked in the deconditioned patients and/or the postprocedural patients.

Careful assessment of patients with valvular disease, particularly when a graded exercise test is used, is psychologically beneficial and motivational. Finding that exercise can be performed without significant risk improves their comfort level during exercise training and leads to improved conditioning.

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Exercise Training in Special Populations: Pacemakers and Implantable Cardioverter-Defibrillators

Robert A. Schweikert and Fredric J. Pashkow
The Cleveland Clinic Foundation, Cleveland, Ohio

CARDIAC PACEMAKERS

Cardiac pacing is a rapidly expanding field of electrophysiology. More than 300,000 pacemakers are now implanted each year, and as many as 25% of patients in cardiac rehabilitation programs have pacemakers. With advances in pacemaker technology, the cardiac rehabilitation prescription for these patients continues to evolve. At one time, the rehabilitation of a patient with a cardiac pacemaker simply involved reassurance and education about the device. High-level physical activity was not recommended because the fixed pacing rate could not respond to exertion (1).

Since that time, there has been enormous progress in the design and manufacture of cardiac pacing devices. Pacemakers are now better equipped to provide atrioventricular synchrony and emulate the normal rate and rhythm response to varying levels of metabolic demand (2). Sensor technology has provided a means of heart rate adaptation for patients with chronotropic incompetence or atrial arrhythmias that preclude reliable sensing of native sinoatrial rhythm. Motion sensors are the most widely used, partly due to their simplicity, speed of response, and compatibility with standard unipolar and bipolar pacing leads. Other sensors are more physiological, yet some require technically complex pacing leads. Of the physiological sensors, only the minute ventilation variety is widely available.

Recently, combinations of sensors have been incorporated into pacemakers in an attempt to more closely match the physiological response to exercise (3,4).

Evaluation of the patient before (5) and after implantation of a rate-adaptive pacemaker is recommended for optimal device selection and programming. Exercise stress testing (6) and ambulatory electrocardiographic (Holter) monitoring are the more common modalities; however, telemetry monitoring (during, for example, exercise training), and other technologies such as Doppler echocardiography for assessment of hemodynamic parameters may also be helpful (7). The pacemaker may be programmed initially on the basis of age and estimated activity; however, exercise testing of some type, even informal (such as hallway walking), allows for more precise programming of the device and demonstrates the efficacy of the sensor at its current settings. If formal exercise testing is used, the selection of the proper exercise protocol is important, as the focus of protocols for the evaluation of rate-adaptive pacemaker systems should be at the lower workloads (1-5 METs), which fall within the range of activities of daily living for most pacemaker patients. For these patients, a protocol with a gradual increase in workload, such as the chronotropic assessment exercise protocol (CAEP), is more appropriate (8).

Once optimal programming has been achieved with a rate-responsive device, subsequent evaluation of the pacemaker patient should be individualized depending upon the clincial status. In general, an annual exercise test can be used to document the patient's tolerance of the programmed parameters of upper rate and sensor response, and Holter monitoring with detailed patient diaries may provide useful information during activities of daily living. Transtelephonic exercise monitoring also has been used for follow-up evaluation (9).

There are several potential problems that may develop during exercise rehabilitation of patients with a pacemaker. The staff must be aware of the type of pacemaker (e.g., single- or dual-chamber) and how the device is programmed, particularly the presence of such features as rate-adaptation and response to tachyarrhythmias. Additionally, pacemakers now have more complicated algorithms to more smoothly manage the heart rhythm as the upper rate limit of the device is approached during exercise. Early dual-chamber pacemakers developed abrupt, fixed block when the upper rate limit of the device was reached. Modern DDD pacemakers have incorporated advanced technologies into their design to minimize heart block during upper rate behavior, sometimes producing a Wenckebach-like behavior. However, 2:1 block may still occur during exercise, particularly if the pacemaker is suboptimally programmed.

Another problem that may be encountered during exercise is the pacemaker syndrome, which has been defined as the signs and symptoms that occur in the pacemaker patient due to inadequate timing of atrial and ventricular contractions (10). A common cause of pacemaker syndrome is retrograde ventriculoatrial (VA) conduction, which leads to atrial contraction against closed atrioventricular valves. VA conduction that is not present at rest may be facilitated during exercise and result in pacemaker syndrome. Pacemaker syndrome may also occur due to a feature of some DDD pacemakers called "*mode switching*." This refers to the capability of a dual-chamber pacemaker to convert to single-chamber ventricular pacing to prevent nonphysiological ventricular pacing triggered by tracking of an atrial arrhythmia. Mode switching may occur during exercise due to an atrial arrhythmia and result in symptoms from loss of AV synchrony. In the absence of the mode-switching feature, atrial arrhythmias that occur during exercise could result in rapid ventricular pacing as the pacemaker attempts to track the atrial rate (a form of pacemaker-mediated tachycardia). The resultant wide-complex (paced) tachycardia may appear to be ventricular tachycardia, especially for pacemakers with bipolar leads where the pacing artifact may be difficult to discern on the ECG tracing.

These examples emphasize the need for the rehabilitation staff to be aware of the type of pacemaker and the programmed parameters, including lower and upper rate limits, maximum tracking limit (often a separately programmed parameter), and the presence of other features such as rate adaptation and automatic mode switching. Attention to these details will allow anticipation of potential problems during exercise training of patients with a cardiac pacemaker and more efficient management should a complication occur.

IMPLANTABLE CARDIOVERTER-DEFIBRILLATORS

Patients with an implantable cardioverter-defibrillator (ICD) pose a special challenge during exercise training. Since the introduction of ICDs in 1980 for clinical use for patients with cardiac arrest (11), thousands of these devices have been implanted worldwide. The early devices were relatively simple "*shock box*" units capable only of detecting ventricular fibrillation and delivering a high-energy defibrillation shock. Advances in technology and surgical techniques have led to a nonthoracotomy transvenous lead system and the development of smaller generators, which permits implantation into the prepectoral site.

As surgical techniques continue to advance, the technology of the ICD has also evolved. ICDs have become complex multiprogrammable systems capable of a wide range of low- and high-energy shocks, antitachycardia pacing, and backup ventricular pacing for bradyarrhythmias (12). Modern ICDs can be programmed to provide progressive therapy dictated by the rate of the tachyarrhythmia and the failure of the previous therapy ("*tiered*" therapy). Thus, these devices may be programmed to deliver antitachycardia pacing, followed by low-energy shock if unsuccessful, then high-energy shocks if necessary. ICDs now have a means of avoiding delivery of therapy for nonsustained arrhythmias ("*noncommitted*" shocks) with an algorithm that reconfirms the continued presence of a tachyarrhythmia after the device charges but before delivering the therapy (13).

Dual-chamber pacemaker ICDs are now available, and future developments will involve incorporation of rate-adaptation technology. This development would virtually eliminate the problem of adverse interaction between an ICD and pacemaker, as well as improve the specificity of ventricular arrhythmia detection. With the recent introduction of the implantable atrial defibrillator, a combined atrial and ventricular ICD device is conceivable.

Exercise training for a patient with an ICD poses more risk than for the average patient, as such patients are at higher risk for arrhythmia recurrence. However, there are also potential problems with the ICD itself during exercise that may be circumvented with proper precautions. It is imperative that the supervising physician and exercise laboratory personnel know how the ICD is programmed. Especially important is knowledge of the detection interval, that is, the interval in milliseconds or heart rate in beats per minute at which the device recognizes a tachyarrhythmia and delivers therapy. In general, ICDs are capable of recognizing rate, not specific arrhythmia patterns. While there are now programmable features that attempt to improve the specificity of ventricular tachycardia detection, including distinction between regular and irregular tachycardias, as well as evaluation of tachycardia initiation (gradual vs. rapid onset of the rhythm disturbance), these features are imperfect. Therefore, any rhythm that becomes sufficiently rapid to reach and/or exceed the detection interval of the ICD for sufficient duration, including sinus tachycardia, may be recognized as a tachyarrhythmia and treated accordingly. Inappropriate therapies from an ICD are not only uncomfortable for the patient but also may precipitate arrhythmias (14,15).

The risk of the ICD detecting sinus tachycardia during exercise (''*rate crossover*'') is obviously dependent upon the programmed detection interval of the device. It is not unusual for patients with slower ventricular arrhythmias to have a detection interval well within the range of age-predicted maximum heart rate, especially for younger patients. There are several methods of managing the potential for rate crossover, and the appropriate method should be individualized from one patient to another. Consultation with the patient's cardiologist is recommended. One method of avoiding rate crossover is to carefully monitor the heart rate during exercise and terminate the test when the heart rate approaches the detection interval of the device. However, when a maximal stress test is required, this approach may not be suitable for those patients with slower tachycardias and, therefore, slower programmed detection rates. One approach to managing such patients involves inactivation of the ICD with a programmer immediately prior to the test. This method may result in the patient being unprotected from malignant arrhythmias during the period of time the test is conducted. An alternative would be to reprogram the detection interval to a level beyond that expected for sinus tachycardia during exercise. The advantage of this method is the protection from rapid ventricular tachycardia or ventricular fibrillation, but it would not allow detection of slower ventricular tachyarrhythmias that could result in syncope. Both of these methods require the use of specialized programming equipment that may not be readily available.

Perhaps more convenient is the method of temporarily inactivating or *blinding* the device with a magnet during exercise. All ICDs have an internal reed switch that closes when a magnetic field of sufficient strength is applied, most commonly by a standard ring or donut-shaped magnet. The response to this maneuver is somewhat variable between ICD models and manufacturers (16). The magnet can be stored in an easily accessible location and applied only if rate crossover is imminent. Alternatively, the magnet can be secured in place over the ICD with adhesive tape for the duration of exercise (and quickly removed in the event of a ventricular arrhythmia). A note of caution: devices manufactured by Guidant Cardiac Pacemakers, Inc. (St. Paul, MN) are unique in that the application of a magnetic field for a sufficient period of time (30 s) can be used to permanently inactivate the ICD (*turning it off*) without the use of programming equipment.

Patients with ICDs are excellent candidates for exercise rehabilitation programs that have supervision by medical professionals and telemetry monitoring capability, at least until the likelihood of inadvertent defibrillation has been ruled out with sufficient experience (17). The implantation of such a potent device into an individual can have significant psychological ramifications (17,20). These patients may therefore benefit from the group support and socialization during rehabilitation sessions (18,19). Formal group psychotherapy can be offered to those patients who are identified as having significant adjustment problems (18,20). Most patients employed before ICD implantation are able to return to work after the procedure (21).

SUMMARY

Patients with an implantable device such as a pacemaker or ICD add a level of complexity to cardiac rehabilitation. However, a general understanding of how these devices function and a review of the programmed parameters before the exercise test or exercise training program will result in reduced likelihood of complications and more efficient and appropriate action should a complication occur.

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270 Madison Avenue, New York, New York 10016

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Exercise Training in Special Populations: Peripheral Arterial Disease

Mitzi A. Ekers
Clearwater, Florida

Peripheral arterial disease (PAD) is a leading cause of disability in the elderly and has been identified as a significant marker of coronary artery disease (1,2). The incidence of intermittent claudication alone has been estimated at 20 per 1000 men and women 65 years of age and older (3). These numbers can only be expected to increase as the number of elderly persons in the United States continues to rise. Vascular surgery and other revascularization procedures relieve symptoms and save limbs, but do nothing to modify the underlying atherosclerotic disease process. Without aggressive medical management, this systemic disease will markedly increase morbidity and mortality for these patients. Whether treating cardiac patients who coincidentally have PAD, patients whose primary diagnosis is PAD, or patients who have undergone revascularization, a vascular rehabilitation program (VRP) provides the assistance and information they need to improve and maintain optimal vascular health.

ASSESSMENT OF PATIENTS WITH PAD

A comprehensive assessment of the PAD patient entering a rehabilitation program should include the following:

1. Objective hemodynamic evaluation
2. Assessment of intermittent claudication

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3. Cardiac status
4. Exercise capacity
5. Functional status
6. Skin and foot assessment

Hemodynamic Evaluation

An objective assessment of the severity of lower extremity PAD is obtained through noninvasive testing in a vascular laboratory. Use of a Doppler or pulse volume recorder will record segmental systolic pressures, arterial waveform tracings, and the ankle-brachial index. These studies can be repeated at the end of the rehabilitation course, but even though both functional status and exercise capacity may have greatly improved, there may be no significant increase in these hemodynamic measurements.

Intermittent Claudication

Intermittent claudication is relatively easy to differentiate from other sources of leg discomfort in the elderly. For example, arthritis pain occurs in the joint, varies with the weather, and may occur with or without activity. Claudication is pain or extreme fatigue in the muscle that occurs while walking and is relieved by rest. This symptom can be experienced in the hip or thigh muscle but is most commonly felt in the calf muscle. It is a consistent finding, occurring each time the person walks and subsiding after a few minutes of rest. Associated physical findings include diminished or absent pulses, decreased temperature of the extremity, and abnormal color of the extremity, such as pallor if elevated above heart level or rubor when in a dependent position. Mild claudication poses no threat of limb loss and responds well to exercise and aggressive medical therapies to modify atherosclerotic risk factors. If untreated and allowed to progress to the point of interference with daily activities, relief of claudication may require a revascularization procedure.

All patients with claudication must be carefully questioned to determine if they experience the more serious symptom of "rest pain." This burning pain in the toes is particularly severe at night or when the leg is elevated. Patients may get temporary relief if they hang the foot over the side of the bed or sleep in a chair, using gravity to provide more arterial blood to the ischemic toes. Rest pain is a limb-threatening condition requiring consideration for prompt revascularization.

Cardiac Status

Patients with PAD are at three to ten times the risk for *coronary* artery disease (1,2). Many are without cardiac symptoms because their claudication prevents them from walking far enough to become symptomatic. To determine the significance of any cardiac disease prior to beginning exercise training, these patients should undergo a cardiac stress test on a bicycle instead of a treadmill. Alternatively, dipyridimole or thallium testing could be used. If significant myocardial ischemia is detected, the patient may be referred for cardiology consultation and subsequently into the cardiac rehabilitation program instead of a vascular program. Information obtained from the stress test is used to calculate the exercise prescription for either program.

Exercise Capacity

The treadmill is used to evaluate claudication as well as the effectiveness of various modalities used to treat it, such as exercise, revascularization, and medications. In the past, a constant-load treadmill test was performed using a fixed speed and grade. Recent studies have identified several limitations to this technique. Subsequently, two *graded* protocols have been developed for use in evaluating exercise capacity in these patients. The speed is kept constant in both protocols (2 mph) with an initial 0% grade. The Hiatt protocol increases the grade by 3.5% every 3 min (4). The Gardner-Skinner protocol increases the grade by 2.0% every 2 min (5). In both cases, the onset of claudication and the maximum claudication time is recorded. Both protocols have been validated in the PAD population and show improved reproducibility and consistency, accommodation to varied disease severity, and wide patient acceptance.

Functional Status

Documenting the distance a patient can walk on a treadmill does not determine the actual impact of claudication on a patient's ability to perform activities of daily living. The Walking Impairment Questionnaire and the Peripheral Arterial Disease Physical Activity Recall Questionnaire are disease-specific tools to record functional status both at the beginning and completion of the rehabilitation program (7,8).

Skin and Foot Assessment

Because of arterial insufficiency, patients with PAD are at increased risk for injury and wound infections on their feet and legs. Additionally, many patients with PAD are also diabetic and may have decreased sensation in their feet due to neuropathy. Careful assessment of feet prior to beginning the rehabilitation program will identify potential problem areas. Instructing patients on proper fit of shoes and meticulous foot hygiene will help prevent any potentially limb-threatening skin damage.

REHABILITATION STRATEGIES FOR PATIENTS WITH PAD

The cardiac rehabilitation staff will encounter patients with PAD primarily in two ways: (1) by the significant number of their cardiac patients who also have PAD; and (2) by establishing a dedicated vascular rehabilitation program specifically for PAD patients. Regardless of the referral pathway, development of specific vascular protocols will enhance the rehabilitation of both patient populations. Interventions for patients with PAD include a structured exercise program at the rehabilitation center and at home, development of a maintenance program, education and behavior modification techniques, and pharmacological therapies.

Exercise Training in Cardiac Patients with PAD

Cardiac rehabilitation program goals focus on improving cardiac function, usually through aerobic exercise. If the cardiac patient also has PAD, claudication could seriously limit the ability to achieve a therapeutic target heart rate during exercise. When calculating exercise prescriptions for this patient, rehabilitation staff should emphasize equipment that is sparing of calf muscles and limit the time on the treadmill where exercise demands on calf muscles are greatest. However, treadmill exercise should not be eliminated entirely because it will supply some initial training benefit to improve the claudication symptoms. When structured cardiac rehabilitation has been successfully completed and the patient is in a maintenance phase, more concentrated rehabilitation can be directed toward the vascular diagnosis.

Exercise Training in Patients with PAD

If the primary diagnosis is PAD, the emphasis from the beginning of the rehabilitation program is on leg exercise to improve claudication. Exercise prescriptions should include several walks on the treadmill during each rehabilitation session, with scheduled time on other equipment between treadmill walks. This will provide the benefits of continued exercise while allowing claudication pain to subside. While target heart rates are not to be exceeded, it is the patient's leg pain that guides the exercise intensity and duration for the PAD patient. Patients should be instructed to walk to near maximal claudication pain to obtain the greatest training benefits. The greatest benefits are derived from programs that are at least 6 months in length (9). It is also preferable to keep vascular patients together in their own exercise sessions. They tend to identify more with patients with similar diagnoses, symptoms, and experiences. It also may enable the rehabilitation staff to maintain a "vascular" perspective as they help guide the patients during the exercise sessions (10).

Home Exercise and Maintenance Program

All patients with claudication will benefit greatly by walking at home between scheduled visits to the rehabilitation program. They have to begin immediately to make a daily walking program a way of life if they hope to keep the disease in check. Instruct patients to attempt to go for a fitness walk *every day*. If they only strive to walk three or four times a week, because of weather and other schedule conflicts, by the end of the week they may have only walked two or three times, which is inadequate to maintain an improved exercise capacity. Requiring patients to keep a daily walking log that will be reviewed weekly by staff may improve compliance with a home walking regimen (11). This home walking program continues as the maintenance program after the formal rehabilitation program is over.

Education and Behavior Modification

Although separate exercise sessions are recommended for the vascular and cardiac rehabilitation patients, it is acceptable, even desirable, to include both patients in the same educational sessions. The risk factors are the same for both groups and they each have to be aware of the systemic nature of atherosclerosis and the accompanying symptoms. Patients must understand they are at increased risk for stroke. Additionally, cardiac patients have to be cognizant of claudication symptoms and vascular patients must understand their increased risk for cardiac symptoms. Also, since smoking has been cited as the single most controllable risk factor for PAD, extra time and effort should be invested in assisting these patients with their smoking cessation techniques (12,13).

Pharmacological Therapies

Patients with PAD need just as aggressive treatment of their atherosclerotic risk factors as cardiac patients. Lipids have to be lowered, hypertension and blood glucose must be regulated, and nicotine replacement should be used for smoking cessation. Some PAD patients also have thromboembolic conditions that may require monitoring of anticoagulation, antiplatelet medications, and thrombolytic therapy. There has been relatively little success in developing medications that specifically treat claudication. Pentoxifylline (Trental) has been helpful for some patients and Cilostazol, a new drug, shows promising results in clinical trials (14,15). These medications treat the symptom of claudication, not the underlying disease. For this reason they should be used in conjunction with, not in lieu of, an exercise program. If effective, the medication may alleviate symptoms and enable patients to participate in the exercise training that can positively impact the disease process.

CONCLUSION

Patients whose health and independence are threatened by claudication and systemic manifestations of atherosclerosis can benefit greatly from exercise training and comprehensive rehabilitation programs. Whether admitted into a cardiac program or a dedicated vascular rehabilitation program, patients with PAD have different needs than the cardiac patient. Adherence to specific vascular protocols will greatly increase the chances of a successful outcome.

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Exercise Training in Special Populations: Associated Noncardiac Morbidities

Barbara J. Fletcher
University of North Florida, Jacksonville, Florida

Gerald F. Fletcher
Mayo Clinic Jacksonville, Jacksonville, Florida

Physical inactivity is a major risk factor for coronary artery (1) and vascular disease, and properly prescribed exercise training is an important risk factor intervention for both primary and secondary prevention in populations with noncardiac morbidities. Because of the brevity of this chapter, the reader is referred to the recent Pulmonary Rehabilitation Guidelines for extensive data relating to exercise training in this specific noncardiac morbidity (2).

EXERCISE TRAINING AND CEREBRAL VASCULAR ACCIDENTS

Debilitating loss of function after a stroke and the associated elevated energy costs for routine mobility contribute to enhanced immobility in this population. Impaired functional effects include paresis, paralysis, spasticity, and sensory-perceptional dysfunction. These changes may accompany comorbid cardiovascular disease and should be considered when exercising stroke patients (3). Aerobic exercise training in this population is safe (4,5) and reduces energy expenditure and cardiovascular demands of the measured activity (6,7). Limited data suggest that left ventricular ejection fraction improves after upper extremity aerobic train-

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ing (7). Exercise training programs must be uniquely and individually prescribed for each related physical impairment (3,6–8). Evidence also documents that protection from stroke in later life is conferred by exercise patterns in earlier years (9,10).

EXERCISE TRAINING AND MUSCULOSKELETAL DISEASE

Osteoarthritis

Maximal functional capacity decreases with age, is even lower in patients with osteoarthritis (11), and more commonly, knee osteoarthritis (12). Reduction in functional capacity appears secondary to reduced muscle function and improvement in muscle function results in increased functional capacity (11,12). Walking programs have been shown to improve functional capacity in this population (13) as well as programs with a combination of aerobic and resistance exercise (14). In addition to functional capacity, beneficial effects have been noted in pain levels, medication use, and joint mobility (12–14).

Rheumatoid Arthritis

Rheumatoid arthritis is a chronic, progressive, painful disease with long-term comorbidities and accompanying loss of functional capacity (15). Progressive resistance training has been shown to be feasible and safe in selected patients and has resulted in improvements in strength, aerobic exercise endurance, pain, and fatigue (16). Water exercise is ideal in this population and allows the same training effect as land exercise (17).

Neuromuscular Disorders

Slowly progressive neuromuscular disorders are accompanied by poor cardiorespiratory endurance and decreased strength (18). Moderate resistance exercise programs result in improved strength parameters (19) and walking programs have been shown to result in improved functional capacity (18). These programs are well tolerated and safe (18,19). A high resistance offers no benefit over a moderate resistance program and may be harmful to patients with markedly weak muscles (20).

Postpolio Syndromes

Postpolio syndromes occur 20 to 40 years after the acute episode and are generally confined to previously affected muscles. Weakness in the muscles increases over time until use exceeds the narrow margin of reserve and the syndrome becomes clinically apparent (21). The signs and symptoms include new weakness, fatigue, poor endurance, reduced mobility, breathing difficulty, intolerance to cold, and sleep disorders (22). Carefully prescribed strength-training programs provide increased strength and endurance without harmful effects and demonstrate remaining adaptability in previously compensated muscles (23,24). Functional capacity benefits have also been demonstrated with aerobic exercise programs (25).

Osteoporosis

Moderate physical activity in subjects with osteoporosis can reduce risk of falls and fractures, decrease pain, and improve functional capacity and quality of life. There are also limited data suggesting that exercise stimulates "bone gain" and decreases "bone loss" (26,27). These positive effects are an adjunct to other interventions, such as hormonal therapy and proper nutrition (26). Lack of compliance to the exercise program in this population is often noted and enhances the lack of response to treatment (28).

Cervical Disk Disease

Progressive exercises ranging from passive to active should be begun as soon as possible in subjects with cervical disk disease. As soon as active exercises are tolerated without excessive pain, passive exercises should be discontinued. If neck pain becomes chronic, behavioral modification techniques in a multidisciplinary setting are the treatment of choice (29).

EXERCISE TRAINING AND RENAL DISEASE

Chronic Renal Failure

Exercise training has been shown to increase functional capacity without beneficial or harmful effects on the progression of renal disease (30,31). This improvement in exercise indices is mainly due to improved muscular function (32). When erythropoietin is administered during exercise training, a significant correlation is noted between improvement in anemia and exercise capacity (33,34).

End-Stage Renal Disease (ESRD)

Patients on hemodialysis can safely engage in exercise programs at intensities and frequencies resulting in improved functional capacity (35). Fatigue is common in this population and has been shown to be more related to inactivity than to anemia (36). In addition, altered skeletal muscle function adds to the impaired exercise capacity and is a better predictor of exercise capacity than hemoglobin indices (37). Support groups, younger age, and internal loci of control are predictors of adherence to exercise programs in this population (38).

Postrenal Transplantation

Supervised aerobic exercise training is feasible and significantly improves functional capacity in this group. This improvement in functional capacity is most likely related to a combination of improved renal function and hemoglobin concentration together with exercise training (39). Physical strength tends to improve over time after renal transplantation in adults. However, the average elderly person does not gain strength with transplantation alone (40).

EXERCISE TRAINING AND LIVER DISEASE

Hepatitis

Patients should be advised to carefully initiate low-level exercise programs during the acute stage of viral hepatitis. Regular exercise training results in improved functional capacity and earlier return to work (41,42) and should be recognized as an important treatment modality in this group (42).

Cirrhosis

The cardiovascular response to exercise appears normal in the patient with cirrhosis. However, this response appears mediated through supernormal activation of the sympathoadrenergic and renin-angiotensive systems (43). In patients with cirrhosis and portal hypertension, data indicate moderate-to-low intense exercise increases portal pressure and may increase the risk of bleeding, especially in patients with esophageal varices (44).

Obesity and Fatty Liver

The incidence of obese patients with fatty liver has recently increased in the United States, Europe, and Japan (45). Restricted caloric diet and exercise training have been shown to result in improved blood biochemical data and histological findings in liver tissues related to fatty liver, thus hampering the progression from fatty liver to cirrhosis (45).

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SUMMARY

As our population ages, noncardiac morbidity will become more prevalent and confer a greater impact on rehabilitation. Exercise training and its beneficial effects will have an important role in addressing these issues, as highlighted in this chapter.

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Multifactorial Cardiac Rehabilitation: Education, Counseling, and Behavioral Interventions

Erika Sivarajan Froelicher
Schools of Nursing and Medicine, University of California, San Francisco, California

INTRODUCTION

Education, counseling, and behavioral interventions are essential elements of cardiac rehabilitation. We define "education" as systematic instruction, and "counseling" as providing advice, support, and consultation. "Behavioral interventions" refer to systematic instruction in techniques to modify health-related behaviors. Patients with cardiovascular disease have to learn to manage their illness and their symptoms to prevent or retard progression or induce regression of atherosclerosis (1,2). This management focuses on techniques to manage lifestyle changes, guided by health professionals. In the early years of cardiac rehabilitation, approaches to teach patients and families effective health management techniques and health messages were almost entirely based on educational models. More recently, it has been recognized that a combination of principles using educational, counseling, and behavioral intervention strategies are necessary to effect desirable behavioral outcomes (3,4). Chapters 22 to 28 focus on smoking cessation, lipid lowering, management of hypertension, weight management and exercise in the treatment of obesity, and several psychosocial risk factors such as anger/hostility, depression, and social isolation. Stress management is also discussed. Chapters 29 to 32 consider secondary prevention and rehabilitation efforts within a broader context of the patients and their families, as well as their

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work place and community; thus issues relevant to return to work and vocational counseling are discussed. Education for special populations and assessment of quality of life in secondary prevention are also included.

THE ROLE OF EDUCATION

Education is essential, but by itself is insufficient to produce significant behavior changes that result in risk factor reduction. Two comprehensive reviews on the topic of education for cardiac patients have concluded that while such efforts are essential in providing sufficient information for patients and families to make decisions or to increase their knowledge, education alone does not usually result in behavior changes (5,6). In spite of these data, many cardiac rehabilitation programs offer only exercise therapy together with some informal educational content. It is in this realm that one can envision major programmatic advances in the twenty-first century, in that the 1995 Cardiac Rehabilitation Guideline clearly and definitively calls for a combined counseling and behavioral intervention approach (4). Educational approaches that are suitable as the foundation upon which to base the counseling and behavioral interventions have been described by Sivarajan and Newton (3) and by Scalzi and Burke (7). Both of these examples use adult learning principles.

THE ROLE OF COUNSELING

Counseling allows for a rich exchange between the patient and the nurse or other health professional who functions as a consultant to the patient by rendering advice. The advice is usually in response to the patient's questions and concerns about symptoms, medications, exercise, smoking cessation, lipid management, and problems concerning competing demands on the patient's time and other resources. Assisting the patient in active planning and problem solving is the most commonly utilized counseling technique. Counseling takes place in an atmosphere of acceptance and empathy. This type of approach provides the patient with the necessary support that is conducive to developing a trusting relationship.

THE ROLE OF BEHAVIORAL INTERVENTION

Behavioral interventions are critical for behavior change to take place and be sustained. While major progress has been achieved in the fields of research relevant to rehabilitation, almost all studies guiding current practices are based on Caucasian and male populations. Studies of women and ethnic subgroups are practically nonexistent, or represent such a small fraction of any given subgroup as to be noninformative at best. If ethnic or gender differences were to exist in such studies, this mixing of data from a majority group with a series of small numbers of subjects from a variety of ethnic groups would surely result in confounded results. Use of small numbers of mixed groups does not allow for accurate estimates to be made on any group, unless stratified sampling is utilized and sufficient numbers of each ethnic group are enrolled to allow for strata-specific results. The recent mandate by the National Institutes of Health (NIH), which is often followed to the letter, is unlikely to be very useful scientifically because it leads to the aforementioned problem of further confounding of results. A more useful policy would be to designate research dollars specifically to answer the important gender- and ethnic-specific research question. Considerable progress in this area has occurred in the development of behavioral theories to guide the interventions. However, this author supports a careful review of theories that have proven useful in guiding behavioral interventions at least in part, if not totally. It appears that theorists and clinicians often work and live in different worlds. Theorists live in an academic center and clinicians in a hectic clinical environment. Therefore, a closer alignment of theorists with clinicians may yield more promising and clinically useful approaches to guide our science and practice in the future. Several social learning theories appear to have some utility. Examples are Bandura's self-efficacy theoretical work that has been applied to exercise therapy, called exercise self-efficacy (8). Lichtenstein and Condiotte's (9) approach to smoking cessation and nicotine addiction is another example. Examples of the application of this theory are discussed in Chapter 22.

Also important is Cognitive Behavioral Therapy (CBT), a psychological treatment method using behavioral interventions. This method was first described by Aaron Beck (10) and then further advanced by Judy Beck (11) and others. It is a well-recognized and proven interventional approach used by psychologists to treat anxiety, depression, and phobias. Cognitive behavioral therapy has more recently been applied to both depression and social isolation in a national multicenter clinical trial in patients following a myocardial infarction. This trial is in progress in nine centers across the United States, with results still pending. Examples of the application of CBT are found in the chapter on depression and on social isolation. Testing, clarification, and identification of which treatments result in cost-effective outcomes will provide the basis of further clinical advances in the twenty-first century.

CASE MANAGEMENT APPROACHES

Delivery of cardiac rehabilitation services appears to be both efficient and cost effective using case management approaches (2,12). Case management is defined by the American Nurses Association as "a collaborative process which assesses, plans, implements, coordinates, monitors and evaluates the options and services to meet an individual's health needs, using communication and available resources to promote quality, cost-effective outcomes'' (13). Theories in books do not seem to find their way into practice, and when they do they are often not integrated into practice. An example of the most consistent theoretical approach in cardiac rehabilitation research with relevance to practice is self-efficacy theory for exercise. Yet this approach seems so simple, that one fails to see how this theory alone can account for all the factors operating in a behavior change event. The nurse case management intervention incorporates principles of the aforementioned social learning theory combined with addiction models. In social learning theory, self-efficacy, or a person's confidence to undergo change, is viewed as the main determinant of behavior change. Self-efficacy, in turn, is influenced by four main factors: (1) persuasion from an authority; (2) observation of others; (3) successful performance of the behavior; and (4) physiological feedback. The practical application of this theory to successful secondary prevention and rehabilitation has been demonstrated in a number of studies with cardiac patients (2,12). Nurse case management has been used successfully by Sivarajan before the label case manager appeared in the literature (3,14–16).

During the 1990s, the emphasis became the demonstration of cost-effective outcomes. In response to this demand by payers, a number of different approaches to demonstrate cost-effectiveness have emerged (17–19) and a flurry of outcomes research was initiated. This new standard is likely to continue in the twenty-first century. Clearly, cardiac rehabilitation services that include exercise as well as education, counseling, and behavioral interventions have to be closely coordinated with the patient's primary health care providers. Such services will require a planned approach to coordinate, collaborate, and provide continuity of services across the patient's transition from the home to the hospital and back to the home setting.

OTHER ISSUES

Cardiac rehabilitation, in public health language, is tertiary prevention but the services offered by cardiac rehabilitation professionals are equally suited for secondary prevention. Since expectations for secondary and tertiary prevention differ, it is important to maintain clarity with respect to the different program offerings and expectations for outcome. Cardiac rehabilitation is used in many places synonymously with a physical activity and exercise program. This limited approach, while useful, clearly is a disservice to cardiac patients and to the profession. The usefulness of the above-mentioned interventions with special populations will have to be considered when serving people from varied cultural backgrounds and who speak languages other than English. Future research will have to determine if and to what extent the above-mentioned interventions are suitable and desirable to these special populations. The challenge for the next century will be to use the scientific evidence and to develop services that are based on proven principles so that all cardiac patients may benefit from proven therapies.

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Matching the Intensity of Risk Factor Modification with the Hazard for Coronary Disease Events

Valentin Fuster
Mount Sinai Medical Center, New York, New York

Thomas A. Pearson
University of Rochester School of Medicine, Rochester, New York

The management of cardiovascular risk factors is an integral part of the optimal care of the patient with established cardiovascular disease or at high risk for the development of this disease. Improvement of levels of risk factor management will require a coordinated effort by cardiovascular specialists, primary care physicians, and other health professionals such as nurses, nutritionists, hospitals, health care systems, and third-party payors. The cardiovascular specialist is uniquely positioned to provide leadership in risk factor management by virtue of the specialist's role in giving care and advice to those patients with established atherosclerotic disease who are at the very highest risk of disability and death due to these risk factors. The 27th Bethesda Conference of the American College of Cardiology was convened (Table 1) with the specific goal of clarifying the role of the management of risk factors in the care of high-risk patients (Tables 2 and 3) (1). Specifically, the rationale for heightened attention to cigarette smoking, lipid disorders, hypertension, thrombotic diathesis, and other risk factors in the high-risk patient was developed, allowing for specific recommendations for case management and for organizational strategies to assure the optimal provision of these services. At the same time, recommendations about screening and case management in low-risk patients emphasized the need for assessment of cost-effectiveness in patients who may or may not incur benefit from interventions

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Table 1 The 27th Bethesda Conference: Matching the Intensity of Risk Factor Management with the Hazard of Coronary Disease Events

Valentin Fuster, MD, PhD (Conference Co-Chair)
Thomas A. Pearson, MD, PhD (Conference Co-Chair)

Task Force 1 Pathogenesis of Coronary Disease: The Biological Role of Risk Factors Valentin Fuster, M.D., Ph.D. (Chair)	*Task Force 5* Stratification of Patients into High-, Medium-, and Low-Risk Subgroups for Purposes of Risk Factor Management Robert M. Califf, M.D. (Chair)
Task Force 2 Clinical Epidemiology: The Conceptual Basis for Interpreting Risk Factors Curt D. Furberg, M.D., Ph.D. (Chair)	*Task Force 6* Cost-Effectiveness of Assessment and Management of Risk Factors Lee Goldman, M.D. (Chair)
Task Force 3 The Spectrum of Risk Factors for Coronary Heart Disease Richard C. Pasternak, M.D. (Chair)	*Task Force 7* Evaluation and Management of Risk Factors for the Individual Patient H.J.C. Swan, M.D., Ph.D. (Chair)
Task Force 4 Efficacy of Risk Factor for Management James S. Forrester, M.D. (Chair)	*Task Force 8* Organization of Preventive Cardiology Service Thomas A. Pearson, M.D., Ph.D. (Chair)

Source: Ref. 1.

Table 2 The 27th Bethesda Conference: Cardiovascular Risk Factors Responsiveness to Intervention

Category I Risk factors for which interventions are proven to lower risk: cigarette smoking; LDL cholesterol; high fat/cholesterol diet; hypertension; left ventricular hypertrophy.

Category II Risk factors for which interventions are likely to lower risk: diabetes mellitus; physical inactivity; HDL cholesterol; triglycerides (small, dense LDL); obesity; postmenopausal status (women).

Category III Risk factors which, if modified, might lower risk: psychosocial factors; lipoprotein (a); homocysteine; oxidative stress; no alcohol consumption.

Category IV Risk factors which cannot be modified: age; male gender; low socioeconomic status; family history of early-onset CVD.

Source: Ref. 4.

with high cost or sizable risks of management intensity with cardiovascular risk.

Our understanding of the pathophysiology of atherosclerosis and the role of risk factors in this disease process has drastically changed in the last few years (Task Force 1) (2). This understanding should lead to continued advances in control of the disease and its sequelae. However, current evidence from basic and clinical studies provides a strong rationale for the control of risk factors as an essential strategy to normalize endothelial function; halt the progression of coronary atherosclerosis; and prevent the instability, rupture, and thrombosis of atherosclerotic plaques.

Cardiovascular specialists, primary care physicians, and other health care providers must have a firm grasp of the concepts of "risk" and "risk factors" to properly interpret and use evidence linking risk factors and disease (Task Force 2) (3). This evidence supports the development of four risk factor categories based on both observational studies and efficacy studies (clinical trials) (Task Force 3, Table 2) (4). The feasibility and desirability of assessment and treatment of risk factors in each category can then be summarized (Task Force 4) (5). Risk factors that are useful in risk assessment should be measured, and those in categories I and II that are responsive to treatment should be modified as part of an optimal care plan; consideration should also be given to modification of certain factors in category III, when appropriate.

The cardiovascular specialists and primary care physicians are particularly well positioned to stratify patients into high-, medium-, and low-risk subgroups for purposes of risk factor management (Task Force 5) (6). In general, the patient with diagnosed coronary artery disease (e.g., stable angina, prior myocardial infarction, coronary artery bypass surgery, and coronary angioplasty) is at the highest risk for disability and death, in general, and is the patient in which the presence of untreated risk factors is most damaging. However, the cardiovascular specialist is currently able to identify additional high-risk patients before the onset of symptoms; this trend is likely to continue as newer technologies are shown to effectively identify high-risk subgroups. Other individuals may be at high risk by virtue of atherosclerotic disease elsewhere (e.g., stroke, peripheral vascular disease), the combined presence of several risk factors, or extremely elevated levels of single-risk factor. The responsibility of the physician caring for these patients is to match an appropriate level of risk factor management with the level of the patient's risk. Those patients at high risk for disability and death deserve aggressive treatment of their risk factors.

Another benefit of risk stratification is the identification of subgroups in whom risk factor management strategies are likely to be cost effective (Task Force 6) (7). Cardiovascular specialists and primary care physicians should be especially sensitive to results of studies that establish or refute the cost-effectiveness of the interventions they use, understanding the uncertainties that exist in

Table 3 Guide to Comprehensive Risk Reduction for Patients with Coronary and Other Vascular Disease

Risk Intervention	Recommendations				
Smoking: *Goal* complete cessation	Strongly encourage patient and family to stop smoking. Provide counseling, nicotine replacement, and formal cessation programs as appropriate.				
Lipid Management: *Primary Goal* LDL <100 mg/dL	Start AHA Step II Diet in all patients: ≤30% fat, <7% saturated fat, <200 mg/dL cholesterol. Assess fasting lipid profile. In post-MI patients, lipid profile may take 4 to 6 weeks to stabilize. Add drug therapy according to the following guide.				
Secondary Goals: HDL >35 mg/dL; TG <200 mg/dL	LDL <100 mg/dL No drug therapy	LDL 100 to 130 mg/dL Consider adding drug therapy to diet as follows:		LDL >130 mg/dL Add drug therapy to diet as follows:	HDL <35 mg/dL Emphasize weight management and physical activity. Advise smoking cessation. If needed to achieve LDL goals, consider niacin, statin, fibrate.
		Suggested drug therapy			
		TG <200 mg/dL	TG 200 to 400 mg/dL	TG >400 mg/dL	
		Statin	Statin	Statin	
		Resin Niacin	Niacin	Consider combined fibrate, statin	

If LDL goal not achieved, consider combination therapy.

Physical Activity: *Minimum Goal* 30 min 3 to 4 times per week	Assess risk, preferably with exercise test, to guide prescription. Encourage minimum of 30 to 60 min of moderate-intensity activity 3 or 4 times weekly (walking, jogging, cycling, or other aerobic activity) supplemented by an increase in daily lifestyle activities (e.g., walking breaks at work, using stairs, gardening, household work). Maximum benefit 5 to 6 h a week. Advise medically supervised programs for moderate- to high-risk patients.
Weight Management:	Start intensive diet and appropriate physical activity intervention, as outlined above, in patients >120% of ideal weight for height. Particularly emphasize need for weight loss in patients with hypertension, elevated triglycerides, or elevated glucose levels.
Antiplatelet Agents/ Anticoagulants:	Start aspirin 80 to 325 mg/d if not contraindicated. Manage warfarin to international normalized ratio = 2 to 3.5 for post-MI patients not able to take aspirin.
ACE Inhibitors Post-MI:	Start early post-MI in stable high-risk patients [anterior MI, previous MI, Killip class II (S_3 gallop, rales, radiographic CHF)]. Continue indefinitely for all with LV dysfunction (ejection fraction ≤40) or symptoms of failure. Use as needed to manage angina rhythm or blood pressure in all other patients.
Beta-Blockers:	Start in high-risk post-MI patients (arrhythmia, LV dysfunction, inducible ischemia) at 5 to 28 days. Continue 6 months minimum. Observe usual contraindications. Use as needed to manage angina rhythm or blood pressure in all other patients.
Estrogens:	Consider estrogen replacement in all postmenopausal women. Individualize recommendation consistent with other health risks.
Blood Pressure Control: *Goal* ≤140/90 mmHg	Initiate lifestyle modification, individualized to other patient requirements and characteristics (i.e., age, race, need for drugs with specific benefits) if blood pressure is not less than 140 mmHg diastolic in 3 months or if initial blood pressure is >160 mmHg systolic or 100 mmHg diastolic.

ACE = angiotensin-converting enzyme; AHA = American Heart Association; CHF = congestive heart failure; HDL = high-density lipoprotein; LDL = low-density lipoprotein; LV = left ventricular; MI = myocardial infarction; TG = triglycerides.
Source: Ref. 10.

the data, and the impact of future changes on an intervention's cost-effectiveness. In general, the higher the underlying risk of the patient for adverse outcomes and the more powerful the intervention's ability to reduce the risk, the more the intervention can be directed toward high-risk subgroups, the more likely a regimen will be cost-effective. Therefore, interventions in patients at high risk for cardiovascular disease frequently show cost-effectiveness.

These considerations of biological plausibility, risk, efficacy, and cost-effectiveness then guide the cardiovascular specialist in selection of risk factor management strategies. Emphasis is placed on the individualization of the management program to each patient and the requirement for life-long management of risk (Task Force 7) (8). For the patient with coronary or other atherosclerotic disease, a guide to comprehensive risk reduction has been endorsed by the American Heart Association and the American College of Cardiology (Table 3).

Despite the currently available evidence in support of risk factor management, the proportion of high-risk patients receiving appropriate care is alarmingly low. The barriers that preclude this appropriate care include those at the levels of the patient, physician, health care setting, and community/society (Task Force 8) (9). Strategies to overcome these barriers include the development of clinical guidelines for risk factor management; the requirement of expertise in risk factor management that have been shown to be effective, including those utilizing nonphysician professionals; the inclusion of risk factor management as a key indicator of quality of care in quality assurance programs; and the adequate reimbursement of coverage for those risk factor management services shown to be effective.

In conclusion, risk factor management is a cornerstone of that optimal care. A team approach, involving family physicians, general internists, other specialists such as endocrinologists and vascular surgeons, nurses, nutritionists, exercise physiologists, behavioral scientists and cardiovascular specialists, should assure the provision of this care.

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Scientific Basis for Multifactorial Risk Reduction: Overview with Emphasis on National Guidelines

Sanuj K. Ravindran
Jefferson Medical College, Philadelphia, Pennsylvania

Philip Greenland
Northwestern University Medical School, Chicago, Illinois

NATIONAL GUIDELINES FOR MULTIFACTORIAL RISK REDUCTION FOR SECONDARY PREVENTION

Clinical trials demonstrate that patients living with cardiovascular disease may benefit from interventions aimed at cardiovascular risk reduction. The American College of Cardiology (1,2), the American Heart Association (1), and the U.S. Department of Health and Human Services' Agency for Health Care Policy and Research (3) all advocate comprehensive implementation of such multifactorial interventions.

A Consensus Panel of the American Heart Association (AHA) published its *Guide to Comprehensive Risk Reduction for Patients with Coronary and Other Vascular Diseases* in 1995 (1) with four goals: to extend overall survival; to improve quality of life; to decrease the need for intervention procedures such as coronary angioplasty and coronary bypass grafting; and to reduce the incidence of subsequent myocardial infarction. This guide to risk reduction was also endorsed by the American College of Cardiology (ACC) (2). The guide addresses well-established risk factors such as smoking, dyslipidemia, obesity, and hypertension as well as interventions not directly related to specific measurable risk factors (i.e., antiplatelet therapy, ACE-inhibitors, beta-blockers,

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exercise, hormone replacement therapy). The AHA Consensus statement did not specifically address blood glucose control, psychosocial factors, or nutritional factors, but these issues were discussed by the ACC's 27th Bethesda Conference (2).

The Agency for Health Care Policy and Research (AHCPR) issued a Clinical Practice Guideline in 1995 (3), which addresses the role of cardiac rehabilitation for patients with cardiovascular disease. The AHCPR defined cardiac rehabilitation as "comprehensive and long term programs involving medical evaluation, prescribed exercise, cardiac risk factor modification, education, and counseling . . . designed to limit the physiologic and psychological effects of cardiac illness, reduce the risk for sudden death or reinfarction, control cardiac symptoms, stabilize or reverse the atherosclerotic process, and enhance the psychosocial and vocational status of selected patients."

The AHA/ACC guideline and the AHCPR guideline differ in that the AHA/ACC provides specific recommendations with regard to risk factor modification whereas the AHCPR provides broader recommendations with emphasis on exercise, education, counseling, and behavioral interventions. All three organizations, however, recommend a comprehensive approach to the patient with cardiovascular disease and advocate risk reduction as a multifactorial intervention process.

EVIDENCE THAT "RISK FACTORS" CONFER INCREASED RISK FOR RECURRENT EVENTS IN PATIENTS WITH CARDIOVASCULAR DISEASE

Cigarette Smoking

Observational studies in both male and female patients with cardiovascular disease have shown that smoking habits after myocardial infarction (MI) have substantial influence on rates of mortality and recurrent nonfatal events. A report from the Framingham Study showed a 62% reduction in all-cause mortality over 6 years in patients who stopped smoking compared to those who continued smoking after myocardial infarction (4). The Coronary Drug Project reported a 29% higher risk of recurrent nonfatal MI in MI survivors who continued to smoke compared with those who stopped (5). Mulcahy et al. (6) summarized findings from several studies which measured the long-term effects of continued smoking in patients with cardiovascular disease; risks of coronary and total mortality were nearly doubled compared to patients who quit smoking. Based on results such as these, it is widely held that cigarette smoking is a major risk factor for recurrent events in patients with CVD.

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Dyslipidemia

The role of elevated serum cholesterol as a risk factor for subsequent morbidity and mortality in patients with CVD is also established. Mechanisms associated with increased risk can be attributed to elevated LDL-cholesterol concentrations that are associated with endothelial dysfunction, smooth-muscle proliferation, plaque destabilization, and thrombosis (7). The placebo group of men in the Coronary Drug Project (8), followed after myocardial infarction, demonstrated that serum total cholesterol was significantly related to total mortality, coronary mortality, sudden cardiac death, and incidence of nonfatal MI. Pekkanen et al. (9) studied 471 men in the Lipid Research Clinics Prevalence Study who had evidence of any CVD at baseline. Compared to men with desirable LDL-C levels (<130 mg/dL), those with elevated LDL-C (≥160 mg/dL) demonstrated a multivariate-adjusted sixfold increase in 10-year cardiovascular mortality. The Framingham study described a cohort of 260 men and 114 women who had survived myocardial infarction. Individuals who had total cholesterol levels above 275 mg/dL were at increased risk for total mortality [relative risk (RR) = 1.9], coronary mortality [RR = 2.6], and reinfarction [RR = 3.8] compared to those with total cholesterol below 200 mg/dL (10).

A low HDL cholesterol level also confers increased risk in patients with cardiovascular disease. Pekkanen et al. found a multivariate-adjusted relative risk of 6.0 for cardiovascular mortality in patients with cardiovascular disease and low serum HDL cholesterol levels (<35 mg/dL), as compared with those with normal HDL-C (≥45 mg/dL) levels (9). Miller et al. reported similar results (11), even in a cohort of CAD patients with desirable total cholesterol levels.

Hypertension

Blood pressure, as a prognostic marker in patients after myocardial infarction, is somewhat complex. Both lowered blood pressure after a myocardial infarction and hypertensive blood pressures after MI are associated with higher risks for mortality (12,13). In a study addressing blood pressure and survival after myocardial infarction in 193 Framingham cohort men with myocardial infarction history, hypertensive patients who had a substantial decrease in pressure after MI were at twice the risk for mortality when compared with men who remained hypertensive. Furthermore, when excluding those hypertensive patients who experienced a significant (≥10 mmHg) reduction in blood pressure, patients who remained hypertensive after MI experienced a fivefold increase in mortality as compared with normotensive patients (12). Wong et al., also using Framingham data, addressed risk factors for long-term (up to 30-year) prognosis after myocardial infarction in both men (n = 464) and women (n = 233). Elevated systolic and diastolic blood pressures were each significantly predictive of both reinfarction and coronary mortality (13), and as such are important determinants of prognosis in patients with cardiovascular disease.

Diabetes Mellitus

In diabetic men and women aged $\geq$ 65 years with established coronary disease, follow-up data (mean = 12.8 years) from the Coronary Artery Surgery Study (CASS) indicated that diabetes conveyed a 57% increase in death after controlling for other known risk factors (14). Diabetes as a marker for risk in patients with established cardiovascular disease appears to be of greater importance in women than in men. Khaw et al. (15) demonstrated that in women with cardiovascular disease, a personal history of diabetes confers 9-year relative risks for total mortality and cardiovascular mortality on the order of 2.4 and 4.1, respectively, as compared with respective values of 0.8 and 0.9 in men. More recently, from the Israeli SPRINT Study Registry, covariate adjusted relative odds of 1-year mortality after myocardial infarction in diabetic women and men were demonstrated to be 1.67 and 0.96, respectively (16). Thus, at least in diabetic women, and possibly in men as well, diabetes confers increased risk after MI.

Psychosocial Factors

A variety of psychosocial factors are thought to potentiate risk in patients with cardiovascular disease. Frasure-Smith et al. reported that major depression in hospitalized patients following an MI is an independent risk factor for mortality at both 6 and 18 months, the impact of which was approximately equivalent to that of left ventricular dysfunction and history of previous MI (17,18). Studies such as that by Berkman et al. show that one's level of emotional support is an independent risk factor for mortality in the 6-month period following a cardiovascular event in both men and women (19), a factor in this study that increased risk by threefold.

Nonmodifiable Risk Factors

Age and gender are risk factors after onset of CAD. Age is the strongest contributor to risk of subsequent death in the post-MI setting. Many studies also demonstrate that women fare worse after MI than men, and some studies show that female gender is an independent risk factor itself (16).

INTERVENTIONS LOWER RISK: REVIEW OF THE EVIDENCE

Smoking Cessation

Many observational studies have suggested a benefit from smoking cessation after myocardial infarction, in both men and women. For obvious ethical reasons, there have been no randomized controlled trials of smoking cessation after myocardial infarction. One study of 564 males with first myocardial infarction demonstrated that the risk of recurrent disease was reduced by 50% within 1 year of smoking cessation and normalized to that of nonsmokers within 2 years (20). Results from the CASS Registry also demonstrated beneficial effects of smoking cessation in older men and women with cardiovascular disease (21). CASS demonstrated a 42% higher risk of total mortality and a 33% higher risk of myocardial infarction among patients with cardiovascular disease who continued to smoke compared with those who quit. Despite the absence of randomized trials, the observational evidence is compelling that smoking cessation is beneficial in CVD patients.

Lipid Reduction

The most conclusive studies demonstrating the benefits of lipid-lowering therapy are randomized, controlled clinical trials in patients with cardiovascular disease. The Scandinavian Simvastatin Survival Study (4S) (22), a landmark secondary prevention trial, enrolled men and women with established cardiovascular disease and elevated serum lipids. Entry criteria required a baseline total cholesterol level between 5.5 mmol/L and 8.0 mmol/L (201 mg/dL to 309 mg/dL). The study demonstrated significant changes in total cholesterol (−25%), LDL cholesterol (−35%), HDL cholesterol (+8%), and triglycerides (−10%), with marked reductions in total mortality (−30%), coronary mortality (−42%), revascularization procedures (−37%), and hospital days (−34%) in the simvastatin group compared to the placebo group. Subgroup analyses suggested equivalent treatment outcomes in women and men, patients older or younger than 60 years of age, and patients with LDL cholesterol levels in the upper and lower twenty-fifth percentiles.

The Cholesterol and Recurrent Events (CARE) Trial (23) studied effects of lowering cholesterol in men and women after MI with "average" baseline levels. CARE demonstrated significant changes in total cholesterol (−20%), LDL cholesterol (−32%), HDL cholesterol (+5%), and triglycerides (−14%) related to treatment with pravastatin. These changes resulted in a 24% reduction in risk for a fatal coronary event or nonfatal myocardial infarction. Also noted were reductions in CABG (−26%), coronary angioplasty (−23%), and stroke (−31%).

In both CARE and 4S, the aforementioned benefits occurred within 1 to 2 years with no increase in noncardiovascular mortality.

Raising HDL cholesterol and lowering triglycerides may lower risk for recurrent cardiovascular events (24). An HDL cholesterol < 35 mg/dL is a risk factor. Consideration of the HDL cholesterol level is required to assess overall CVD risk. A high HDL cholesterol is considered protective against CAD. Several clinical trials have utilized fibric acid derivatives in secondary prevention of CAD. Fibric acid derivatives generally raise HDL cholesterol, but also affect triglycerides and, in the case of some drugs, also lower fibrinogen. Results of the Veteran's Affairs–HDL-C–Intervention Trial (VA-HIT) and the European BECAIT study (25) suggest that patients with low HDL-C may benefit from drug therapy to raise HDL cholesterol. On the other hand, the Israeli Bezafibrate Infarction Prevention (BIP) study failed to show an overall beneficial effect of bezafibrate in secondary prevention. Thus, while low HDL-C is clearly a marker of CAD risk, drug therapies targeted at raising HDL-C alone for primary prevention remain unproven. Efforts to raise a low HDL-C by smoking cessation, weight control, and aerobic exercise are widely accepted but generally produce only modest effects on HDL. Alcohol consumption in moderation may raise HDL-C, but excessive alcohol ingestion is ill-advised.

Antihypertensive Therapy

Randomized controlled trials utilizing antihypertensive therapies in patients with established cardiovascular disease are limited. Nonetheless, results from primary prevention trials are encouraging; and in the Hypertension Detection and Follow-up Program (26), hypertensive men and women with preexisting heart disease who were randomly assigned to the treatment group benefited by a 20% reduction in total mortality (27). Also encouraging in terms of benefits of antihypertensive therapy is the fact that both beta-blockers and ACE inhibitors confer proven survival benefits in coronary patients and are as such antihypertensive agents of choice in the post-MI setting (28–30).

Diabetes (Glucose) Control

In diabetic patients with cardiovascular disease, prevention of recurrent events should be a primary aim with particular attention paid to women with diabetes. However, there is limited evidence linking strict blood glucose control with a reduction in coronary complications. Nevertheless, glucose control is likely to lower cardiovascular risk given evidence that improved glucose control reduces microvascular complications associated with diabetes mellitus (31). Suggestive evidence of the benefit of intensive diabetes management on macrovascular events and on CVD risk factors in the Diabetes Control and Complications Trial (DCCT) has been published (31). In addition, a recent Swedish trial in diabetics employed insulin-glucose infusions in-hospital after acute MI followed by subcutaneous insulin 4 times daily for ≥3 months after discharge. Mortality was reduced by about 25%, suggesting a benefit related to improved glucose control (32).

Psychosocial Intervention

While trial results are not extensive in the area of psychosocial intervention after MI, a meta-analysis of 11 relatively small controlled trials suggested significant reductions of recurrent events in cardiac patients (men and women) undergoing psychosocial stress interventions, particularly with emphasis on the type A behavior pattern (33). Additionally, a trial of telephone-based stress monitoring and stress reduction in 453 male myocardial infarction patients by Frasure-Smith et al. (34) suggested that this type of nurse-managed program can reduce cardiovascular mortality by as much as 50%. A large cooperative NIH multicenter study is in progress attempting to confirm these results.

INTERVENTIONS PROVEN TO BE BENEFICIAL IN SECONDARY PREVENTION THAT DO NOT ADDRESS SPECIFIC RISK FACTORS

Antithrombotic Therapy

Aspirin as an antiplatelet agent has been proven in several studies to reduce both primary and secondary cardiac events, as well as cardiovascular mortality (35,36). Recent findings postulate that aspirin, also an anti-inflammatory agent, may also act via a second mechanism in the treatment of cardiovascular disease, as inflammation may be important in the pathogenesis of atherothrombosis (37). In the Warfarin on Mortality and Reinfarction (WARIS) Study, warfarin was found to have important beneficial effects after MI, and after 3 years was associated with significant reductions in mortality and recurrent events (38). Warfarin is recommended in secondary prevention of cardiovascular disease only in patients unable to tolerate aspirin as warfarin has not been shown to have effects that are additive to those of aspirin in prevention of recurrent coronary events (39).

Beta-Blockers

Beta-blocker use has been well established over the past 30 years in the treatment of hypertension, angina pectoris, and in the prevention of adverse cardiovascular events in the post-MI period. Beta-blocker trials have been shown to significantly reduce total mortality (−21%), cardiac mortality (−24%), sudden cardiac death (−30%), and reinfarction (−25%) in patients following MI (28,40).

ACE Inhibitors

ACE inhibitors are advised for indefinite use in patients with left ventricular dysfunction after MI (1) and are thought to attenuate ventricular dilatation and remodeling (29). The SAVE study (29) demonstrated that ACE inhibitor therapy reduced total mortality (by 19%), cardiac mortality (lower by 21%), recurrent hospitalizations (lower by 22%), recurrent MIs (lower by 25%), and revascularization procedures (lower by 24%) in asymptomatic patients with CHD. A similar trial (SOLVD) also reported reductions in occurrence of unstable angina, MI, and cardiac mortality in both symptomatic and asymptomatic patients with left ventricular dysfunction (30).

Obesity/Diet/Exercise

Obesity is thought to contribute to cardiovascular risk largely through its effect on other risk factors such as diabetes, insulin resistance, hypertension, and dyslipidemia. In patients with established cardiovascular disease, the role of weight reduction without other risk factor interventions in secondary prevention has not been established. However, a trial by Singh et al. (41) suggested that comprehensive changes with diet rich in fiber and antioxidants in conjunction with weight loss after myocardial infarction may alter lipoprotein levels and reduce morbidity and mortality after 1 year.

Evidence also suggests that diet change in conjunction with exercise may have beneficial effects on the progression of coronary disease. Two controlled trials addressing the management of coronary disease with diet and exercise resulted in significant improvements in atherogenic lipoproteins, myocardial perfusion, and physical work capacity, as well as significantly more atherosclerosis regression and less progression of atherosclerosis (42). A meta-analysis by Oldridge et al. (43) of ten trials concluded that exercise rehabilitation in coronary patients reduces total mortality, cardiac mortality, and incidence of sudden cardiac death.

Hormone Replacement Therapy

Estrogen status is an important and independent diagnostic clinical variable in women with suspected coronary disease and an important prognostic tool in women with established cardiovascular disease (44). In secondary prevention, observational studies have assessed the impact of estrogen replacement therapy on women with CHD, with virtually all showing reductions in risk of mortality on the order of 70 to 90% (24). Plausible mechanisms for risk reduction with estrogen replacement therapy include: (1) increased HDL cholesterol levels and lower LDL cholesterol and fibrinogen levels (45) and (2) an improvement in endothelial function (46). The Heart and Estrogen/progestin Replacement Study (HERS) was a secondary prevention trial of combined estrogen and progestin therapy in CAD patients (47). Despite favorable effects of HRT on LDL-C and HDL-C, the HRT group experienced no overall reduction in recurrent CHD events over an average of 4.1 years. Many questions about hormone replacement therapy remain unanswered following the HERS trial. While HERS data should not be extrapolated beyond the specific therapies used in that study, and in those specific high-risk women, these trial data offer no assurance that hormone replacement regimens will be beneficial in primary prevention settings. In addition, no conclusive data are available on the role of Selective Estrogen Receptor Modulating (SERM) drugs in primary prevention of CHD. At present, advice must continue to be based on careful clinical judgment to guide individual women in the decision to use, or avoid, long-term HRT.

RATIONALE FOR MULTIFACTORIAL INTERVENTION AND CONCLUSIONS

Based on the evidence presented, it is clear that there is strong scientific basis for risk-factor modification in the patient with cardiovascular (especially coronary) disease. However, based on the same body of evidence, it is also clear that single-factor modification alone is incompletely effective. As reviewed, smoking cessation reduces risk of recurrent disease by about 50%. Lipid-lowering therapies reduce risk of total and coronary mortality by about one-quarter to one-third. Beta-blockers reduce risk of total mortality, cardiac mortality, sudden cardiac death, and reinfarction by 20 to 30% in patients with cardiovascular disease. While impressive as single interventions, none of these interventions alone is capable of preventing all or most recurrent events. As discussed, the various CVD risk factors are independent and therefore additive, or multiplicative, when they coexist. In order to achieve maximal risk reduction, all risk factors should be addressed concurrently in the coronary patient. All U.S. Guidelines recommend such a multifactorial approach.

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22

Smoking Cessation and Relapse Prevention: Case Management Approaches

Nancy Houston-Miller
Stanford University School of Medicine, Palo Alto, California

At his 70th birthday speech in 1905, Mark Twain said, ''I have stopped smoking now and then . . . but it was not on principle, it was only to show off. It was to pulverize those critics who said I was a slave to my habits and couldn't break my bonds.'' The plight of Mark Twain is experienced by the millions of Americans who have attempted to quit smoking. While it was hoped in 1990 that the year 2000 would see a smoke-free America, the decrease in smoking prevalence has leveled off among Americans. Between 1990 and 1993, the prevalence of smoking remained stable at 25% after a 25-year decline. Smoking prevalence actually increased over 4 years until 1995 among ninth and tenth graders and over the same 3 years for high-school seniors (1).

The high cost of tobacco-related disability and death summons all healthcare professionals to take an active role in intervening to assess and counsel smokers. This need is especially great among patients with established coronary and vascular disease, whose risk of recurrent infarction and mortality is increased greatly by continued smoking.

The Agency for Health Care Policy and Research (AHCPR) Smoking Cessation Clinical Practice Guideline (2) calls for the application of systematic approaches to smoking cessation in numerous healthcare settings. While many interventions exist to aid smokers in quitting, this chapter emphasizes the success of case management approaches for cessation and relapse prevention. Case management systems significantly increase smoking cessation rates in clinical practice settings (3–5).

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THE AHCPR GUIDELINE: WHAT IS KNOWN?

The AHCPR Guideline on Smoking Cessation (2) published in 1996 provides important information about the success of interventions for smoking cessation based on randomized controlled trials. Based on strength of evidence, the Guideline documents four critically important points:

1. Smoking cessation interventions delivered by multiple types of providers (both medical and nonmedical) triple cessation rates when compared to interventions in which there is no provider.
2. Smoking cessation interventions using counseling sessions of more than 10 min compared to briefer sessions more than double cessation rates.
3. In general, the more prolonged the counseling/treatment, the more effective it is, with a doubling of cessation rates (10.4 vs. 23.8) for treatment lasting 8 weeks or more.
4. Individualized treatment over four to seven sessions appear to be more efficacious than treatments of fewer than four sessions.

The Guideline also supports Kottke's meta-analysis of clinical trials undertaken in the 1970s and early- to mid-1980s (6). Kottke found that smoking cessation was best achieved by sustained reinforcement: increasing the number of therapeutic contacts with the smoker attempting to quit or remain abstinent and increasing the types of contacts and the number of people making the contacts. Thus, multiple healthcare providers making multiple contacts over time using multiple intervention modalities appear to be the most effective clinical strategy to facilitate smoking cessation.

CASE MANAGEMENT APPROACHES: HOW SUCCESSFUL ARE THEY?

The case management approach to smoking cessation entails the use of a healthcare provider to apply individualized interventions to aid the smoker in quitting. Case managers also provide systematic follow-up face to face or by other means such as the telephone or computer. Such approaches have been successful in clinical trials in a variety of settings. Hollis (5) compared the efficacy of physicians advising patients to quit smoking in a large HMO compared to that of assigned physician advice augmented by one of three nurse-assisted interventions. These interventions included (1) self-quitting; (2) referral to group classes; or (3) a combination of self-quit training and referral. All nurse-assisted interventions included videotapes, written materials, and one follow-up telephone call. At 3 and 12 months, the self-report and biochemically confirmed smoking cessation rates were twice as high with these interventions compared to those who received physician advice alone. No differences were noted between the types of smoking interventions provided by the nurse.

Similar approaches have also been used in patients with coronary heart disease. In a randomized controlled trial of 187 post-myocardial infarction patients, Taylor and colleagues (3) found that a case management approach to smoking cessation provided by nurses significantly increased cessation rates over usual care (71% vs. 45%). The interventions for smoking started in-hospital and included 1- to 2-min of strong physician advice delivered at the bedside followed by a 30-min behavioral counseling session provided by nurses, augmented by self-help materials, pharmacological therapy, and nurse-initiated follow-up telephone contacts in the 6 months following hospital discharge. This same intervention was found to be highly effective when applied in a multiple risk factor intervention trial of post-MI patients (7).

Ockene used a similar approach to patients hospitalized for coronary angiography (8). In that study, behavioral counseling provided by health educators at the bedside aided the smokers who used self-help materials. Follow-up included four telephone contacts during the first 4 months after discharge. At the end of 1 year, the biochemically confirmed cessation rate was 35% compared to 28% in usual care (8). Ockene found smokers with more severe coronary artery disease (3 vessel versus 1 vessel) were more likely to respond to the intervention (8). Most recently these same approaches using a single caregiver (nurse or health educator) to apply multiple interventions (behavioral counseling, nicotine replacement therapy, self-help materials) and telephone follow-up (four to five calls) have been shown to be highly successful in facilitating smoking cessation in patients hospitalized with a variety of diagnoses (9,10).

IMPLEMENTING CASE MANAGEMENT

Regardless of the setting (office, worksite, clinic, rehabilitation center, hospital) a systematic approach to the identification and treatment of all smokers may have significant impact on cessation (2). While hospitalization often results in greater long-term success due to enforced cessation and patients' focus on their illness or disease, outpatient case management provided by rehabilitation personnel is also effective. This involves assigning a healthcare professional to provide the following multiple interventions: determine a patient's interest in quitting, apply a motivational interview, direct the patient to strategies for both cessation and/or relapse prevention, and provide responsibility for systematic phone follow-up.

An algorithm for the individualized treatment of patients who are smoking at the time of an initial encounter is shown in Table 1. Patients lie on a continuum of willingness to stop smoking (11). The case manager must be ready to manage

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Table 1 Smoking Cessation Interview: Are You Willing to Quit Smoking Now?

No	Yes
Provide motivational interview	Cessation
strong interview message	Provide strong message/advice (MD)
negative consequences	Determine method for quitting
acute and long-term hazards	Ask patient to self-monitor
potential benefits	
Ask to limit consumption	Relapse Prevention
Protect cardiac status	Identify high-risk situations
Request follow-up	Offer cognitive/behavioral strategies
	Provide counseling
	exercise
	relaxation
	Slips—what to do
	Determine need for pharmacological therapy
	Instruction about: medications
	offer medication sheets
	Follow-up (4 to 7 contacts)

patients along this continuum. A simple question such as ''Are you ready to quit smoking now?'' will reveal the patient's interest in changing his or her behavior. If a patient with cardiovascular or pulmonary disease is opposed to quitting, a ''motivational'' interview can be provided that may enhance his or her future willingness to quit. This motivational interview includes (1) providing a strong message and personalizing the message to the patient's disease state, family, or social situation or characteristics such as health concerns, age, and gender; (2) asking patients to identify the potential negative consequences of smoking; (3) helping them to understand the acute, long-term, and environmental hazards associated with continued smoking; and (4) asking them to identify the potential benefits of quitting smoking. There is also some evidence to suggest that physiological feedback such as the use of spirometry may aid in motivating a patient to quit smoking. The Lung Health Study (12) funded by the National Heart, Lung and Blood Institute, which focused on the early course and prognosis of chronic obstructive pulmonary disease (COPD), showed that patients with early stages of air flow obstruction on spirometry experienced an improvement in air flow after stopping smoking. The study suggested that even patients with normal function or borderline normal lung function benefited from physiological information obtained from spirometry. The risk of future health problems, including premature death, remains high among cardiovascular and pulmonary patients. Case managers may help such patients unwilling to quit by contracting with them to limit the number of cigarettes smoked per day. Finally, such patients with cardiovascular disease who are unwilling to quit should be vigorously treated with prophylactic regimens of antiplatelet agents, beta-blockers, and lipid-lowering agents. Repeating the motivational interview in follow-up may also encourage the patient to think about quitting.

PHYSICIAN ADVICE: A POWERFUL INTERVENTION

Whether a patient is ready to quit or not, physician advice in assisting the case manager is critically important. Why? Numerous randomized trials have shown that physician advice provided in a 2- to 3-min message may significantly impact a patient's smoking behavior (13–15). Moreover, patients state that physicians' interventions significantly influence them (16). Finally, 75% of the adult population visit a physician annually with many patients making as many as 5 visits annually. Most often individuals are focused on their health at the time of a visit and especially during hospitalization, making it easier for them to consider changes in behavior.

Advice to quit smoking should be provided through a strong, unequivocal message to patients. Smokers often tend to deny the hazards of smoking. Specifying the impact of smoking on a specific disease state or indicating a patient's associated risk for the development of a disease often has a powerful impact on the patient. Statements such as, "Quitting smoking now is the most important health advice I can give you," or "You must stop smoking now. Let's figure out how you can do it," give clear, strong messages yet also remain supportive of the patient. Among patients ready to quit, case managers can assume overall responsibility for more intensive counseling and follow-up. For patients not interested in quitting, physicians should further explore the patient's barriers to quitting.

While most physicians believe they have the responsibility to help smokers, studies indicate that only 21% of patients actually receive advice to quit smoking in office settings (17) and only 45% of patients receive such advice during hospitalization (9). Populations more likely to receive physician advice include the elderly, heavier smokers, and those with smoking-related diseases such as cardiovascular and pulmonary disease (17,18). Case management systems that use nurses and others to cue physicians to offer such advice may ensure that a greater proportion of patients receive this information.

PATIENTS READY TO QUIT

Patients motivated to quit smoking will need to be counseled about cessation and/or relapse prevention, depending on the setting. Because hospitalization requires enforced cessation, relapse prevention is the usual focus for a case manager. For

Table 2 Smoking Cessation Methods

Step 1	Help the patient select a quit day normally within 7 days of discussion. Write this date down and sign a contract to support the patient.
Step 2	Select a quitting method. Choose to quit cold turkey or choose to cut down in 3 ways: gradually reduce the number of cigarettes smoked per day reduce the amount of nicotine by switching brands every 3 days to one with less nicotine reduce the amount of each cigarette smoked (half vs. one-quarter vs. 1–2 puffs)
Step 3	Determine the need for pharmacological therapy.
Step 4	Ask the patient to get rid of all cigarettes, butts, matches, and lighters the day before quitting.

patients who have not yet quit smoking, suggested methods for cessation are noted in Table 2.

Like any of the addictive behaviors such as alcohol abuse, gambling, overeating, and smoking, slips or relapses can be common in the early stages of quitting. Marlatt and Gordon (19), in work with addictions, suggest that four steps may be necessary to help individuals deal with slips and the potential relapse back to an old behavior. These include: (1) identifying high-risk situations specific to the patient; (2) conducting skills-building by teaching cognitive and behavioral strategies for managing these high-risk situations; (3) developing global lifestyle strategies such as relaxation and exercise that provide gratification and substitute for the absence of the addiction; and (4) helping patients to undertake behavioral skills if a slip should occur. Marlatt and Gordon (19) suggest that 75% of all high-risk situations reflect negative emotional states such as frustration, anxiety, depression, stress and boredom, interpersonal conflicts in relationships, and social pressure. Situations involving alcohol also may be difficult for ex-smokers. By asking patients to monitor their smoking behavior or complete self-efficacy (confidence) scales rating their capability to resist an urge to smoke in a specific situation, case managers can then help individuals to develop coping strategies for managing these situations. Role playing or rehearsing strategies to overcome these situations increases patients' confidence in their ability to handle high-risk situations. Patients can also be helped by learning new skills that may replace the absence of the addictive substance. Relaxation and exercise serve not only to allow patients to become skilled at a behavior that may be positive for them, but these activities also increase their confidence in their ability to withstand the urge to smoke. Preparing patients for slips or relapses in their behavior can be accomplished by (1) acknowledging that slips may occur; (2) stressing that slips do not represent failure and are not necessarily associated with full-blown relapse to smoking; and (3) recommending that they focus on the situation that caused them to smoke: Where were they? What were they doing?, Why did they smoke? Recommending to patients that they review coping strategies for handling the high-risk situation may serve to help them if they encounter the urge to smoke in the situation again.

SMOKING CESSATION PHARMACOTHERAPY

Cessation rates are often higher when pharmacological interventions and behavioral strategies are combined. The case manager can identify patients who are most likely to benefit from these medications and work with physicians to educate the patients about their proper use. Smoking is well known to precipitate cardiac events by promoting thrombosis, increasing carbon monoxide, thus limiting the delivery of oxygen to the heart, and by the hemodynamic effects of nicotine reflected in an increase in heart rate and blood pressure (20). While agents such as nicotine replacement therapy (nicotine patch or gum) also have some of these properties, they have not been shown to precipitate coronary events in patients with CHD (21,22). In fact, in a recent study of CHD patients who continued to smoke and use transdermal nicotine patches (14–21 mg), no increase in myocardial ischemia was noted by quantitative thallium scintigraphy (23). Physicians must weigh the risks of patients' continued smoking against the risks of nicotine replacement therapy. While gum and patch are both efficacious, the patch is generally preferable due to the sustained systemic release of nicotine. Individuals who have failed the patch, experience a severe skin reaction, or who prefer the oral stimulation may prefer the use of nicotine gum. Other products such as nicotine spray may also be helpful to some patients. There has been little research on the benefits of nicotine replacement therapies such as the patch in lighter smokers (≤15 cigarettes/day). However, highly addicted patients who find it difficult to refrain from smoking in areas where smoking is not permitted or those who smoke immediately upon waking, may benefit from these agents.

Another pharmacological agent that may help to ease withdrawal symptoms and the urge to smoke is an antidepressant Buproprion SR (Wellbutrin SR and Zyban). Buproprion SR appears to facilitate smoking cessation by affecting the neurochemical pathways including norepinephrine and/or dopamine. Whether it is more effective than the nicotine patch is not known. Its clinical effectiveness for smoking cessation has been shown in both depressed and nondepressed individuals. Its effectiveness, however, in large clinical trials of patients with coronary heart disease has not yet been studied. The usual dose is 300 mg daily. Side effect include insomnia, dry mouth, dizziness, and runny nose. Like the patch, Buproprion has been suggested as an aid to help smokers quit during the first 8 weeks of cessation.

CONCLUSION

Some of the highest cessation rates are noted in patients who were smoking prior to a cardiovascular event, yet relapse rates continue to be at 30 to 40% soon after hospitalization (2,9). While physician advice offers some benefit, case management approaches using other health care professionals such as nurses provide patients with the additional support and follow-up needed to ensure success. Such systems are highly cost-effective (23) and can be developed in a wide variety of settings. The National Committee for Quality Assurance recognized the importance of ensuring the delivery of smoking cessation counseling by incorporating a measure into the HEDIS (Health Plan Employer Data Information Study) 3.0 series. Managed care organizations seeking to meet the outcomes of HEDIS may benefit from considering a case management approach to smoking cessation.

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Lipid Lowering for Coronary Risk Reduction

Joan M. Fair
Stanford University School of Medicine, Palo Alto, California

INTRODUCTION

Lipids are essential for a normally functioning body. Cholesterol is necessary for cell wall formation and is a precursor for the formation of steroids and bile acids, while triglycerides are the body's major energy source (1). However, lipid and lipoprotein abnormalities are also firmly linked to the development of coronary heart disease (CHD). Research studies conducted over the last 40 years have consistently demonstrated that high levels of blood cholesterol are associated with both the development and the progression of CHD. In a recent primary prevention trial, lowering cholesterol resulted in a 29% decrease in coronary events and 33% reduction in coronary deaths (2). Benefit was also evident in the AFCAPS/TexCAPS primary prevention trial. Numerous secondary prevention studies have shown that lowering blood cholesterol reduces angiographic progression of CHD, and results in a 25 to 41% decrease in coronary event rates (3) and a 27 to 54% reduction in coronary and all-cause mortality (4). In the past decade, much has also been learned about the cellular and biological effects of elevated cholesterol. High blood cholesterol alters the normal vasodilator responses of the endothelium, resulting in inappropriate vasoconstriction, enhanced platelet adhesion, and increased cell growth and proliferation (5). These cellular effects result in increased cardiac symptoms such as angina, increased plaque growth, plaque rupture, and catastrophic coronary events. The increased knowledge about the effects of elevated blood cholesterol levels has led to the conclusion that blood cholesterol is a primary and modifiable coronary risk factor.

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BLOOD LIPIDS: AN OVERVIEW

Total cholesterol is composed of 18 different cholesterol particles (6). The most common particles are defined by their density and include: very-low-density lipoprotein (VLDL) cholesterol, a triglyceride-rich particle; low-density lipoproteins (LDL) cholesterol, a cholesterol-rich particle; and high-density lipoproteins (HDL) cholesterol, a protein-rich particle involved in the reverse transport of cholesterol (1). When blood lipids are measured, commonly only total cholesterol (TC), triglycerides (TG), and HDL cholesterol are measured and LDL cholesterol is calculated using the following formula (7): LDL-C = TC − (TG ÷5) − HDL-C. This formula provides a reasonable estimate of LDL if TG levels are less than 400 mg/dL.

IDEAL LIPID LEVELS

In 1988, a national consensus conference led to publication of recommendations on the detection, evaluation, and treatment of high blood cholesterol in adults. These recommendations were revised in 1993 (8) and are briefly summarized here. Consideration for lipid-lowering is based on both on CHD risk factor status and on lipid levels. In individuals free of CHD, a nonfasting cholesterol level of $<$200 mg/dL and an HDL $\geq$35 mg/dL is considered desirable, a cholesterol level of 201–239 is considered borderline high, and $\geq$240 mg/dL is defined as high blood cholesterol. In individuals with CHD, an LDL of $\leq$100 mg/dL is desirable. For individuals at high risk for CHD (those with 2 or more risk factors), an LDL level of $<$130 mg/dL is considered desirable, 130–159 mg/dL is considered borderline high, and $>$160 is considered high.

SCOPE OF THE PROBLEM

It is currently estimated that more than 97 million U.S. adults (50%) have cholesterol levels exceeding 200 mg/dL (9). About 36% of American children have cholesterol levels over 170 mg/dL, a level considered comparable to adult levels of 200 mg/dL. Since the publication of the NCEP guidelines, the proportion of the population with cholesterol levels above 240 mg/dL (high blood cholesterol levels) has decreased from 26 to 20% (9), demonstrating the effect of public awareness and changes in diet and exercise habits, as well as pharmacotherapy. While such evidence is encouraging, it is estimated that 29% of all Americans are candidates for lipid-lowering dietary therapy and as many as 7% (12.7 million) would be candidates for lipid-lowering drug therapy (10). When lipid lowering is examined among those with established CHD, studies estimate that

33 to 48% of coronary patients meet the NCEP goal of an LDL cholesterol of <100 mg/dL (11,12). Goal achievement was highest in cardiac rehabilitation patients and considerably lower in other CHD samples such as postangioplasty patients. In view of the vast numbers of individuals requiring lipid lowering and of the convincing evidence of benefits of lowering cholesterol, improving blood lipid profiles must be a major focus of the cardiac rehabilitation practitioner. The remainder of this chapter will focus on the issues and challenges related to lipid-lowering.

ACHIEVING LIPID LOWERING

One of the common approaches used in lipid management involves a behavioral approach focusing on the knowledge, skills, and behaviors needed to produce lipid-lowering (13). Such an approach includes awareness, education, and individual recommendations for risk reduction, dietary and drug therapies. Specific goals are identified, the benefits and barriers are considered, a plan of action is agreed upon and routinely evaluated and modified. A schematic representation of this approach for lipid lowering is shown in Figure 1.

Awareness and education about cholesterol have had an impact on the public as witnessed by the observed decline in cholesterol levels occurring over the last decade (10). Cardiac rehabilitation practitioners can heighten that awareness by providing their clients with written reports that compare their individual profiles to ideal levels. A personal review of these reports often provides an opportunity for further education and awareness. For example, patients with onset of

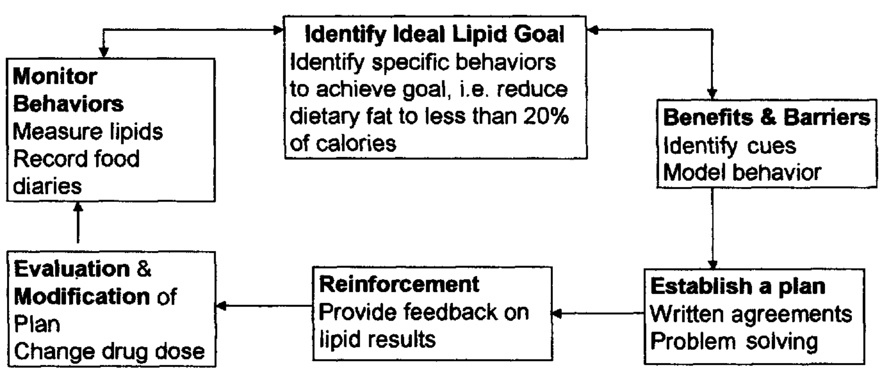

Figure 1 Behavioral approach to lipid management.

CHD at a young age and with a strongly positive family history for CHD should be asked about their awareness of their siblings' or children's cholesterol. Testing of these individuals may be appropriate.

DIETARY INTERVENTIONS

Individual recommendations for lipid lowering always include dietary interventions. The goal of dietary therapy is to reduce LDL-C to desirable levels while maintaining a healthy eating pattern. Current NCEP guidelines suggest a step approach, first reducing saturated fat intake to 8 to 10% of total calories, total fat intake to 30% of calories or less, and dietary cholesterol to 300 mg/day or less (8). Surveys of current food patterns find that the U.S. population has lowered fat intake from approximately 40% of calories to 33% of calories (14). Most persons with CHD have already made dietary changes consistent with a Step I diet. Therefore, it is likely that most patients will require a Step II diet with further reductions in saturated fat to 7% of calories or less, total fat to 20% of calories or less, and dietary cholesterol to 200 mg or less. In general, dietary change will lower LDL-C by 10 to 20%; however, lipid changes in response to diet are variable and reflect both the specific fatty acid diet composition and the level of blood cholesterol. Diets with even more stringent fat restriction have been advocated; however, few individuals are sufficiently motivated to maintain these diets for a lifetime.

Determining the best lipid-lowering diet remains controversial (15). At issue is the type of fat (e.g., the benefits of polyunsaturated versus monounsaturated fatty acids, and the amount and type of carbohydrate that is added to the diet when fat is reduced). Obesity has increased over the last several decades, and some attribute this to the increased dietary carbohydrate intake associated with dietary fat reduction. As noted by Connor (15), the increase in fat-free foods has offered the consumer more sugar; in fact, intake of sugar and refined sweeteners has increased from 120 lb per person in 1970 to 150 lb per person in 1995. Hence, dietary recommendations must emphasize not only fat reduction but increased intake of complex carbohydrates such as fruits, vegetables, and whole grains.

DIETARY STRATEGIES

While food choices are unlimited, most persons eat a fairly limited set of foods on a regular basis. Food preferences and regular food patterns can be readily determined by recording food intake. Several tools are readily available to collect such information, ranging from food diaries to food frequency questionnaires. A simple 1-day food diary recording the type and quantity of all food items consumed can be used to identify high-fat food sources as well as patterns and preferences of eating. Lifestyle factors such as the frequency of travel, restaurant eating, and who usually prepares the food should be considered as these factors may represent barriers to behavioral change. After monitoring food behaviors, this information can be used to set specific dietary goals. Goals should be established by the patient with advice from the practitioner. For example, an achievable goal might be eliminating meat from breakfast meals or cutting meat portions by one-third. The food diary can be used to teach specific skills, such as label reading to identify fat grams. Individuals can be instructed to count fat grams and to score their own food diaries. With every behavioral approach, it is important to teach skills and to model behaviors. Cardiac rehabilitation programs often have social functions that are excellent opportunities to model behaviors, particularly if clients are involved in the planning and organization of such events. Likewise, feedback and continued evaluation are essential for long-term maintenance of change. Since blood lipid response to diet is variable, feedback and reinforcement of dietary behaviors should not be linked specifically to LDL-C levels but rather to change in dietary behaviors or food record analyses.

IMPROVEMENT IN OTHER CHD RISK FACTORS

Other risk factors associated with CHD also influence lipids. Obesity, for example, is associated with increased CHD risk. Weight loss generally results in lipid lowering, particularly of triglycerides; however, reductions in LDL-C and HDL-C are also observed (16). Weight loss is more easily accomplished when diet is combined with a regular exercise program and exercise training. Grundy notes that a 10-kg weight gain can be explained by an energy discrepancy of 300 calories/day, so that a combination of caloric restriction or exercise expenditure can eliminate such weight gains (17). Exercise training is associated with favorable increases in HDL-C levels (18) and cessation of cigarette smoking may also result in 10 to 30% increase in HDL-C (19). Taken together, improvements in these coronary risk factors can favorably alter the lipid profile and should be incorporated into an overall lipid-lowering program.

DRUG TREATMENT FOR LIPID LOWERING

Drug therapy should be considered if dietary therapy fails to achieve LDL-C goals. Drug therapy should be initiated if CHD is present or risk factor status is sufficiently high that it is unlikely that dietary and lifestyle changes will result in the desired LDL-C goal. While drug therapy is effective at lowering blood lipid levels, there are potential side effects and economic costs associated with their use. The choice of drug should consider the individual's lipid profile as well as pertinent medical history, such as the presence of liver disease, diabetes, peptic ulcer disease, gout, as well as concomitant medications.

Approved lipid-lowering drugs are listed in Table 1. Bile acid resins and statins are the major drugs used to treat hypercholesterolemia (8). While these drugs are relatively effective in lowering LDL-C, their side effects and tolerability differ considerably. Bile acid resins are considered very safe drugs because they act only in the gastrointestinal tract and are not systemically absorbed. Adverse side effects include gastrointestinal effects of heartburn, gas, bloating, and constipation. Constipation can be limited by increasing fiber and fluid intake. Resins must be mixed with liquids and due to their insoluble nature form a gritty solution that some consider unpalatable (20). Chilling the mixture and using juices as mixing agents can be helpful. Bile acid resins are most effective when taken with meals and, due to their binding nature, other medications should be taken at least 1 h before or 4 h after taking bile acid resins. Successful resin use requires careful instruction and support by the health care team to ensure long-term compliance.

The statins are also very effective in treating hypercholesterolemia and can be used in combination with nicotinic acid or gemfibrozil to treat combined hyperlipidemias. The statins have been available for over 10 years and recent very large clinical trials (2,4) have shown that these agents are remarkably well tolerated and safe. Side effects include mild gastrointestinal complaints and headaches. Asymptomatic increases in liver enzyme elevations occur in 1 to 2% of users and resolve with discontinuation of the drug (20). Myopathies (muscle soreness) with associated elevations of creatine kinase (CK) and rhabdomyolysis are rare, occurring in less than 0.5% of users. The incidence is increased when statins are used in combination with niacin, gemfibrozil, or erythromycin and are the highest in combination with immunosuppressant therapies (20). Patients should be instructed to immediately report myopathy symptoms and to stop the drug. Liver function and CK blood samples should be drawn to confirm the diagnosis of myopathy. Since statins are generally most effective when taken in the evening, the timing of medications should be reviewed.

Nicotinic acid (niacin) is a vitamin B_3 derivative that can be used to treat a variety of lipid disorders, particularly those associated with high triglycerides and low HDL levels. Niacin is the only lipid-lowering drug reported to lower lipoprotein (a) (21), and to alter LDL particles toward a larger, less dense, and less atherogenic particle (22). Despite the favorable lipid effects associated with niacin, most patients require considerable monitoring to adapt to the drug side effects. The most common side effect is flushing, particularly of the face and trunk, which can be minimized by use of an aspirin taken about 30 min prior to the dose and by taking niacin with meals. Other side effects include abdominal distress, elevations in glucose, uric acid, and liver enzymes, reversible liver toxicity, and the potentiation of atrial arrhythmias (20). All of these side effects can

Table 1 Lipid-Lowering Drug Therapies: Summary of Effects

Drug	Usual Daily Dose	Mechanism of Action	Expected Lipid Lowering % Change			Indications for Use
			LDL	TG	HDL	
Bile acid resins (BAR)		Increases use of hepatic LDL stores to replace excreted intestinal bile acids.	↓15–25%	↑0–10%	↑3–5%	Hypercholesterolemia (↑TC and LDL with normal TG and HDL)
Cholestyramine	4–14 g					
Colestipol	5–20 g					
Nicotinic acid	1.5–3 g	Decreased hepatic synthesis of VLDL resulting in decrease LDL-C. Decrease Lp(a).	Dose-dependent ↓10–25%	↓20–50%	↑15–35%	Hypercholesterolemia Combined hyperlipidemia (↑TC and TG) Hypertriglyceridemia (↑TG) Low HDL
HMG CoA reductase Inhibitors (Statins)		Inhibits the rate-limiting enzyme for cholesterol synthesis. Stimulates increased LDL receptor activity.	↓20–40%	10–20%	↑5–15%	Hypercholesterolemia Combined hyperlipidemia (elevated TC and TG) in combination with niacin or fibrates Low HDL in combination with niacin
Lovastatin (Mevacor)	10–80 mg					
Pravastatin (Pravacol)	10–40 mg					
Simvastatin (Zocor)	5–40 mg					
Fluvastatin (Lescol)	20–80 mg					
Atorvastatin (Lipitor)	10–80 mg					
Cerivastatin (Baycol)	0.1–0.3 mg					
Fibric acid		Enhance clearance of VLDL and TGs. Increases lipoprotein lipase activity.	↓10–15% if normal TGs but LDL may ↑ if TGs high	↓20–50%	↑10–20%	Hypertriglyceridemia
Clofibrate	500 mg q.i.d.					
Gemfibrozil (Lopid)	600 mg b.i.d.					
Fenofibrate	200–400 mg					
Estrogen replacement therapy	0.625 mg conjugated equine	Not fully elucidated.	↓15–20%	↑0–25%	↑5–20%	In women with ↑TC or LDL or with isolated low HDL

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be minimized by starting with low doses and increasing the dose slowly. For example, start with 100 mg t.i.d. for 2 weeks, then increase to 200 mg t.i.d. for 2 weeks until a dose of 500 mg t.i.d. is reached. At this point, serum liver function and lipid effects should be measured and the dose increased if needed. Full discussion of the side effects, written dosing instructions, and follow-up telephone calls help guide the patient through this phase. If niacin is stopped for more than a few days, the patient may have to restart the drug at a lower dose and increase slowly. Patients should be instructed to report symptoms indicative of hepatic toxicity (i.e., nausea, fatigue, and muscle aching). If liver enzymes are elevated, temporary discontinuation and reduction in dosage may be necessary. In addition, diabetic patients using niacin need careful monitoring. Once patients are titrated to an effective dose, side effects seem to occur only intermittently. With the support of a health care provider, niacin users can achieve very effective lipid improvements.

Fibrates are less effective for lowering LDL-C and therefore not considered a first line of drug therapy (8). Gemfibrozil is used to treat combined hyperlipidemia, usually in combination with the above agents. Side effects include mild gastrointestinal distress, headaches, skin rash, and myositis.

Estrogen replacement therapy (ERT) exerts beneficial effects on lipid profiles in postmenopausal women, lowering LDL-C and raising HDL-C (23). Since triglycerides are also increased, ERT should be used cautiously in those with already elevated triglyceride levels. ERT is associated with increased endometrial hyperplasia, and increased risks for uterine and breast cancer. In women with an intact uterus, concurrent use of progestin diminishes the risk of uterine cancer (24). Since hormone replacement therapy is frequently prescribed to counteract menopausal symptoms and to prevent osteoporosis, the lipid effects are a decided plus for women with lipid disorders. Women using ERT often need education and counseling about the side effects associated with estrogen use and reminders to obtain routine mammograms and pelvic examinations to ensure safety.

OTHER NONTRADITIONAL LIPID-LOWERING THERAPIES

Just as physicians explore new drugs for lipid lowering, the public has long been interested in a variety of nondrug modalities to lower cholesterol. Some of these have been scientifically studied, but most have not. Omega-3 fatty acids found in fish and fish oils have been suggested to have cardioprotective effects. They appear to decrease triglycerides, and exert antithrombotic effects (25). Because of the limited lipid effects and safety related to consumption of fish oil supplements, most researchers agree that inclusion of fish in the diet is the most prudent approach. Studies have shown that oxidative modification of LDL-C increases its atherogenic potential and that antioxidants may inhibit this effect. Supplementation with antioxidant vitamins (A, C, and E) has been investigated. Studies indicate that vitamins E and C are associated with a decrease in coronary events; however beta-carotene (vitamin A) has shown conflicting results (26). Current recommendations are that vitamin E at 800–1200 mg/day and vitamin C at 1000 mg/day can be used as adjuncts to other lipid-lowering therapies. Garlic supplementation has also been used to lower cholesterol. Studies suggest that garlic or garlic powder equivalent of less than one clove may reduce cholesterol about 10%. Phytoestrogens, or plant estrogens (found in soy products), are also receiving attention and are currently being studied. While scientific evidence about the nontraditional therapies is being gathered, most practitioners emphasize that supplementation does not replace a diet rich in fruits and vegetables, the natural sources of antioxidants, and should currently be considered only as adjuncts to traditional therapies. Frequently patients believe they know more about these therapies than the practitioner and it can be an effective educational tool to explore the scientific evidence together with the patient.

ISSUES OF COMPLIANCE TO LIPID-LOWERING THERAPIES

Compliance with lipid-lowering interventions, like other lifestyle interventions, is problematic. It is estimated that after 1 year about one-third of patients adhere to dietary interventions and 50% of patients have stopped taking lipid-lowering medications (27). Reasons for poor compliance have not been well studied; however, limited data suggest that major reasons relate to the complexity of the regimen, side effects, and compatibility with the patients' lifestyle and routines (28). Minor factors include the knowledge about CHD and its treatment, attitudes about drug treatment, and the satisfaction with provider–patient relationship. Strategies to improve poor compliance include developing a strong patient–provider relationship, a foundation for providing education, and examining attitudes and experiences with lipid-lowering interventions. It is important to explore how diet and lipid-lowering drugs fit into the patient's everyday routine and what happens when routines change. One of the most common reports from patients is that they "forget" their medication when traveling. Open-ended questions can be used to explore this issue; for example, "do you usually remember to take your medications when you travel?" or "What prevents you from taking your medication when you travel?" Asking about potential travel and problem-solving prior to travel can be helpful to enhance both medication and dietary compliance. Compliance is a problem that waxes and wanes with life and life events. The most effective strategy to improve compliance that can be used by every cardiac rehabilitation practitioner is continued attention to the issue and positive reinforcement for every success.

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Management of Hypertension

Martha N. Hill
Johns Hopkins University School of Nursing, Baltimore, Maryland

INTRODUCTION AND BACKGROUND

The management of hypertension, commonly referred to as high blood pressure, is an important component of multifactorial cardiac rehabilitation. The level of risk associated with hypertension varies with gender, race, and age. It is also influenced substantially by other coexisting risk factors and comorbidity (1–5).

The clear benefits of pharmacologically treating hypertension in reducing rates of stroke, congestive heart failure, and renal failure were demonstrated 30 years ago (6,7). Subsequently, large multisite clinical trials, such as The Hypertension Detection and Follow-up Program (8), The Multiple Risk Factor Intervention Trial (9), the Systolic Hypertension in the Elderly Program (10), and the Trial of Mild Hypertension Study (11), demonstrated the benefits of blood pressure lowering by educational-behavioral nonpharmacological and pharmacological interventions delivered by multidisciplinary teams in clinic and community settings. The efficacy of nonpharmacological interventions in reducing coronary events in hypertensive patients is not as well established as is the benefit of pharmacological treatment (4). Well-designed studies of weight management and nutritional interventions have documented modest reductions in blood pressure in people with stage 1 hypertension or high normal levels of blood pressure (12,13). National consensus guidelines stress treatment to goal blood pressure with individualization of therapy. Table 1 presents the JNC VI treatment algorithm, which begins with lifestyle modification and progresses to pharmacological therapy. Although trends in the awareness, treatment, and control of high blood pressure increased impressively from 1976 to 1989 and 1988 to 1991, more recent infor-

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Table 1 Algorithm for the Treatment of Hypertension

Begin or Continue Lifestyle Modifications

↓

Not at Goal Blood Pressure (<140/90 mmHg)
Lower goals for patients with diabetes or renal disease

↓

Initial Drug Choices[a]

Uncomplicated Hypertension[b]	*Compelling Indications*[b]
Diuretics	*Diabetes mellitus (type 1) with proteinuria*
Beta-blockers	*ACE inhibitors*
	Heart failure
Specific Indications for the Following Drugs	ACE inhibitors
	Diuretics
ACE inhibitors	Isolated systolic hypertension (older persons)
Angiotensin II receptor blockers	Diuretics preferred
Alpha-blockers	Long-acting dihydropyridine calcium antagonists
Alpha-beta-blockers	
Beta-blockers	Myocardial infarction
Calcium antagonists	Beta-blockers (non-ISA)
Diuretics	ACE inhibitors (with systolic dysfunction)

Start with a low dose of a long-acting once-daily drug, and titrate dose.
Low-dose combinations may be appropriate.

↓

Not at Goal Blood Pressure

No response or troublesome side effects	Inadequate response but well tolerated
↓	↓
Substitute another drug from a different class.	Add a second agent from a different class (diuretic if not already used).
↓	↓

Not at Goal Blood Pressure

↓

Continue adding agents from other classes.
Consider referral to a hypertension specialist.

[a] Unless contraindicated. ACE indicates angiotensin converting enzyme; ISA, intrinsic sympathomimetic activity.
[b] Based on randomized controlled trials.
Source: Ref. 5.

Table 2 Trends in Awareness, Treatment, and Control of High Blood Pressure in Adults: United States, 1976–1994

	NHANES II (1976–80)	NHANES III (Phase 1) 1988–91	NHANES III (Phase 2) 1991–94
Awareness	51%	73%	68.4%
Treatment	31%	55%	53.6%
Control[a]	10%	29%	27.4%

Data are for adults age 18 to 74 years with SBP of 140 mmHg or greater, DBP of 90 mmHg or greater, or taking antihypertensive medication.
[a] SBP below 140 mmHg and DBP below 90 mmHg.
Source: Ref. 14 and unpublished NHANES III, phase 2, data provided by the Centers for Disease Control and Prevention, National Center for Health Statistics, and calculated by National Heart, Lung and Blood Institute Staff, 1997, and Ref. 5.

mation presented in Table 2 indicates that improvements have slowed and rates of desired outcomes are declining (5,14).

This chapter presents strategies for improving care and control of hypertension in the cardiac rehabilitation setting through education, counseling, and behavioral interventions to meet carefully considered goals. Strategies are also presented to address the adherence challenge in order to maximize patient benefit by reducing risk and improving health outcomes (15).

CRITICAL PATIENT BEHAVIORS

Recommendations for patient behaviors essential for control of hypertension and guidelines for professionals to help patients with these behaviors were published in 1979 and updated in 1997 (16). The multidisciplinary group of authors reviewed the knowledge, attitudes and skills patients need to control their hypertension and identified the following critical patient behaviors: (1) decision to control blood pressure; (2) follow recommendations for lifestyle and medication; (3) monitor progress toward blood pressure goal; and (4) resolve problems that block achieving blood pressure control.

It is important to consider the exact behaviors the patient must be able to carry out if the goal blood pressure level is to be achieved and maintained over time. Fundamentally, patients must enter and remain in care and follow treatment recommendations. Knowing how to make and reschedule appointments and other essential aspects of navigating the health care system are important. Patients also have to interact successfully with their employer to arrange for time off from work to keep appointments and manage paperwork related to health insurance. Retired, unemployed, and disabled patients have to learn how to interact with other insurance and health care systems. Moreover, in their everyday lives at home and in their community, patients must manage their hypertension with lifestyle and medication, adapting to eating in restaurants, exercising while traveling, and appropriately taking medication on changing schedules while working swing shifts.

CRITICAL PROVIDER BEHAVIORS

Providers can apply numerous effective patient education strategies to enhance the prevention, monitoring, and resolution of adherence problems (17). These interventions are grouped into the following behaviors in Table 3: educate about condition and treatment; individualize the regimen; provide reinforcement; promote social support; and collaborate with other professionals (18).

Educate About Condition and Treatment

Patient knowledge about hypertension has been shown to be necessary but insufficient for successful management of hypertension. It is important to consider the difference between what a patient has to know, what is nice for a patient to know, and what a patient would like to know. Patients vary in their interest in the epidemiology, genetics, pathophysiology, and pharmacokinetics of hypertension. Education should begin when, and with what, the patient is ready to learn and the urgency of patient behavior to lower the blood pressure to prevent and treat target organ damage.

The core content for patient education about hypertension is readily identified: What is hypertension; how is it measured; what is normal blood pressure; what is white coat hypertension; what causes hypertension; why it is important to treat it; and what can be done to control it?

Many patients do not realize that the terms high blood pressure and hypertension are synonymous. Prevalent myths and folk beliefs about hypertension directly influence how patients behave. African American women in New Orleans, for example, held two folk beliefs about hypertension, each with its own causal model (''high blood'' and ''high-pertension''), pathophysiology and course, and appropriate treatment (19). Patients' understanding of hypertension and effective treatment have to be elicited and, if necessary, reframed so that inaccurate perceptions and attitudes do not lead to behaviors that interfere with hypertension care and control.

Few patients have been told why and how the person measuring blood pressure interacts with a stethoscope, arm cuff, and manometer. Showing a patient how to feel their radial pulse and listen to Korotkoff sounds can help patients appreciate the basic physiological process that is being measured. The use of a

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Table 3 Provider Behaviors to Prevent, Monitor, and Address Problems of Adherence

Educate about conditions and treatment:
- Assess patient's understanding and acceptance of the diagnosis and expectations of being in care.
- Discuss patient's concerns and clarify misunderstandings.
- Inform patient of blood pressure level.
- Agree with patient on a goal blood pressure.
- Inform patient about recommended treatment and provide specific written information.
- Elicit concerns and questions and provide opportunities for patient to state specific behaviors to carry out treatment recommendations.
- Emphasize need to continue treatment, that patient cannot tell if blood pressure is elevated, and that control does not mean cure.

Individualize the regimen:
- Include patient in decision making.
- Simplify the regimen.
- Incorporate treatment into patient's daily lifestyle.
- Set, with the patient, realistic short-term objectives for specific components of the treatment plan.
- Encourge discussion of side effects and concerns.
- Encourage self-monitoring.
- Minimize cost of therapy.
- Indicate you will ask about adherence at next visit.
- When weight loss is established as a treatment goal, discourage quick weight loss regimens, fasting, or unscientific methods, since these are associated with weight cycling which may increase cardiovascular morbidity and mortality.

Provide reinforcement:
- Provide feedback regarding blood pressure level.
- Ask about behaviors to achieve blood pressure control.
- Give positive feedback for behavioral and blood pressure improvement.
- Hold exit interviews to clarify regimen.
- Make appointment for next visit before patient leaves the office.
- Use appointment reminders and contact patients to confirm appointments.
- Schedule more frequent visits to counsel nonadherent patients.
- Contact and follow up patients who missed appointments.
- Consider clinician–patient contracts.

Promote social support:
- Educate family members to be part of the blood pressure control process and provide daily reinforcement.
- Suggest small group activities to enhance mutual support and motivation.

Collaborate with other professionals:
- Draw upon complementary skills and knowledge of nurses, pharmacists, dietitians, optometrists, dentists, and physician assistants.
- Refer patients for more intensive counseling.

Source: Ref. 19.

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double-headed stethoscope greatly facilitates teaching patients how to accurately note their systolic and diastolic readings. Patients can become advocates for the accurate measurement of their blood pressure if they know and understand the need for rest, silence, and positioning.

Many people are confused by the terms normal blood pressure, controlled blood pressure, high normal blood pressure, labile blood pressure, white coat hypertension, and isolated systolic hypertension. A glossary of terms can be shared with patients to clarify understanding (20). Understanding these terms helps patients realize the natural variability of blood pressure and the use of controlled blood pressure as a surrogate objective. The importance of setting a goal blood pressure (<140/90 mmHg) and monitoring progress toward the goal cannot be overemphasized. Patients should participate in the decisions about what the goal should be and the interventions to achieve the goal. Patients have to know their blood pressure levels to monitor their progress toward goal blood pressures. Informed patients can follow the pattern of the ranges within which their systolic and diastolic pressures usually fall and how congruent their readings are with goal levels. In addition to knowing their systolic and diastolic pressures, patients can also monitor their pulse pressure, which has been shown to be a strong predictor of coronary heart disease death (21). Reducing pulse pressure becomes another management objective and a clinical indicator with which to document reduced risk for morbidity and mortality.

Patient knowledge about the basic mechanism of elevated blood pressure placing stress and strain on the heart and blood vessels with resulting damage to end or target organs, such as the brain, eye, and kidney, is important. Patients can appreciate the distinction between modifiable and nonmodifiable risk factors. The inability to change one's age, race, gender, and family history is readily understood. The need to attend to modifiable risk factors contributing to hypertension such as overweight, even in small amounts, and alcohol and sodium intake merits great attention in providing a rationale to patients for lifestyle changes. Understanding the relationship between effective therapies and prevention of complications is important if misconceptions and myths are to be minimized or eliminated as confounding factors blocking adherence and blood pressure control. It is essential that patients realize that a great deal can be done to lower blood pressure and, with their active involvement, target organ damage can thereby be prevented, delayed, or minimized.

The fundamental importance of lifestyle changes such as reducing weight if appropriate, reducing sodium and alcohol intake, exercising moderately and regularly, and eating sufficient potassium and calcium has to be communicated to patients. The recent Dietary Approaches to Stop Hypertension (DASH) study demonstrated the beneficial effects on blood pressure of a diet with low-fat dairy products in addition to enhanced fiber, fruits, and vegetables (13). Diet also should be individualized, depending on the patient's weight and sensitivity to sodium.

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The physical activity plan should be developed as part of the rehabilitation program's individualized prescription. The contribution of physical activity to weight control and the importance of maintaining goal weight as a hypertension control intervention *cannot be overemphasized*. It probably is never too late or too little to begin. Improved health benefits such as decreased insulin resistance have been demonstrated after a week of walking or stationary bicycling, for example, even though body weight did not change (22). Several guidelines exist to guide the healthcare professional in physical activity counseling (23,24).

The topic of antihypertensive medication deserves a great deal of emphasis. Patients have to know that it may be necessary to try several antihypertensive medications, alone or in combination and at different dosages, before an effective, well-tolerated, and affordable regimen is found. They have to understand the importance of taking medication as advised and be clear about medication instructions. Patients can be told that although almost all medications have side effects, fewer than 10 to 15% of people on antihypertensive medications, and as few as 2 to 3% on many new medications, experience side effects. Nonetheless, patients should be encouraged to report their concerns about medications, including any possible adverse effects, so that any side effects, perceived or actual, can be addressed. Strategies to address problems with medications include lowering the dose, changing the time of administration, and adding or substituting another medication. Patients have to know the importance of not abruptly stopping or restarting a medication for safety reasons because of potentially serious, but rare, effects. They have to know the answers to the following questions (25):

1. What is the name of the medication and what does it do?
2. How much of the medication should I take, when, and for how long?
3. What food, drinks, other medication, or activities should I avoid while taking this medication?
4. What are the possible side effects and what should I do if they occur?
5. What written information is available about this medication?

Individualize the Regimen

Before antihypertensive treatment is initiated, it is important to consider each patient as an individual and to encourage as much participation in goal setting and decision making as possible. Although there are numerous generic behaviors all hypertensive patients must carry out, such as making and rescheduling appointments, dietary modification, weight control, and taking medication, how these behaviors are carried out within the context of a patient's daily life requires individualization of the regimen. Simplifying the medication regimen is a critical component of successful hypertension management. Adjusting the regimen to minimize complexity, side effects, and cost, and to take advantage of healthful habits is essential. While specific knowledge about physical activity, diet, and the medication regimen must be learned, emphasis should be placed on patients' skills and behaviors that contribute to hypertension control.

The use of antihypertensive medications in special populations requires an understanding of many complex factors (5). Based on clinical trial data, diuretics are the first-choice agents in African Americans. Calcium antagonists and alpha-beta blockers are also effective. In the patient with coexisting cardiovascular disease, special indications include beta-blockers for angina or after myocardial infarction and ACE inhibitors for left ventricular systolic dysfunction.

Provide Reinforcement

Giving feedback at every opportunity on progress toward or maintenance of goal blood pressure is an effective form of reinforcement. Self-monitoring of blood pressure and weight helps engage patients actively in the management of their hypertension. Patients can be given advice on what equipment to purchase and where to find it and guidance on how and when to measure blood pressure, as well as what to do with the information. Staff or patients can plot blood pressure readings on a graphic chart that provides a visual representation of progress toward goal levels. Readings can also be recorded on a wallet card or health passport. Cuing pill taking to established daily habits is strongly recommended. Suggestions such as keeping medication bottles between the tooth brush and tooth paste or by a razor can help patients remember to take their medication. Having a nonjudgmental attitude, for example, about missed doses, makes it easier for patients to admit problems with adherence. Saying "Most people have difficulty remembering to take their blood pressure medication. How much difficulty do you have? How many times did you miss in the past week?" encourages patients to avoid socially desirable responses. Prompting responses with common reasons patients do not take medication, such as forgetting to get prescriptions refilled or concern about real or potential side effects, may give the patient permission to reply. Anticipated or actual impotence is experienced by some men, although rates are much lower with newer antihypertensive agents. Although some patients report effects of their medication that have not been observed in clinical trials, for example, acne, if a patient believes the drug causes the sign or symptom, the provider should openly discuss whether the patient will take the medication or whether another agent should be tried. An additional issue related to medication nonadherence is patients' reactions to controversial news media reports of adverse effects of medications such as increased deaths due to short-acting calcium channel blockers. Patients should be encouraged to express any concerns they have about their medications and know that these concerns will be handled in a responsive, nonjudgmental, supportive manner.

Promote Social Support

Patients can receive helpful emotional and tangible support from family members and friends. Some patients appreciate reminders about taking medication, refilling prescriptions, and keeping appointments. Other patients do not appreciate such assistance. When patients know what is helpful and arrange for assistance from family and friends, adherence improves. Patients who communicate well with providers have their questions answered and receive guidance that also improves adherence and subsequent blood pressure control. Use of the telephone, FAX, e-mail, or mail can increase communication and help with monitoring, feedback, and problem solving (26). Of course, staff and other participants in the rehabilitation program can provide encouragement, advice, and serve as role models on an individual as well as a group basis.

Collaborate with Other Professionals

Cardiac rehabilitation staff are well positioned to communicate with other providers involved with the management of patients' hypertension. Successful collaboration among providers in different settings requires criteria for setting treatment goals and mechanisms to coordinate interventions and progress toward agreed-upon goals (26). Rehabilitation program staff should know the patient's primary care provider and pharmacist, and their cardiologist or hypertension specialist and nutritionist if they have one. The skills and expertise of these health professionals can be called upon as necessary. Guidelines for protecting a patient's privacy and respecting their right to confidentiality have to be developed and shared with patients.

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Weight Management and Exercise in the Treatment of Obesity

Anne M. Dattilo
Hawthorne Internal Medicine, Athens, Georgia

INTRODUCTION

Despite recent attention to health risks associated with excess weight, the prevalence of obesity in the United States continues to increase. Specifically, during the past decade the prevalence of overweight increased by approximately 8%, resulting in one-third of all adult Americans being obese (1). In addition, obesity is documented in approximately 40% (2) of the 12 million people with coronary artery disease (CAD) (3).

Obesity increases the risk of death and numerous chronic diseases. Thus, it appears logical to recommend weight loss to overweight patients with CAD or those at risk for its development. However, intense research interest has focused on evidence, albeit far from conclusive, that there may be physical and psychological risks associated with dieting, weight loss, and the often resulting regain (4–7). Although weight reduction programs have been largely ineffective in producing lasting weight loss, Wadden (8) and the National Weight Control Registry (9) indicate long-term maintenance of weight loss does occur for some people.

Although few studies, particularly long-term investigations, have examined obesity interventions for patients with CAD, there appear to be no differences in outcomes for obese people with CAD compared to other at-risk obese individuals that participate in obesity treatment (2,10,11). Effective obesity intervention has yet to be demonstrated in a prospective, randomized, long-term study. However, in a recent systematic review of 97 randomized controlled trials evaluating the effectiveness of interventions for the treatment of obesity and maintenance

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of weight loss, Glenny and colleagues (12) concluded that several potentially effective obesity treatments do exist. Unfortunately, rigor associated with many of these interventions was low. Thus, there is a need to reexamine promising interventions using rigorous research methods to provide further insight into effective obesity treatment.

The aim of this chapter is to provide information relative to the following questions:

1. Should we treat obesity with goals of weight loss, or is the avoidance of further weight gain sufficient for health?
2. What are benefits of modest weight reduction with regard to cardiovascular disease (CVD) risk factors?
3. What is the relative influence of exercise and diet therapy in the control of body weight?

SHOULD WE TREAT OBESITY?

Due to the apparent lack of long-term success of weight reduction programs, and potential physiological and psychological risks of conventional treatment, weight management, rather than weight loss, has been advocated for obesity by the American Dietetic Association (ADA). Weight management is defined by the ADA (Ref. 13, p. 71) ''as the adoption of healthful and sustainable eating and exercise behaviors indicated for reduced disease risk and improved feelings of energy and well being.'' According to the ADA, goals of any weight management program should include a gradual adoption of at least 30 min daily physical activity, and a healthful nonrestrictive approach to eating. The focus of weight management is to achieve and maintain good health by stopping weight gain, achieving and maintaining a stable weight, and/or reducing health risks.

After reviewing 26 years of follow-up data from the Framingham study, Kannel and colleagues (14) concluded that each standard deviation increment in weight was associated with a 15 and 22% increase in cardiovascular events in men and women, respectively. Thus, weight management to avoid weight gain is imperative to reduce cardiovascular disease, particularly in nonobese patients with CAD.

It has been argued that weight stability appears to be a reasonable goal for *anyone* (emphasis added) with a body mass index (BMI) $<30.0\ kg/m^2$ (4). However, a BMI ≤ 22.6 and ≤ 21.1 for nonsmoking men and women, respectively, is optimal for lowest coronary heart disease (CHD) morbidity and mortality (14–17). Furthermore, if these BMI were achieved, there would be an estimated 25% less CHD and 35% fewer episodes of cardiac failure or stroke (14). Therefore, is it truly in the best interest of overweight individuals, particularly those with CAD, to promote weight maintenance rather than weight loss?

Weight normalization rarely occurs with obesity treatment, even in elaborately designed multifaceted programs. Brownell (18) concluded that if a "cure from obesity is defined as reduction to ideal weight and maintenance of that weight for 5 years, a person is more likely to recover from most forms of cancer than from obesity." Fortunately, reduction to ideal weight is not necessary to ameliorate most obesity-related diseases (19). Modest, realistic, obtainable, and acceptable weight loss occurs if patients achieve a weight loss of 5 to 15% of their initial weight (20). The maintenance of such loss results in a clinically significant change and should become an initial goal for treatment success.

BENEFITS OF MODEST WEIGHT REDUCTION

After combining results of 70 studies on almost 1300 individuals through meta-analysis, Dattilo and Kris-Etherton (21) concluded that modest weight loss is clearly associated with a reduction in CVD risk factors. For every 10 pounds of excess weight lost, total cholesterol is reduced by approximately 9.0 mg/dL, LDL-C is decreased by 4.0 mg/dL, and HDL-C is increased by 2.0 mg/dL. In addition, sustained weight loss of approximately 10% of initial weight is associated with significant metabolic improvements in lipid profiles, glycemic control, and insulin sensitivity for overweight type II diabetics (22). Moreover, sustained weight loss of 5 to 10% improves lipid oxidizability status (23) thus potentially decreasing endothelial injury and atherosclerotic lesions. Finally, blood pressure, lipoprotein (a) in individuals with elevated baseline value, hemostatic factor VII, and plasminogen activator inhibitor also decrease with modest weight loss (23). Considering the effect of weight loss on atherogenic risk factors, weight loss of 5 to 10% appears efficacious in decreasing CVD risk.

INFLUENCE OF EXERCISE ON BODY WEIGHT

As presented in other chapters, benefits of exercise training in obese patients with CAD are numerous. Some studies report a significant decrease in body weight by exercise without concomitant dietary modification (24); however, exercise alone is generally associated with relatively limited changes in body weight and body composition in obese individuals (25,26). The failure of exercise alone to treat obesity may be due, in part, to the inability of many obese people to maintain an exercise intensity level necessary to produce significant weight loss (27).

After reviewing two meta-analyses and several other studies on formal exercise training without significant dietary changes, Wilmore (26) concluded that

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over the course of 1 year an individual would experience a 7.0-pound loss of body mass, 5.8% relative fat loss, and 4.4-pound increase in fat-free mass (FFM) with exercise. Even though the type, duration, and intensity of the exercise was not provided in his summary, weight loss of the aforementioned magnitude is unlikely to provide a 5 to 10% reduction in weight.

In contrast to exercise as a therapeutic agent to obtain weight loss, exercise is beneficial in maintaining reduced body weight once weight loss has been achieved (24,28). Explanations as to why exercise is a strong predictor of success in maintaining weight loss have not been clearly formulated. In addition to the energy cost of exercise, conservation of lean tissue and increases in fat-free mass (29) potentially minimizing the decrement in metabolic activity that occurs after weight loss (30) have been observed. Furthermore, postexercise oxygen consumption, although generally minor (31), increased adipose tissue lipolysis and fat oxidation, enhanced dietary compliance (32), and decreased binge eating (33) are associated with regular exercise and contribute to our understanding of the relationship between exercise and weight maintenance.

Individuals successful at long-term maintenance of weight loss report expending approximately 2800 kcal per week through physical exercise (9). In a recent study of obese women with newly obtained weight loss, Schoeller and colleagues (34) calculated a threshold for caloric expenditure through exercise associated with weight maintenance. They concluded that an average of 35 min of vigorous activity or 80 min of moderate activity added daily to a sedentary lifestyle is needed to maintain weight loss.

Public health recommendations for weight management advocate at least 30 min of physical activity daily (13), or a weekly caloric expenditure of 2100 kcal (35). Since different exercises influence fuel metabolism in different ways, a program of high-intensity exercise followed by low-intensity exercise results in a greater reduction in weight and fat than continuous exercise of low or medium intensity that involves expending the same number of calories (36). In addition, weight loss, and compliance with exercise, appears to be slightly greater in subjects that perform multiple 10-min sessions of exercise daily compared to those that exercise for one session of 20 to 40 min (37).

INFLUENCE OF DIET THERAPY ON BODY WEIGHT

Dietary restriction appears to induce faster and more substantial rates of weight loss than exercise (24,38). However, resting metabolic rate (RMR) declines after caloric restriction, primarily from a loss of fat-free mass. In most studies, exercise added to a calorie-restricted diet does not attenuate the drop in RMR (24). Therefore, it should follow that exercise added to a calorie-restricted diet will not change FFM. However, investigations assessing the conservation of lean tissue with the addition of exercise to a reduced calorie diet report inconsistent conclusions (39,40).

Weight reduction through dietary methods decreases adipocyte lipolysis and fat oxidation, which may predispose reduced-obese individuals to weight regain. The addition of exercise to hypocaloric dieting has been shown to partially counteract the decline in fat oxidation (41,42) and potentially enhance weight maintenance.

The best diet for a safe and acceptable weight loss, recently recommended by Blackburn (43), is an ad libitum, low-fat, portion-controlled, high-fiber diet with healthy meal and snack replacement foods. However, ad libitum, by definition, means ''to the desire.'' Thus, portion-controlled and ad libitum are incompatible.

Results from studies that describe weight loss from ad libitum, low-fat diets should be reviewed with caution. Although it has been reported that weight loss occurs when individuals consume a low-fat, otherwise unrestricted diet (44), the caloric deficit may actually be the responsible factor rather than some unique property of the fat or its metabolism (45). Some studies described as ''ad libitum, reduced fat'' instruct subjects to also restrict calories by 500 per day (38). Others (46) report an unintentional caloric deficit of 400 per day when a low-fat diet without calorie restriction is consumed. Therefore, it is difficult to determine if fat consumption or total caloric intake is responsible for weight loss when an ad libitum, reduced-fat diet is followed.

Reduced fat diets may attenuate FFM loss and encourage more body fat loss than isocaloric diets high in fat (47) and are consistent with National Cholesterol Education Program Guidelines (48). However, when only fat is restricted, it is essential to provide realistic weight loss expectations to patients. For an individual consuming 2225 kcal with 37% calories from fat (91 g fat), a reduction in fat to 30% of calories (74 g fat), with carbohydrate and protein consumption remaining constant, would create a daily energy deficit of 153 kcal. Although this approach may be effective for weight maintenance, it is not likely to provide much enthusiasm for individuals with medically necessary weight loss goals. To be effective as a treatment for weight reduction, a reduced fat diet can be augmented by reduction in other macronutrients as well (49) to provide a larger energy deficit.

Since 3500 calories is the approximate equivalence of 1 pound of weight, a calorie deficit of 500 per day from baseline allows 1 pound weight loss per week. Self-reported food records have been the foundation for determining baseline caloric intake; however, obese patients substantially misreport their food intake. Differences between actual intake and self-reported caloric intakes have been >1000 kcal per day, even when subjects are thoroughly instructed on how to maintain dietary records (50).

Given the problems with self-reported food intake, and lack of accessibility to sophisticated energy balance equipment in most clinical settings, using estimated energy expenditure as a surrogate for daily baseline caloric intake seems reasonable. Of the numerous predictive equations, the Committee on Dietary Allowances (51) chose to use (11.6 m × kgbw) + 879 to calculate basal metabolic rate (BMR) for males aged 30 to 60 years, and (8.7 m × kgbw) + 829 to estimate BMR for females aged 30 to 60 years. To estimate energy expended during physical activity, the committee (51) clustered various activities according to intensity and effort under the categories of light through heavy. Once a category is established for the overall activity level of an individual, the activity factor is multiplied by the BMR to estimate total energy needs. Blackburn (43) identified an activity factor of 1.2 as sedentary (sitting), a factor of 1.5 as mild activity level (activities of healthy daily living), and a factor of 1.7 for moderate activity (30 min of strenuous exercise or 60 min of brisk walking). Thus, total energy expenditure for an obese 185-pound woman who generally engages in mild activity is estimated at 2341 kcal per day.

All too often patients are prescribed unrealistic calorie level diets. Perhaps this explains, in part, the lack of long-term success with traditional diets. A diet prescription of 1200 kcal per day for the aforementioned hypothetical woman would reduce her habitual energy intake by 50% and provide her with <80% calories required for her BMR. For long-term compliance, this degree of caloric restriction appears excessively restrictive and likely to be associated with failure. In contrast, subtracting 500 kcal per day, to encourage 1-pound weight loss per week, renders a caloric recommendation at approximately 1800 kcal per day. Restricting calories from fat to 20 to 30% allows for a generous allowance of 40 to 60 g per day.

Data are lacking to compare outcomes of dietary programs with moderate versus severe dietary restrictions. However, when overweight men were instructed to reduce daily intake by approximately 500 kcal, adhere to a low-fat intake (22 to 25% of calories), and hold activity constant, at 1-year follow-up, subjects reduced body weight by an average of 7.2 ± 0.9% (13.9 pounds) (38). Unfortunately, 40% of this weight loss was lean tissue. It would be interesting to observe the effect of adding a moderate exercise program to this moderate dietary program.

CONCLUSION

Obesity is often associated with CAD. If the definition of successful weight reduction changes from achieving desirable or ideal body weight to one that is associated with reducing comorbidity and disease risk, then even weight loss of 5 to 10% of initial body weight represents success. In light of evidence that

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modest weight loss may decrease CVD risk factors, it seems worthwhile and responsible for clinicians to assist obese individuals in their weight loss efforts, rather than encourage them to ''manage'' their current weight.

The best way to achieve a modest weight loss has yet to be identified. Exercise programs aimed at weight loss must generate a large energy expenditure and are thus largely ineffective. Modest dietary change, whether it be solely a reduction in fat, or reduction in all macronutrients appear to be more effective at initially reducing excess body weight than exercise. However, even modest dietary change may result in unacceptable levels of FFM loss. For long-term maintenance of reduced body weight, exercise is beneficial. A limited number of studies describing the energy cost from exercise for weight maintenance indicated that moderate-to-high levels of physical activity are necessary.

After applying standardized equations to predict habitual caloric intake, individual assessment of a realistic caloric deficit and reduction in dietary fat is recommended. The addition of exercise, which increases energy expenditure, fat oxidation, and potentially prevents loss of lean tissue, seems a logical adjunct to diet therapy for the treatment of obesity.

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Psychosocial Risk Factors: Overview, Assessment, and Intervention for Anger and Hostility

Wayne M. Sotile
Wake Forest University Cardiac Rehabilitation Program and Sotile Psychological Associates, Winston-Salem, North Carolina

A burgeoning body of research has focused on the health consequences of hostility. Generally considered the coronary-prone component of the global type A behavior pattern (TYABP), hostility is an emotion that is fueled by a set of negative attitudes, beliefs, and appraisals through which others are viewed as frequent and likely sources of mistreatment, frustration, and provocation (1). The construct of hostility encompasses three distinct factors: anger—an unpleasant emotion ranging in intensity from irritation to rage; aggression—overt behavior, typically defined as attacking, destructive, or hurtful actions; and/or cynicism—the attitude of skeptical distrust of others and the wish to inflict harm on them (1). This chapter offers a brief overview of cogent issues in the clinical assessment and management of patients who evidence elevated levels of hostility and anger.

THE PHENOMENOLOGY OF HIGH HOSTILITY

Several facts about the phenomenology of high hostility set the stage for identifying treatment targets. Individuals with high hostility levels assessed by the Cook-Medley Hostility Scale from the Minnesota Multiphasic Personality Inventory have been found to evidence exaggerated sympathetically mediated physiological reactivity when angered and diminished parasympathetic functioning (2). Episodes of expressed anger increase the risk of myocardial infarction onset (3).

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Anger suppression, on the other hand, has been shown to contribute to the development of hypertension (4) and to mortality in the presence of hypertension (5). High hostility may also contribute to generally poor health habits, such as increased consumption of caffeine, nicotine, alcohol, and calories, and to more frequent high-risk behaviors such as driving while intoxicated (2). The highly hostile also tend to create taxing interpersonal environments, then suffer pronounced physiological reactivity during conflictual interactions (6). Finally, Williams (2) proposed that both hostility and its health-damaging biobehavioral characteristics could result from reduced brain serotonin levels.

TREATMENT IMPLICATIONS

Existing literature generally lacks controlled comparative studies of the various strategies commonly used in clinical practice to treat hostility. However, a wealth of observational and clinical data can help structure clinical interventions. For example, while it remains for future controlled studies to determine whether increased serotonin can help anger management, the use of pharmacological agents that enhance serotonin is gaining increasing attention in clinical practice.

Typically, anger and hostility treatment programs combine various interventions that are modifications of treatment protocols for TYABP. In prior writing, I described one such model for managing the physiological/cognitive/behavioral/relationship processes that comprise a patient's coping style (7). Nine strategies for structuring interventions can be gleaned from this and other models.

1. Start by challenging patients to disrupt maladaptive coping progressions by learning to implement new steps in their typically reactant progression of coping ''dominoes.'' Emphasize that the treatment goal is to help the individual to more thoughtfully assess situations and choose more carefully from an expanded range of coping options.

2. Convey an understanding of the positive, adaptive aspects of anger. Solicit the patient's personal underlying beliefs about anger and what role it plays in his or her life. Here, typical responses include statements such as: ''My anger helps guard me from being mistreated by the incompetence of others.'' Or, ''My anger is how I motivate myself to do things I don't want to do or that I fear doing.'' Making such beliefs conscious can facilitate the patient's ability to examine alternative coping methods.

3. Educate patients regarding the physical risks of mismanaged hostility. Emphasize that hostility increases cortisol, elevates lipid levels in plasma, and heightens overall physiological reactivity, and that unchecked flurries of aggressive behavior or cynical thinking create prolonged episodes of cardiovascular and neuroendocine reactivity (8). Offer compassion about the fact that the physiological arousal that accompanies anger can be ''addictive'' (9). Soothe the individual's shame or self-criticism regarding temper outbursts with a brief explanation of the physiology of hostile reactivity (10). Emphasize that the goal is to learn to lower baseline levels of stress, to realistically anticipate high-arousal situations, and to build in mechanisms for disrupting bouts of anger or aggressive behavior. Emphasize the fact that regular aerobic exercise and relaxation training can reduce physical and emotional arousal and bolster parasympathetic calming reactions in acutely stressful situations (9).

4. *Promote cognitive changes*. Here, the goal is to increase awareness of the personal beliefs that promote hostility. Prescribe journaling of thoughts to point out hypercritical world views; cynicism; distrust; suspiciousness; attributions of malevolence by others; and hypercritical generalizations about groups (such as other races or certain professions). Particular targets should be ideas of "persecution" (e.g., "these people are purposely slowing this line, just to aggravate me") and ideas of incompetence (e.g., "these lines move so slowly because only stupid people operate these registers"). Challenge hostile beliefs in an effort to promote healthier, less inflammatory attitudes.

5. *Encourage philosophies that promote self-reflection and compassion for others*. Challenge patients to learn to maintain self-control of their emotional processes, rather than relinquishing control to others or to situational stressors. Extended treatment formats can incorporate exploration of existential, spiritual, and philosophical issues that relate to the patient's attitudes toward others.

6. *Promote self-monitoring and targeted behavioral changes*. Self-monitoring can be facilitated with the use of inventories that measure hostility (7). Based on the maladaptive patterns observed, guided practices or drills for cognitive and behavioral change can be constructed. Clinical experience strongly suggests that time urgency—"the frenetic drive to accomplish an unrealistic number of tasks in progressively less time" (9, p. 274)—is the fuel that most often perpetuates maladaptive TYABP and bouts of hostility, frustration, and aggression. Encourage patients to experiment with a new pace: drive slowly and practice courtesy to other drivers; pause briefly between tasks; practice doing one thing at once; purposely choose long lines when rushing is not objectively important. Extensive guidelines for countering hurry sickness are available (11,12).

7. *Coach patients to differentiate between anger reactions that are justified and those that are not and between provocations that can be remedied and those that cannot* (10). Instruct patients to practice detaching from their personal distress when faced with a provocation that cannot be remedied. This can be done by refocusing attention from anger-generating cognitions to self-soothing reframes (e.g., "Waiting in this line gives me a chance to pause and enjoy a favorite fantasy.") Advise that cognitive self-instruction paired with relaxation training can be especially helpful in disrupting the "AIAI" syndrome: anger, irritation, aggravation, impatience (9).

8. *Teach relationship skills*. The highly hostile benefit from psychoeduca-

tional interventions that teach them to differentiate aggressive from assertive behaviors and to use effective conflict negotiation strategies. Here, too, useful guidelines for structuring input are available (7,10,13,14). At minimum, patients should be instructed to monitor subtle manifestations of hostility, like sarcastic comments, facial grimacing, persistent teasing, or use of profanity. In addition, the following keys to adaptively expressing anger can be taught, modeled, or role-played (15):

1. Focus on the problem at hand.
2. Give a clear and genuine expression of personal feelings.
3. Avoid expression of opinions that belittle others.
4. Focus on internal reactions, rather than on the listener's actions.
5. Avoid any judgment about the listener's character.
6. Inflict no harm; do not attempt to coerce the listener.
7. Suggest constructive remedies to the bothersome situation.
8. Convey a spirit of intention to get beyond the tension at hand.
9. Protect one's own and the listener's self-esteem.

Also helpful is social skills training that combines rehearsal and imaginal and role-played practice for dealing with high-stress situations. Recommend that the patient practice smiling, listening, and reflecting what is heard during conversations. Instruct the patient to disrupt anger and aggressive behavior by inducing an incompatible emotional or behavioral response (such as empathy, humor, or relaxation) during tense interchanges.

9. If all else fails, refer for specialized help. Patients who evidence protracted difficulty with anger and hostility management should be referred to a mental health specialist for extended evaluation and treatment.

CONCLUSION

Mismanaged hostility and anger pose significant hurdles in the course of cardiac rehabilitation (16). Unfortunately, treatment of these syndromes is typically omitted from the routine delivery of medical care. Two factors seem to contribute to this omission: relatively few cardiac care teams employ mental health specialists; and the misguided notion that only specialists can provide effective interventions in treating anger and hostility prevails. The information in this chapter should help to encourage front-line providers of medical care to incorporate into their treatment protocols brief, common-sense interventions that can be quite helpful in promoting better management of this risk factor.

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Psychosocial Risk Factors: Assessment and Intervention for Depression

C. Barr Taylor and Rebecca P. Cameron
Stanford University School of Medicine, Palo Alto, California

Although high rates of depression have long been observed in post-myocardial infarction (MI) patients, the impact of depression on morbidity and mortality in patients with cardiovascular disease (CVD) has only recently become apparent. Moreover, our knowledge in this area will change dramatically in the next 5 years as the results of a large, multicenter trial sponsored by NHLBI are reported. This study, called ENRICHD (for Enhanced Recovery in Coronary Heart Disease patients), will follow up to 3000 depressed and/or socially isolated patients, randomized to treatment for depression and/or social isolation or to control and follow-up for 4 years (1). In this chapter, we review what is known about the prevalence, course, assessment, and treatment of depression in patients with CVD.

PREVALENCE

Rates of major clinical depression range from about 15 to 25% of post-MI/coronary artery bypass graft (CABG) patients and patients with coronary artery disease (CAD) or coronary heart disease (CHD), depending on the population, and methods of survey and diagnosis (2–7). In addition, during the immediate post-MI/CABG event, as many as 40 to 65% of patients may have periods of depressed mood (8–10), which usually resolve once patients return home and begin to resume customary activities.

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Such high rates of depressed mood during the immediate event are not surprising. Having a heart attack with concomitant medical and surgical treatment is a major life stressor, associated with real and perceived loss, which are factors tending to precipitate dysphoria or depression (11). However, the rates for clinical depression are considerably higher than the expected rates of 5 to 15% for men and women in their fifties and sixties (12). These higher than anticipated rates suggest that depression may be a risk factor for CVD events and/or that CVD events may tend to exacerbate underlying clinical depression.

Some evidence that depression may be a risk factor for CVD comes from studies that have shown that symptoms often caused by depression may precede onset of an MI. Building on earlier studies that have shown that sleep disturbance may precede an MI, Carney et al. (2) found that most patients reporting insomnia prior to MI were suffering from depression. Fatigue, another symptom of depression, has also been shown to be a risk factor for MI (13,14).

A recent prospective analysis of 1151 individuals free of heart disease in 1981 and reassessed about 15 years later provides more direct evidence that depression may be a risk factor for CVD (15). Compared with respondents with no history of dysphoria, the odds ratio for MI associated with a history of dysphoria was 2.07 (95% CI, 1.16 to 3.71), and the odds ratio associated with a history of major depressive episode was 4.54 (95% CI, 1.65 to 12.44), independent of coronary risk factors. These rates were not explained by use of tricyclic antidepressant medications, which may increase risk of sudden cardiac death.

MORBIDITY AND MORTALITY

A number of studies have now shown that depression has a major impact on mortality, morbidity, and functional recovery in patients with CVD (4,16–20). In an early study, Malzberg (21) examined the mortality rates of patients admitted to the New York State Psychiatric Hospital from 1928 to 1931 with a diagnosis of "involutional melancholia," a severe form of depression. This study is important because it examined CVD mortality rates in severely depressed patients before antidepressant and other somatic therapies were available, which in themselves might affect mortality. The death rates for male and female patients with melancholia were 6 and 6.8 times greater than that of the general population.

Carney and his colleagues (17) found that depression at the time of coronary angiography was the best noncardiac predictor of future major cardiac events during the following 12 months. In this study, 77% of the depressed patients either died or underwent a major cardiac event during the year following coronary angiography, compared with less than 35% of the nondepressed group. Similarly, Frasure-Smith and colleagues (22) showed that major depression in patients hospitalized for a myocardial infarction was an independent risk factor for mortality at 6 and 18 months with an impact equivalent to that of left ventricular dysfunction or a history of previous MI. In a large sample from Finland, Aromaa and colleagues (23) found that during a 6.6-year follow-up, the risk of CVD death and coronary death was elevated in depressed persons regardless of whether or not they had CVD at entry.

Depression also increases the functional impairment of CVD patients. Depressed patients have longer hospital stays following an MI than nondepressed patients (24) and incur greater medical costs associated with CVD than nondepressed patients. Depression may also delay return to work. For instance, Wells and colleagues found that only 38% of patients with major depression had returned to work within 3 months of their myocardial infarction, in contrast to 63% of the nondepressed patients (20).

MECHANISMS

A number of potential mechanisms have been suggested to explain how depression might increase post-MI morbidity and mortality. One possible explanation is that depressed patients may adhere less well to medical regimens compared to nondepressed patients (18,25). In support of this hypothesis, Carney and colleagues (26) used an electronic monitoring system to measure medication adherence over a period of 3 weeks. Depressed patients adhered to the regimen on 45% of days, whereas nondepressed patients were adherent on 69% of days ($p < 0.02$). To the extent that adherence to the medical regimen confers benefit, depression may thus affect outcome. Depressed patients may also be less likely to act on potentially life-threatening symptoms of CVD or may even confuse these symptoms with chronic somatic complaints, limiting their ability to benefit from available treatments.

A second mechanism that has been proposed is that depression may affect one or more physiological processes directly relevant to myocardial functioning. First, depression may predispose patients to arrhythmias or exacerbate the danger of existing arrhythmias. Frasure-Smith and colleagues (22) found that the risk of CVD events was greatest among patients with ≥10 premature ventricular contractions per hour. Dalack and Roose (27) found that "beat-to-beat" variability was markedly diminished in depressed patients, implying that these patients had decreased parasympathetic activity compared with normal controls. Insofar as decreased parasympathetic tone lowers the threshold for ventricular fibrillation, it is possible that this variability in depressed patients may be related to the increased rate of cardiovascular death. Kennedy and colleagues (28) reported that among patients with serious cardiac arrhythmias, clinical depression was significantly correlated with mortality. Another possible physiological mediator has been proposed by Piccirillo and colleagues (29), who noted that serum cortisol levels were increased in depressed patients and that higher levels of serum cortisol were associated with increased levels of thromboxane B2, which increases clotting and might dispose patients to thrombosis. Both the arrhythmia hypothesis and cortisol hypothesis remain speculative, however.

A recent, intriguing report suggests that the possibility that CVD itself contributes to depression should not be overlooked. Although it is unlikely to explain the overall rates of depression in patients with CVD, Alexopoulos and colleagues (30) note that cerebrovascular disease may predispose, precipitate, or perpetuate some depressive syndromes by disrupting prefrontal systems or their modulating pathways. Some patients with coronary disease may also have cerebrovascular disease, which might, to the extent that the cerebrovascular disease affects the above-mentioned neuroanatomical systems, contribute to their depression.

COURSE

The course of depression prior to and following an MI is only now being characterized. Lesperance and colleagues (31) examined the course of depression in 222 patients admitted for acute MI. Some 28% of patients had experienced at least one episode of major depression at any point prior to their MI, but only 8% were depressed at some point during the year preceding the infarct. Overall, 32% of patients experienced depression in the hospital or during the year postdischarge. Most patients with a clinical depression post-MI have had a first episode of depression many years before the event (32).

There is evidence that depressed *mood* tends to remit in many patients, particularly as patients begin to return to customary activities (33). In contrast, *clinical depression* usually follows a chronic course during the first year after MI (7,34–36), or may recur after an initial remission (37). Hance and colleagues (6) administered a psychiatric diagnostic interview to a series of 200 patients undergoing diagnostic cardiac catheterization and coronary angiography. Seventeen percent were diagnosed with a current major depressive episode, and another 17% with a current minor depressive episode. Half of the patients with major depression either remained depressed or relapsed within 12 months. Nearly half of the patients with minor depression remitted, but 42% subsequently developed major depression. Wells and colleagues (37) examined the course of depression over 2 years for outpatients with and without a history of hypertension, myocardial infarction, or current insulin-dependent diabetes. Patients with a lifetime history of myocardial infarction had significantly more spells of depression over the first follow-up year, more total symptoms of depression in the second follow-up year, and more depressive symptoms at the end of each follow-up year thereafter than depressed patients without myocardial infarction. Taken together, these re-

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sults suggest that major depression, if left untreated, is persistent in patients with coronary heart disease.

In a small sample of patients, Travella and colleagues (38) provided data suggesting that there may be two types of depression following MI: an acute depression associated with greater functional impairment and a prolonged depression that may be associated with inadequate social support. This finding merits further research attention.

POTENTIAL RISK FACTORS FOR DEPRESSION IN PATIENTS WITH CVD

Understanding risk factors for depression in patients with CVD would help in the development of preventive or early interventions (33). Unfortunately, such studies have not been systematically undertaken. Researchers have suggested several possible risk factors relevant to this population, including gender, lifetime history of depression, socioeconomic status (SES), intensive reduction of serum cholesterol, smoking cessation, and medications used to treat CHD. Evidence for these risk factors is reviewed below.

It has been widely reported, based on population studies, that women have higher rates of depression than men (39–41). Consistent with population evidence, in the Stanford Multifit study of post-MI patients (33), women had higher rates of moderate-to-severe depression than did men during hospitalization and throughout the first post-MI year. In fact, gender was the strongest predictor of level of depressed mood at 1 year post-MI.

The literature on depression among the general population has established that previous depression is a risk factor for depression (42). Evidence on the course of depression among post-MI patients, discussed above, suggests that this holds true for this subpopulation. Thus, patients who report significant previous episodes of depression should be observed closely for the early signs of recurrent depression and be instructed to notify their healthcare providers if such symptoms occur.

SES has been shown to be related to general psychopathology and to depression, specifically in a number of epidemiological studies (43–46). In addition, SES appears to be related to health outcome in depressed patients among the general patient population. For instance, in a study of 264 depressed elderly Finns, patients with a low SES had a poorer medical prognosis than patients with a higher socioeconomic status (47). The mechanism for these findings is not known. The degree of generalizability of this risk factor to post-MI patients needs to be researched. Lower SES is a particularly problematic risk factor, as it may also limit patient access to mental health interventions.

There has been some concern that lowering lipids may increase the risk of depression and suicide (48). If so, this would create a major dilemma, in which the advantages of lipid-lowering would have to be balanced against the increased risk of depression. However, the epidemiological data on the importance of suicide in patients who have undergone significant reduction in lipids is mixed. For example, in a Swedish study (n = 52,000) the relative risk of suicide was 4.2 for men in the lowest cholesterol quartile compared to those in the highest quartile during the first 7 years of follow-up, although no difference in risk was found for women (49). In the Multiple Risk Factor Intervention Trial (MRFIT), men with low cholesterol levels had greater risk of suicide than men with higher levels during the 12 years of follow-up (50), and Golier and colleagues (48) found a significant relationship between low cholesterol and serious suicide attempts in psychiatric populations. However, a recent meta-analysis of the 10 largest cohort studies, two international studies and 28 randomized trials found "no evidence that low or reduced serum cholesterol concentration increases mortality from any cause other than hemorrhage stroke" (51). The benefit of aggressive management of lipids far outweighs any increased risk of suicide in this population. However, routine assessment of depression in patients undergoing intensive lipid lowering seems warranted.

Smoking cessation has also been linked to increased depression. For instance, Glassman (52) has reported that some patients become depressed upon quitting smoking and that previous depressive episodes are risk factors for the onset of postcessation depression. Given the fact that about 30 to 50% of patients with an MI, or those undergoing coronary artery surgery or angioplasty, smoke and that 40 to 70% of such patients are able to quit following a cardiac event (53), a substantial percentage of patients with cardiac disease will have quit smoking. We examined the Multifit data from the standpoint of those who had quit smoking after an MI compared to those patients who had continued to smoke and those who had not smoked for at least the 6 months preceding the MI (nonsmoker). The most striking aspect of these data was the high rate of moderate-to-severe depression (20%) reported in-hospital by women who continued smoking as compared to women who quit (4%), suggesting that depressed women admitted for an MI may have low levels of motivation to stop smoking, perhaps because of concerns about the impact of cessation on their mood (54). Such women may need particular help in quitting, including monitoring of and treatment for depression. Interestingly, the mean levels of depression decreased for men who stopped smoking over the first post-MI year, whereas they increased slightly for women.

A number of medications used in patients with CVD can cause depression (55,56), although the beta-blockers are particularly important given their high use in patients with CVD. Some studies have found that as many as 15% of patients on propranolol, a widely prescribed beta-blocker, become "depressed." According to the *Physicians' Desk Reference* (57), the incidence of depression for some other common beta-blockers is: sotalol (4%), metoprolol (5%), and

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atenolol (1–12%). Previous depression is a risk factor for depression on beta-blockers. It should be noted, however, that some of the side effects of the beta-blockers mimic those of depression (e.g., fatigue) and a careful history should be obtained to determine if the medication may actually be contributing to the symptoms of depression. If so, different medications with similar physiological effects should be considered.

Although the severity of medical illness has been associated with increased depression in general medical populations, in post-MI populations the severity of illness has not been found to be a clear-cut predictor of depression. Ladwig and colleagues (58) found that patients who reported serious life events in the last 2 years before an MI, or who suffered from exhaustion and fatigue in the prehospital phase, were subject to significantly higher levels of depression post-MI. Of course, it is possible that the symptoms of exhaustion and fatigue were related to pre-MI, apparently undiagnosed, depression. The depressed patients with a history of previous MI had twice as many depressive symptoms in 2 years of follow-up and were four times as likely to have a recurrent depressive episode compared to patients without a history of MI. The reasons for this worse prognosis, however, were not clear from the study. For instance, it is possible that patients with heart disease were less likely to be treated with antidepressant medications.

ASSESSMENT

While primary prevention of depression in post-MI patients may not be possible, early recognition and treatment of depression following the event is likely to reduce the emotional and physical impact of the disorder. Depression is usually quite easy to diagnose, although, as noted above, diagnosis can be complicated by overlap in symptoms with symptoms of CVD and side effects of medications. However, even when the depression is clear cut and clinically significant, many surveys have demonstrated that it is often overlooked by medical professionals. For instance, Carney and colleagues (17) found that only 20% of depressed CVD patients were correctly diagnosed by their primary care physicians. Other studies have found that fewer than 20% of patients with both CVD and major depression received psychiatric treatment (59,60).

A number of screening instruments have been developed to assess depression in medical populations. These instruments have demonstrated high sensitivity and specificity and good efficiency. Self-report measures include full-length (21 items) or short versions (13 items) of the Beck Depression Inventory (BDI) (61,62), the National Institute of Mental Health Center for Epidemiological Studies Depression Scale (CES-D; 20 items) (63), the Zung (64) Self-Rating Depression Scale SDS (20 items), and the Symptom-Driven Diagnostic System for

Primary Care (SDDS-PC; 16 items) (65). In addition, a self-report screening measure combined with a short follow-up interview, the PRIME-MD (66), that requires less than 9 min to complete and covers several diagnostic categories, is available. Patients who screen positive for depression on a short screen should undergo further assessment and/or be referred to a mental health provider for a clinical interview and treatment. Standardized diagnostic interviews are also available, such as the Structured Clinical Interview for Diagnosis (67), but these tend to be too long for clinical practice purposes. Although any of the above assessment tools can be used to screen patients, the PRIME-MD may be particularly useful in busy medical practices, as the basic screen for mood disorders consists of only two self-report items, as follows:

''During the PAST MONTH, have you been bothered A LOT by (1) little interest or pleasure in doing things (yes or no); and (2) feeling down, depressed, or hopeless (yes or no).''

If either item is scored ''yes,'' a short follow-up interview to establish a diagnosis is indicated. The two screen items yield a sensitivity of 69% and specificity of 82% when diagnoses made by a mental health professional are used as the criterion standard. Spitzer and his colleagues suggest administering a mood disorder interview module that is included in the PRIME-MD if there is clinical suggestion that the patient may be depressed, even if he or she screens negative on the above questions (66). Alternatively, patients who screen positive or give other indications of being depressed may be referred for additional assessment by a mental health provider. Copies of the complete PRIME-MD, including the full screening instrument and the follow-up interview modules, can be obtained by writing Robert L. Spitzer, MD, Biometrics Research Department, Unit 74, New York State Psychiatric Institute, 722 W. 168 Street, New York, NY 10032.

TREATMENT

There is evidence that treating depression in post-MI/CABG patients may improve morbidity and mortality (68). In addition, treatment of depression significantly improves a patient's quality of life (69). A variety of psychosocial and pharmacological interventions have been developed for treatment of depression in general populations. We will discuss the findings of initial intervention trials using psychosocial approaches, the potential roles of exercise and social support, and then discuss the use of antidepressant medications in this population.

Avery and Winokur (70) reported that the rates of MI were much lower in a group of depressed patients who received adequate therapy (defined as a minimum dose of antidepressants and/or electric shock treatment) compared to inadequately treated patients. In a nurse-telephone follow-up for crisis intervention designed to monitor and reduce stress and discomfort in post-MI patients, Frasure-Smith (22) found that participants in the intervention had lower rates of mortality following an MI when compared to patients receiving usual care. Depression was a significant source of distress in this population and a target of treatment. In a follow-up trial, Frasure-Smith and colleagues (71) conducted a randomized controlled trial of 1376 post-MI patients assigned to an intervention or usual care. In contrast with previous results, there was no evidence of any benefit for men in the trial and, surprisingly, all-cause mortality actually increased among women in the intervention group. The intervention was primarily designed to help patients cope with distress rather than to treat depression, and therefore the actual impact on depression and anxiety was small.

The Agency for Health Care Policy and Research (AHCPR), after reviewing a number of randomized controlled trials, found that psychotherapy was effective for treating mild-to-moderate depression (69). Of note, most of the controlled trials involved short-term cognitive-behavioral or interpersonal psychotherapy. Cognitive-behavioral therapies focus on changing the distorted cognitions that are a significant feature of depression (e.g., negative views of the self, the world, and the future) and acquiring skills or engaging in behaviors that promote positive, rewarding experiences and diminish unpleasant experiences (72). Interpersonal therapies, in contrast, focus on relearning affective aspects of relationships within the context of the therapeutic relationship, in order to achieve more balance with respect to issues of autonomy and relatedness (73). Based on this evidence, the AHCPR guidelines recommend that psychotherapy for patients with mild-to-moderate depression is the treatment of choice for patients who prefer it to medication. The AHCPR also noted that psychotherapy alone is not recommended for the acute treatment of patients with severe and/or psychotic major depressive disorders.

Given the nature of depression—a tendency for patients to feel isolated and to withdraw—social support is likely to help the depression as well as ameliorate the symptoms of depression. A great deal of work has documented the benefits of positive social ties for psychological well being (74). Group therapy, one method of providing social support, has proved helpful for reducing depressive symptoms in post-MI patients (75,76). However, relatively little work has been done to determine the nature, extent, or implementation of social support needed as a means of preventing depression in medical or surgical CVD patients.

As mentioned above, the ENRICHD trial will provide important evidence on many questions related to depression in post-MI patients, but particularly on the effects of interventions targeting depression on reducing morbidity and mortality. The ENRICHD treatment intervention centers on the use of individual cognitive-behavior therapy (CBT) followed by group therapy (up to 12 weekly sessions) for treatment of depression and/or social isolation.

A number of studies have shown that exercise can help relieve some of the symptoms of depression. Taylor and colleagues (77) found post-MI patients participating in a gym training group had significantly lower depression scores than post-MI patients who had received no training. However, the mean scores on the self-report and interview depression instruments were very low, and the differences between the conditions were not large. Exercise appears to be particularly beneficial in patients with CVD who have clinically significant depression (78). Given the many benefits of exercise in the population with cardiovascular disease, patients should be encouraged to incorporate exercise in their rehabilitation program.

Medications are also effective in reducing symptoms of depression and preventing recurrence of depression (69). Until recently, the tricyclic antidepressants have been the most widely used and studied medications for treating depression. These medications can be used safely in most CHD patients; however, they have side effects that are potentially dangerous in some patients. For instance, the tricyclics increase Q-T conduction and may cause serious arrhythmias in vulnerable patients. Fortunately, newer antidepressants, such as the selective serotonin reuptake inhibitors (SSRIs), which include fluoxetine, paroxetine, sertraline, fluvoxamine, appear to be as effective as the tricyclics for treating depression and have few cardiovascular side effects (79–82). Although SSRIs can be used safely in most patients with CHD, they inhibit cytochrome P450 enzymes. The cytochrome P450 system is responsible for metabolizing many drugs given to patients with CVD and changes in plasma levels of other drugs have to be considered when prescribing SSRIs.

CONCLUSION

Moderate-to-severe depression occurs in about 15 to 25% of patients with CVD and increases post-MI morbidity and mortality. The mechanism(s) by which depression affects the course of CVD are still unknown, but intriguing hypotheses have been suggested about potential biobehavioral mechanisms.

Given the prevalence and negative impact of depression, it is important to recognize and treat such patients. A number of screening instruments have been developed for use in primary care settings that are practical and can be adapted for use in cardiovascular/cardiology settings. These instruments can assist medical personnel in identifying patients at risk for a depressive episode during the course of their cardiovascular illness. A variety of effective treatments for depression are available, including both psychosocial treatments and medications, and work is being done to apply these interventions to the needs and circumstances of patients with CVD. Over the next several years, we can look forward to the wealth of information on the health effects of therapeutic intervention for depression and social isolation that the ENRICHD trial will yield.

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Psychosocial Risk Factors: Assessment and Intervention for Social Isolation

Carol Rogers Pitula
Illinois Masonic Medical Center and RUSH University College of Nursing, Chicago, Illinois

Matthew M. Burg
Veterans Affairs Medical Center and Yale University School of Medicine, New Haven, Connecticut

Erika Sivarajan Froelicher
Schools of Nursing and Medicine, University of California, San Francisco, California

The social environment is an essential component in survival and recovery from cardiovascular disease. Comprised of our relationships with family and friends and the potential support these relationships provide, the social environment both mediates and moderates the life-threatening illness experience. Social isolation can be a consequence of the loss of significant others through death, divorce, or relocation (social network deficit). Social isolation also can be a perception borne of unsatisfying relationships with others or cognitive structures that limit efforts at social outreach. Both social network deficits and low perceived social support (collectively referred to as LPSS) have been linked to survival and recovery in individuals with myocardial infarction (MI) and coronary artery disease (CAD) (1–3). Individuals who live alone, lack a confidante, or report little available support are at higher risk for future cardiac events and cardiac death (4–7). Studies indicate that interventions to increase social support or decrease network deficits among cardiac patients increase quality of life and physical health outcomes (8) by modifying perceptions or social interaction patterns and mobilizing network resources (9,10).

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How do emotional support and network relationships enhance survival and recovery for patients with cardiac disease? Which patients have a social support deficit? What can be done about this problem? Who should intervene to solve the problem? In this chapter, we briefly review social support theory, provide some examples of LPSS, and describe assessment and intervention for low perceived social support.

Social support can be thought of as specific supportive behaviors such as emotional or instrumental help (help with daily tasks), as network relationships such as a spouse or confidante, as subjective appraisal of support (being satisfying or helpful) (11), and as coping assistance (12). For example, an individual must have access to people who can be mobilized in time of need to listen, give advice, and supply love, money, or transportation. In addition, different types of relationships are sources of different types of support (13,14). A patient can expect love and opportunities for confiding and physical care from a spouse relationship, especially a female spouse, whereas friendship relationships are more often sources of companionship and recreation. Kin relationships, which are considered to be the most reliable sources of emotional and instrumental support (15), obligate people to supply certain types of support. However, support from nonkin relationships, because they are voluntary and maintained by affective bonds, can be more valued.

Perception, attitudes, and expectations about support also are critical: do you think you need it, who do you think should provide it (family or friend), what do you see as the cost of accepting it (emotional involvement and reciprocity), do you ''deserve'' it, and are you satisfied with the support you get (16). Conflictual or demanding relationships, poor social skills, negative affect regarding social situations, and low self-esteem can reduce one's perception of supportedness (17,18). Gender and ethnic variations in attitudes and expectations about support contribute to the host of individual differences that influence the use, desirability, and utility of such support. For instance, since women live longer than men, we can expect more women to be widows and have fewer family and friends serving support functions as they age (19). This gender phenomenon puts women at risk for LPSS. Although little is known about ethnic variation in the use of social support, the literature and anecdotal evidence suggests that family, including extended family, rather than friends, are important and available to African American and Hispanic patients (20). Thus, the experience of being adequately supported is contingent upon a number of factors and LPSS arises from cognitive, behavioral, and environmental conditions.

The social support intervention targets three interacting mechanisms—behavioral, psychological, and physiological—which may provide links between low perceived social support and cardiac outcomes (21). In the behavioral domain, supportive interactions may encourage risk reduction efforts, adherence to medical regimens, and timely seeking of medical attention should clinical symptoms occur. In the psychological or cognitive domain, supportive interactions can serve to buffer the impact of stressful encounters, help patients redefine stressors as benign, provide encouragement, particularly with regard to recovery from MI, and enhance self-esteem and self-efficacy. Such support then has an impact on the physiological realm by reducing the degree of physiological activation that occurs during stressful encounters (22,23).

ASSESSMENT

A conceptualization and formulation of the patient's unique reason(s) for feeling unsupported determine the individualized course of treatment. The first step in this formulation is assessment of the type and source of support currently available to the patient. The healthcare professional can assess the patient for indications of LPSS. This does not require a sophisticated technique or measure, although a brief inventory exists (24). Questions concerning who the patient lives with, who they have confided in about their fear, worry, or stress since the MI, who they see for recreation, to which organizations they belong (church, synogogue, interest group), and whether they have someone with whom to share good news or discuss decisions will elicit important information about their social resources and their use of those resources.

Any of these questions about kind of support and kind of relationships will initiate a discussion of a patient's social environment. Often, simply bringing up the topic prompts a patient to admit dissatisfaction with network members, the type of support they are getting from them, or their loneliness. Using examples of other patients and their social support problems can serve to normalize these support problems as common to others and encourages a discussion of particular difficulties. The timing of assessment also is important. Often, the best time for an accurate assessment of support may be after the patient has been discharged and resumed his or her usual living arrangements and lifestyle. During a period of high stress, such as hospitalization, patients may report artificially high amounts and sources of support because family and friends are more likely to respond to the need for support at such times (14). After returning home, family and friends tend to disappear because the crisis is over. This is the time when the adequacy of support is most obvious and best measured.

INTERVENTION

Although much research has demonstrated the negative impact of support deficits on mental and physical illness, there are few theory-based, systematic approaches to improving LPSS. A number of interventions targeting a variety of expressions of LPSS have been described (25). These multimodal interventions take the form of clinical treatment, family enhancement, neighborhood helping, and case management (26). They target factors such as social interaction and communication skills, cognitive and affective aspects of isolation, self-efficacy, and empowerment, and access to public and private services. Much of this literature is atheoretical and lacks a reproducible, systematic protocol to explain why the intervention works, describe which elements are critical to its success, and which outcomes measure effectiveness.

One therapy approach that addresses the complexity of the social support phenomenon has been developed to treat LPSS. This treatment is based on a social cognitive behavioral model that posits that thinking, feelings, and behavioral factors plus environmental events are interacting determinants of each other via operations such as symbolization, self-regulation, and self-evaluation. The primary goal of a social support intervention based on this model is to alter the patient's perception of being unsupported. Intervention efforts are aimed at social outreach, network development, and improving interpersonal effectiveness. Often, this can require work on the patient's thoughts, behaviors, and feelings within a dynamic social environment that does not operate the way the patient assumes or expects. Thus, intervention work may be aimed at modifying thoughts about receiving support (e.g., "I should be able to cope without anyone's help") while targeting notions about social roles and the rules governing role behavior as well (e.g., "They should know what I need now" or "That was my wife's job to keep in touch") when these cognitions interfere with outreach activities. Then, specific new behaviors can be enacted to "test" the patient's and therapist's predictions about outcome. The responses of others in the patient's network interact with the patient's experience to change his or her thinking about social support needs. The outcome is analyzed, modified as needed, and enacted again until the patient's perception of being inadequately supported has changed.

There are several key elements in this approach. The first is the immediate establishment of a supportive alliance between therapist and patient so that the patient begins to experience a strong sense of supportedness and social connection. Then, the therapist helps patients to: identify sources (situations, relationships, cognitions, emotions) of their low social support and plan how to remedy the problem, use new sources, either formal or informal, of emotional, informational, and instrumental support, when applicable, apply communication skills to modify or extricate themselves from conflictual or demanding relationships, and modify cognitive and affective experiences that contribute to low social support.

The two sources of social support deficiency, social isolation and perceptions of unsupportedness require different approaches to modification. Social isolation or lack of family and friends may be a "practical" problem rather than a psychological one in which the patient requires help identifying and mobilizing naturally existing relationships that can provide support—how, when, and where to meet new people or reestablish old ties—and perhaps, some communication skills training. This type of support deficiency, however, may be a consequence of losses from the network coupled with unworkable social rules that prevent the patient from reestablishing old relationships or maintaining existing ones. For example, after the death of a spouse, men often become socially isolated in the midst of a network of family and friends. This occurs as a result of the role expectation that the wife maintains family and social contacts. An intervention for this deficit entails cognitive restructuring of dysfunctional attitudes about social support roles before network building activities can be attempted.

A second cause of low social support, perceptions of unsupportedness and alienation are qualitative in nature. That is, the patient has people in the network but is unable or unwilling to access their support because of (a) dysfunctional attitudes, expectations, or perceptions and/or (b) conflict and dissatisfaction in the relationship. This psychological problem requires the therapist to assist the patient to discover the "why" about interactions with others rather than the how, when, and where focus noted above. Intervention is aimed at cognitive restructuring and improving marital/other communication skills. For example, women often refuse to allow family members to provide support because "caring for them is my job." Reciprocity is another concern for many women who refuse help from friends or acquaintances because "I can't return the favor (e.g., transportation, meals) so I can't accept the help."

The involvement of members of the patient's social network may be a key intervention in the course of treatment because reconnecting or reestablishing "old" relationships is more acceptable and effective than attempting to build new ones, especially among older patients. This includes individuals who are identified as potential sources of social support, but are currently unavailable, individuals who are sources of conflict or stress for the patient (e.g., spouse or children), and/or individuals with whom the patient feels little connection. In determining the appropriateness or advisability of involving another person in the treatment, the therapist should work closely with the patient in identifying potentially supportive others and in engaging these others in the treatment process. Careful assessment of the person and his/her potential for support is necessary to ensure that he/she will help rather than hinder the treatment.

When treating LPSS, it is important to be sensitive to the needs of the patient with heart disease. This population is distinct from the mental health population in that a profound physical insult is a large part of their clinical presentation. The problems that patients may encounter as part of their daily experience include chest pain, especially on exertion, loss of usual roles and level of functioning, threat and unpredictability of pain and death, fear of and longing for sexual intimacy, and reluctant adjustment to lifestyle changes. These problems should serve as an initial focus of each session. In this way, the treatment "makes

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sense'' in the context of an acute MI and is seen by the patient as a way of alleviating the likelihood of subsequent cardiac problems.

A small caveat is worth mentioning here. In our clinical experience, depressed mood or depressive disorder can contribute to either type of social support deficit. Depression is notorious for producing negative perceptions (see Chap. 27). This would include a patient's perception about being inadequately supported by others. Other symptoms of depression are lack of interest in previously enjoyable activities, and decreased motivation and energy. Any of these symptoms could affect a patient's ability to perform the social/behavioral activities necessary to maintain or reestablish relationships. Depressive disorder is a treatable illness that is amenable to the type of counseling or psychotherapy described in this chapter as well as to antidepressant pharmacotherapy. Assessment of signs and symptoms of depression will complement and enhance the assessment and treatment of social isolation among patients with cardiovascular diseases.

The nonpsychiatric health care professional may believe that he or she is not qualified to provide the treatment described here. If so, it is recommended that the patient be referred to a licensed counselor/psychotherapist (advanced practice psychiatric nurse, licensed psychologist, or clinical social worker) for social support intervention. This chapter assists the referring clinician to understand the goals and process of the treatment. The psychosocial treatment described here is expected to produce improvement almost immediately, since the initial goal is to establish a supportive alliance between patient and therapist. This initial support provision can be delivered by the healthcare professional before referral and should continue after the psychosocial treatment has ended. Treatment duration is 4 to 16 weeks, depending on the specific issues involved in treatment. Treatment effectiveness is measured as improvement in perception of support from family and/or friends.

This intervention was developed for an ongoing multicenter clinical trial, Enhancing Recovery in Coronary Heart Disease Patients (ENRICHD), funded by the National Heart, Lung and Blood Institute. Patients with acute myocardial infarction are screened for LPSS (and/or depression) and treated using this social cognitive behavioral model. Primary endpoints for the trial are all-cause mortality and reinfarction. Treatment includes individual and group interventions over 6 months.

In summary, social isolation and low perceived social support are associated with increased risk for poor outcome among patients with acute myocardial infarction and coronary artery disease. Availability and helpfulness of network members (family and friends) and the patient's cognitive, behavioral, and emotional assets and environmental events are the factors requiring assessment and intervention. Interventions to alleviate LPSS focus on social outreach and network development unless behavioral deficits (social skills) and interfering cognitions emerge during the outreach process. Then treatment will include social skills training and cognitive-behavioral therapy.

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Stress Management

Eileen M. Stuart-Shor
Roxbury Heart Center and Simmons College, Boston, Massachusetts

BACKGROUND

Although stress is a well-known and frequently experienced phenomenon, it is an elusive concept to define. Stress varies greatly from individual to individual and within the same individual stress triggers vary from day to day. It is also important to acknowledge that not all stress is bad. A certain amount of stress creates interest and challenge in our lives, which in turn can lead to positive growth. Too much stress, however, leads to negative consequences and can adversely affect health. In this chapter, stress is operationally defined as the *perception* of threat to one's physical or psychological well being, and the *perception* that one does not have the resources to cope with this threat (1).

The causal relationship between stress and the etiology and progression of cardiovascular disease has not been clearly established; however, much *is* known about the association between stress and cardiovascular disease. Sympathetic nervous system (SNS) arousal in response to stress has been associated with increased angina (2); changes in vascular tone (3); cholesterol metabolism (4); platelet aggregability (5); glucose metabolism (3); and elevations in blood pressure (3). Recently, stress was reported as an important factor in the 24 h preceding myocardial infarction (MI). Investigators studying triggers for MI found that in the 24 h preceding a MI, there was a ninefold increase in the incidence of subjects having experienced a stressful day (2). Other studies have demonstrated that myocardial ischemia can be induced by mental stress (6).

Stress has been shown to increase the incidence of negative mood states (depression, anxiety, anger/hostility), and can contribute to withdrawal or social isolation. This has relevance for the cardiovascular clinician since psychosocial

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factors, specifically depression, anxiety, anger, hostility, and social isolation have been associated with adverse cardiovascular (CV) outcomes (7). In addition, stress has been linked to "stress disinhibition," meaning that in response to stress individuals are more likely to revert to less healthy behaviors such as smoking, sedentary lifestyle, poor food choices, interrupted sleep, increased alcohol/drug use, and antisocial behaviors (isolation and violence) (7). This stress disinhibition effect has particular relevance to primary and secondary coronary prevention programs where risk factor modification is largely dependent on changing adverse lifestyle behaviors.

There are three physiological pathways affected by stress, the musculoskeletal system (MSS), the autonomic nervous system (ANS), and the psychoneuroendocrine system (PNE). In response to the perception of threat to one's physical or psychological well-being, the cerebral cortex processes this threat and activates the limbic system and hypothalamus. Neural messages are transduced down the MSS, ANS, and PNE systems causing increased muscle tension, arousal of the SNS (fight-or-flight response) and the hypothalamic-pituitary-adrenocortical axis, respectively (3). Acutely, these changes enable us to react to and successfully cope with physical danger, but they do little to deal with the myriad nonphysical stresses in our lives. Over time, when repeatedly exposed to stress, physiological arousal is associated with adverse health. For these reasons, any comprehensive multiple risk reduction program for the treatment of cardiovascular disease should include stress management.

INTERVENTION STRATEGIES

If one accepts the premise that biological, psychological, and social factors affect the etiology and progression of CV disease and symptom management, then inherent in the treatment of CV disease should be an understanding that the intervention needs to be multifactoral, integrated, and multidisciplinary. In this context, stress management should not be viewed in isolation as a psychological intervention, but as an integrated intervention imbedded into routine coronary prevention.

For the purposes of this chapter, the scope of the interventions discussed is limited to nonpharmacological management of stress. It is often appropriate and sometimes necessary, however, to utilize pharmacological therapy, specifically antidepressant and anxiolytic medications, as part of a comprehensive treatment strategy.

The interventions included in an integrated, biopsychosocial, nonpharmacological approach to stress management as part of a multiple risk factor reduction paradigm are outlined in Table 1. While clinicians often identify the importance of relaxation techniques, humor, and cognitive restructuring in managing

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Table 1 Nonpharmacological Management of Stress

Stress is a multifactorial problem caused by and affecting the following systems: biological psychological social behavioral spiritual	It requires a multifactorial intervention: exercise nutrition cognitive strategies—cognitive restructuring, empathy, humor, communication, relaxation response behavioral strategies—diary, skills, drills connection—with self, others, life meaning and purpose, integrating illness into life meaning, journal writing, life road map, social support, connection with feelings and emotions, values clarification

stress, the value of exercise, proper nutrition, sleep, and social support is often overlooked. There are physiological benefits derived from exercise, proper nutrition, and sleep, which directly affect mood state and stress. In addition, when individuals are exercising, eating well, sleeping well, and enjoying the companionship of others, they often report positive quality of life measures, particularly vitality, which directly impacts on an individual's ability to cope with stress as well as his or her perception of threat. This has been called stress hardiness (8). Individuals who exercise, have a network of social support (connections), and have the characteristics of the "three C's" (challenge, commitment, and control) are less prone to illness than those who do not. Stress-hardy individuals see stress as a challenge rather than a threat, feel in control of their life situation, and have a sense of commitment rather than alienation from work, home, and family. Cognitive therapy, a short-term psychological intervention, is helpful in engendering attributes of hardiness and is described later in this chapter.

ELICITATION OF THE RELAXATION RESPONSE

The physiological opposite of the flight-or-fight response—the relaxation response—is an innate response that leads to quieting of the mind and body and is an important component of any comprehensive approach to stress management. Benson et al. (9) first described the physiology of the relaxation response while studying practitioners of transcendental mediation. They described the relaxation response as a state of deep rest brought about by focused attention on a thought, word, phrase or prayer, and passive disregard of distractions. Elicitation of the relaxation response is associated with decreased SNS activity acutely, and longer term has been shown to decrease end-organ responsivity (10). To the extent that stress causes or exacerbates a symptom or illness, eliciting the relaxation response can break the stress-symptom cycle.

In addition to these physiological changes, psychological and behavioral changes may also occur. Patients who regularly elicit the relaxation response report that they can more easily focus attention and appraise attitudes in a more conscious, objective way. This realistic appraisal facilitates the work of cognitive therapy. Patients who begin to elicit the relaxation response often experience an openness to new possibilities and embrace healthy lifestyle choices. This process of behavioral change begins when the patient clarifies core values, and makes a behavioral plan that is aligned with his or her core values. Simply stated, they make changes because they "want to" rather than because they are "supposed to." In addition, interventions that facilitate eliciting the relaxation response often engender a sense of well-being and peace of mind and can facilitate the patient (re)connecting with personal life meaning and purpose (spiritual domain) as well as personal growth (10).

Many techniques can be used to elicit the relaxation response (RR) (Table 2). In our experience, it is best to teach a variety of techniques so that the patient will be able to identify the technique(s) that works best for them. For patients who are concrete thinkers (practical, problem-solvers, "left brain"), movement-oriented techniques and kinesthetic techniques such as diaphragmatic breathing or progressive muscle relaxation often work best. For patients who are more "right brain," visualization and mindfulness often work well. We advise patients to develop a regular practice to elicit the relaxation response, once a day for 20 min. The general requirements of the prescription include: a quiet environment, a comfortable position, a passive mental attitude to intruding thoughts, and repetition of a simple mental stimulus (such as a word, thought, image, phrase, or

Table 2 Relaxation Response

Two components necessary to elicit the relaxation response:	Techniques to elicit the relaxation response:
Focused awareness on a thought, work, prayer, sound, or muscular movement.	yoga/tai chi
Passive disregard of distracting thoughts.	progressive muscle relaxation
	diaphragmatic breathing
	mindfulness
	prayer
	visualization
	repetition of thought/word

prayer). We have found it helpful to recommend that patients elicit the RR in the same place every day, do it first thing in the morning, take the telephone off the hook, tell people not to bother you, do not use an alarm clock, do not engage in RR after a large meal, and attend to their comfort if uncomfortable. The vast majority of patients can find 20 min four to five times a week to practice this technique. The critical variables for success are finding the technique that works best for the patient and providing continuous feedback and problem solving as would be done for exercise or nutrition prescriptions.

Patients are taught to use minirelaxation exercises (minis) (stop, take a breath, release physical and mental tension) whenever they feel stress, or as a preventive measure. For instance, we have suggested that patients use the transition from home to work and schedule a mini at the beginning of their commute each day, as a way of beginning one's day relaxed. In addition, minis are recommended as an acute strategy any time the patient is feeling tense or stressed. In our 5-year follow-up studies, patients report the highest compliance with long-term use of minis. Many patients report using ''minis'' 15 to 20 times a day, especially at times when they might have felt impatient, irritated, or stressed (11).

Techniques to elicit the relaxation response are useful in both the inpatient (acute care) setting and the outpatient setting described above. In the initial stages of adjustment to an event, an intervention, or the diagnosis of coronary artery disease, patients can be anxious and at risk for becoming depressed. Teaching a focused breathing technique to cope with the pain and anxiety of hospitalization, as well as the anticipated losses inherent in illness, is effective. Guiding the patient through a relaxation exercise also provides an opportunity for the practitioner and patient to connect around empathic, compassionate, healing and healthcare, as well as to reduce stress and increase the patients' feelings of control.

COGNITIVE RESTRUCTURING

Cognitive therapy is a short-term psychological intervention that addresses the relationship among thoughts, feelings, beliefs, behaviors, and physiology. Initially used as a short-term treatment for depression and anxiety, cognitive therapy has been successfully applied in reducing health-risking behaviors, physical symptoms, and the emotional sequelae of coronary disease. It is particularly useful to reduce symptoms of depression, anxiety, anger, and hostility, all psychosocial factors known to place the patient with coronary heart disease at risk for premature morbidity and mortality.

Cognitive therapy was introduced and developed by Aaron Beck, Albert Ellis, Donald Meichenbaum, and David Burns (12). This psychological model proposes that our thoughts, not external events, create our moods; that the thoughts which cause stress are usually unrealistic, distorted, and negative; that

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these distorted, illogical thoughts and self-defeating beliefs lead to painful feelings such as depression, anxiety, and anger; and that by changing maladaptive, unrealistic, distorted thoughts, we can change how we feel as well as our physiology and behaviors. There are several goals for cognitive therapy, often called cognitive restructuring. First, patients should be able to pinpoint the negative, automatic thoughts and silent assumptions that trigger and perpetuate their emotional upsets. Then they are asked to identify the distortions, irrational beliefs, or "cognitive errors." Once they have identified the distortions, they can substitute more realistic, self-enhancing thoughts that will reduce the stress, symptoms, and/or painful feelings. It is then important to go back and replace self-defeating "silent assumptions" with a more reasonable belief system. Once patients are able to identify automatic thoughts and cognitive distortions and choose a more effective coping mechanism, they can work to improve their social skills as well as coping, by learning effective skills for communication and empathy.

We have reduced the complex tenets of cognitive therapy to the simple, but effective, four-step model presented in Table 3. Patients are taught this four-step model, and it is utilized consistently to examine all stressful situations that arise. Repeatedly guiding the patient through the four steps is critical to mastery (10).

Stop. Break the cycle of escalating, catastrophizing thoughts.

Take a breath. In the process of taking a breath, the individual relaxes physically and mentally and is distracted from focusing on the stress.

Reflect. What is going on—what is *really* going on? Identify the automatic thoughts, cognitive distortions, and irrational beliefs that are operating in this stress. Separate the practical problem from the emotional hook. Put it in perspective. Ask yourself the question; "What's the worst thing that could happen in this situation?" Look at it from the other person's perspective (empathy).

Choose. The most effective way to respond to the stress. Use nonjudging communication.

Nonadherence to dietary, exercise, or stress management advice provides rich examples to guide the patient through the four-step model. This model is

Table 3 Cognitive Restructuring

Stop: Break the cycle of escalating stress.
Take a breath: Release physical/mental tension.
Reflect: What's going on, what's really going on. Realistic appraisal of stress. Identify cognitive distortions, irrational beliefs. Separate practical problem from emotional hook. Ask, "What's the worst that can happen?"
Choose: How do I want to respond?

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also useful to examine anxiety, depression, or anger in the context of triggers and to identify more realistic ways to cope.

Cognitive therapy can be used in both the inpatient and outpatient setting, but the goals and processes are different and need to be clearly identified. The goal of cognitive therapy in the hospital setting is typically confined to assisting the patient to cope more effectively with the stress of hospitalization and acute illness. Long-standing issues are more appropriately dealt with in the outpatient setting. Outpatient cognitive therapy can be provided either individually or in groups. This should be woven into each of the interventions inherent in multiple risk factor reduction and used by all practitioners on the multidisciplinary team.

CONNECTION

Connection with self (mind and body), others (social support), and life meaning and purpose (spirituality) are important aspects of stress management and multiple risk reduction. This conceptualization of connection is important because much of the stress we generate in our lives evolves from being disconnected from or unaware of stress warning signals (physical, emotional, behavioral, cognitive), contact with others, or that which constitutes our definition of life meaning and purpose. Relaxation techniques and cognitive therapy, in addition to exercise, healthy nutrition and adequate sleep, are important interventions in this area. In addition, we use a variety of other techniques including keeping a diary or journal, drawing pictures, life road maps, and behavioral drills (10). In qualitative studies, we have noted that patients who sustain behavioral change, or make transformational changes, are those who identify connection with self, others, and life meaning and purpose as being important (13).

CONCLUSION

Coronary heart disease is a complex illness involving biological, psychochological, social, and behavioral factors in its etiology and progression. For this reason, the treatment and prevention of coronary disease has to be addressed as an integrated, biopsychosocial intervention. The causal relationship between stress and the pathogenesis of coronary disease has been debated at length; however, there is no debate about the association between stress and changes in physiology, mood state, health habits, and social context. These changes in physiology, mood state, adverse health habits, and social context have been clearly shown to adversely affect outcomes for patients with coronary disease. For this reason, it is important to include stress management for primary and secondary prevention of coronary disease as an integral component of multiple risk factor reduction.

ACKNOWLEDGMENTS

I would like to acknowledge the contribution of my many colleagues in the Division of Behavioral Medicine, at the Beth Israel Deaconess Medical Center in Boston, to the evolution of the integrated biopsychosocial CAD prevention model described in this chapter.

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Return to Work: Factors and Issues of Vocational Counseling

Diane Shea Pravikoff
Cinahl Information Systems, Glendale Adventist Medical Center, Glendale, California

The importance of compensated work in the lives of adults in the United States cannot be overestimated. Due in part to this culture's work ethic, it appears obvious that an ''individual's work is an integral part of his identity''(1) and, therefore, unemployment, whether caused by disability or loss of a job, can be harmful to the individual, not only from a financial perspective but from damage to the individual's self-image. The importance and cost to the individual, combined with the cost to corporate America of recruitment and training of replacement workers, stress the importance of awareness of those factors that are important in determining whether and when cardiac patients can return to work.

Cardiovascular diseases, particularly coronary artery disease, affect a large number of individuals who are still working at the time of illness. Most of these patients, generally over 80%, return to previous employment (2). According to the Cardiac Rehabilitation Clinical Practice Guideline (3), coronary heart disease is the ''leading diagnosis in the United States for which patients receive premature disability benefits under the Social Security system.''

Many variables have been examined in research concerning return to work of cardiac patients with inconsistent results. Knowledge of these variables, however, is essential in counseling patients as to the likelihood of going back to work successfully. Rost and Smith (4), in fact, used return to work as the variable predictive of emotional distress after an initial myocardial infarction (MI) in 143 patients. Emotional distress, while not different when measured at hospital discharge between the group that ultimately returned to work compared to those who did not, decreased only in those who returned to work when examined at 4 and 12 months later.

The issue of return to work is a complex one. Confronting psychological, social, and economic issues together with the physiological, the usual focus of research, is crucial (5). The variables studied in return to work research can be categorized into the following: (1) demographic; (2) clinical; (3) psychosocial; and (4) workplace-related. Differing populations, instruments for data collection, definitions of terms and interrelatedness of the variables themselves can cause inconsistency in findings

DEMOGRAPHIC FACTORS

A wide range of demographic variables is generally included in return to work research. Most frequently, age, gender, ethnicity, socioeconomic, marital, and occupational status are measured. Both age and gender have been used as exclusionary criteria as well. Although these variables are not modifiable, they are meaningful when estimating an individual's possibility of returning to work and should be included in a vocational assessment.

Of all variables, younger age is most frequently associated with successful return to work (6–8), as is more education (8), although education is not a consistent predictor (9,10). Men more often return to work than do women (6,8,11), possibly because women develop cardiac disease later in life, closer to retirement age, resulting perhaps in a decision not to return to employment. Obtaining a sample of working women with cardiac disease has proved challenging (9) because of the later onset of disease as well as employment patterns of older women. Current participation of women in research studies ranges generally between 10 and 20%. With the trend of an increasing percentage of aging women in the workforce, study participation may increase.

Riegel and Dracup (12), in comparing a matched sample of 64 men and women as to psychosocial adjustment, functional class, and return to work after an initial MI, found no difference at 4 months between the two groups. Pravikoff (9) also found no significant difference between men and women in either the outcome of return to work or the time it took to return to work. However, in the latter study, women comprised only 13.3% of the sample population.

White collar workers and those with higher socioeconomic status return to work more frequently than do blue collar workers (8,12,13) White collar positions may be those requiring less physical work and may offer more control over the work environment, making return easier.

Marital status, neither frequently studied nor frequently significant in return to work, was important in one study (9). Being married or in a close relationship was predictive of both return to work and the timing of return to work—those not in a close relationship returned to work later than those who were.

CLINICAL FACTORS

Clinical factors include those variables related to the patient's physical status. Some physicians use these factors in predicting recovery and recommending work resumption. Yet they are even less consistent than demographic factors in successfully predicting return to work. Clinical factors include disease severity, pain, functional capability, overall disability, and treatment influences such as medications or physician's advice.

None of these variables is consistently successful in predicting return to work. Disease severity, frequently discussed in research studies, was found significant in few. Obviously, patients with severely impaired ventricular function resulting in chronic heart failure have a decreased chance of returning to work, although this is not always the case (14). The timing of the heart failure—whether it occurs during or following hospitalization—is apparently important, with ''patients with complications during the acute phase of illness and patients with longer hospitalization'' being less likely to return to work (15).

Duration of sick leave from work, a possible indicator of disease severity, was consistently found to be a predictor of return to work in cardiac patients (6,7,16). The majority of studies were in coronary bypass surgery (CABG) patients and were frequently conducted in countries where the healthcare system may have necessitated a wait for surgery (7,16), resulting in delays and increased time away from work.

Functional capability as measured by exercise capacity has been found significant in several studies (7,15,17,18). Patients with higher exercise capacity both at hospital discharge and after rehabilitation resumed work more frequently (19,20). An objective measure such as exercise testing also gives confidence to physicians in advising patients as to safe activity levels and, in fact, an earlier study (21) found advice of physicians to be the most significant predictive variable regarding return to work in 187 patients after MI. Cardiac rehabilitation, formalized exercise training, however, has been disappointing in its failure to affect return to work rates in cardiac patients (3). After several decades of the existence of this type of program, it is discouraging that more is not known about its possible benefits, some of which are difficult to measure in a controlled research environment—and yet are apparent in clinical experience—increased optimism, confidence, energy level, social functioning, decreased anxiety and depression.

The results of the exercise test must be evaluated against the physical work demands, responsibilities, and specific tasks of the individual's job, all of which should be known to the physician to allow recommendations for return to work based on accurate information. However, as most jobs in today's work world have only sporadic physical demands, the sustained work required on a supervised exercise test is generally more than adequate to test physical capability of job performance.

Extremely important in this ''mix'' of variables is the patient's own assessment of functional capacity. In the Mark (8) study of 1252 cardiac patients, the strongest predictor of return to work after 1 year following a cardiac event was functional status, measured by the Duke Activity Status Index, a self-report evaluation of individual capability at a point in time.

Any chest pain experienced by a patient must, of course, be evaluated, but also has not been found consistently significant in its association with return to work. More reliable as an indicator in patients after CABG (7,16,22) than in patients after MI (8,15), the importance of chest pain may lie not only with its intensity but also when in the recovery period it occurs, whether or not it was anticipated by the patient, and its meaning to the patient.

PSYCHOSOCIAL FACTORS

Depression, frequently included as a psychosocial factor in research concerning cardiac patients, was found to predict return to work in several studies (8,13). Social support, a well-known and often-used but difficult to define variable, may be important in return to work—not only in substance, but in timing. In one study (12), patients who experienced less family support than desired at 4 months following an MI, but who had been overprotected at 1 month, returned to work at a higher rate than others receiving higher levels of support. In another study (11), a more moderate degree of social support resulted in a more rapid return to work. Other researchers have examined social support (16,24), social functioning (10), and patient satisfaction with social activities (23) and found them not associated with return to work.

Patients' perceptions of their ability to return to work is a variable of considerable importance, yet studied only sporadically. As mentioned earlier, the specific meaning of pain or exercise capability to the individual in terms of job performance should not be ignored. Additionally, the meaning of the job to the individual, its place and value in his or her life is worthy of assessment. Expectations the patient has about return to work are also important. Self-efficacy, a form of expectation, regarding return to work was found to be the most significant predictor of return to work in two studies (9,24). Fitzgerald (24) studied 82 PTCA patients while Pravikoff's sample (9) included 158 patients following MI or CABG. Additionally, Maeland and Havik (25) found that expectations of future capabilities that may be related to later functioning may NOT be related to actual physical impairment, stressing again the importance of individual perception as a predictor for return to work.

WORKPLACE FACTORS

Of all the factors involved in return to work of the cardiac patient, those related to the actual job or work environment have received the least attention. These include job satisfaction, physical requirements of the job, and job strain. Of these, only job requirements were found to be associated with return to work. Aside from actual physical work requirements, incorporated in this category may be components such as job control or flexibility, prestige, and even some aspects of job stress. In addition, Burgess (11) found that patients who did not recognize reemployment barriers such as hesitancy on the part of management or inflexibility of work hours, returned to work earlier than those who believed these obstacles existed.

SUMMARY OF RETURN TO WORK VARIABLES

The return to work literature has several problems that must be considered. Return to work is rarely the outcome variable around which a study is designed (2,9). Usually, it is an additional endpoint in a study with a different or related focus and only a subset of the original sample is evaluated. Unfortunately, a study cannot be relied upon to answer a question it was not designed to answer. Additionally, the definition of return to work is often inconsistent, sampling bias may exist in that healthier patients may, or *may not* be, offered an intervention such as cardiac rehabilitation, and the social or political environment—both in a micro (institution level) and macro (community level) sense—may affect the sample as well as the outcome.

In the current environment, no variable is always associated with return to work following a cardiac event. Those patients who were younger, more highly educated with higher socioeconomic status, greater exercise capacity, less depressed with less time away from work and jobs with fewer physical requirements and who also had higher expectations of returning to work did so more frequently. Income, occupational status, race and marital status, disease severity, ejection fraction, chest pain, social support, and job satisfaction were less dependable as predictive of return to work.

IMPLICATIONS FOR VOCATIONAL COUNSELING

The decision to return to work is actually a two-part decision that includes both *if* the patient should return and *when* this return should take place. In this age of the importance of "outcomes" in healthcare, return to work is actually a very meaningful outcome to measure, more so, perhaps, than length of stay in the hospital or other benchmarks currently being used. It is important for the clinician to include this goal, when appropriate, as part of the initial care planning for the patient.

There are several components to the decision-making process about return to work. Knowledge of the physical and emotional status of the patient and those factors mentioned above is, of course, fundamental to the process. However, the health care provider should also know: (1) job duties and tasks, (2) physical requirements of the job; (3) attitude of the patient toward the job and workplace; (4) status of the work environment and culture; (5) barriers that exist at the workplace which might hamper return to work; and (6) hazards at the workplace that might be harmful to the patient. This knowledge is essential to determining the balance between individual capacity to perform the job and the requirements of the job to be performed.

Barriers and hazards that could exist at the workplace include both employer and coworker attitudes and fears about cardiac patients, employer unwillingness to modify jobs, reduce total hours worked, or allow part-time hours upon initial return to work, poorly designed work areas, requirements for shiftwork, job stress, chemicals such as carbon monoxide, organic nitrates, chlorinated hydrocarbons, carbon disulfides and other solvents, temperature extremes, or noise. Many of these barriers can be overcome through education and communication with the employer or an occupational health nurse.

Cardiac rehabilitation is even more important today in return to work than previously. Emphasis on decreased length of stay in the hospital results in decreased time for patient education, decreased exercise and monitoring time in the hospital, and decreased time to talk with the patient about fears and concerns about resuming previous activities and life. A cardiac rehabilitation program that incorporates not only supervised exercise but also education and counseling regarding risk factor modification and behavioral interventions is important in recovery of these patients. It is important to note that although the worker's functional capacity may be reduced as a result of the cardiac event, most jobs can still be performed safely and efficiently. Only a small percentage of jobs in today's work world in the United States require great physical energy. On the other hand, there is a fallacy in assuming that the exercise test can mirror all physical requirements in a work position (5). Psychological stress, climate, and other requirements of the job may add to energy requirements. The clinician making recommendations for return to work must be cognizant of these factors.

Mital and Shrey (26) recommend the use of an ergonomist as part of a vocational assessment in cardiac rehabilitation. Ergonomists can be useful in assessing transferable work skills as well as developing work hardening programs, examining possible job redesign or restructuring, light duty, or permanent job reassignment.

Finally, the healthcare provider will determine that some patients are unable to return to their current job and yet need and want to be employed. Early identification of these patients and referral to vocational rehabilitation will give them the best opportunity to remain economically self-sufficient. A vocational rehabilitation program will include an evaluation, counseling, retraining, if necessary, and assistance with job placement. The healthcare provider should remain part of the rehabilitation team with the goal of returning the patient to the highest possible level of functioning.

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Education for Special Populations

Alan J. Goble
Heart Research Center, Carlton, Victoria, Australia

Patient education in cardiac rehabilitation was built around the needs of patients with coronary heart disease. While much of the information supplied to such patients is not applicable to other special patient populations, the gains from education are similar in all groups. The patient learning process is the same. The desired outcomes are the same as those sought to be achieved in patients with coronary heart disease.

The desired outcomes include the minimization of physical and psychological disability, maintenance of social integration, resumption or retention of work within the patient's physical and psychological capacity, and a lifestyle that leads to delay or prevention of disability, recurrent events, and death. These issues have been reviewed in the Report of a WHO Expert Advisory Committee of 1993 (1).

EXERCISE

Most cardiac rehabilitation programs devised for coronary heart disease patients have been built around exercise programs onto which educational programs have been grafted (2). This is somewhat in conflict with the view of the recent past that patients with heart failure, cardiomyopathy, hypertensive heart disease, and rheumatic or congenital heart disease should lead restricted lives. It had been thought that increasing levels of exercise in such patients could lead to further deterioration of myocardial function, the provocation of cardiac failure, serious arrhythmias, or possibly death. Thus there remains a view within the community and among many medical practitioners that patients in these special groups should

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restrict their activity. It is now recognized that, regardless of the diagnosis, gradually increasing levels of exercise within the patient's capacity and without the production of significant discomfort, can safely lead to increasing physical performance due to peripheral muscle training. This improved function is related to better utilization of oxygen by the muscles and is accompanied by structural and functional changes in the muscle cells (3,4). Thus the first step in the education of these patients is for health professionals to teach that physical activity within the patient's capacity is beneficial, and that it will lead to improvement in function similar to that which is achieved by patients with coronary heart disease. Teaching, coupled with demonstration of safety and supervised group exercise activity, should overcome this first barrier to patient rehabilitation.

NUTRITION

A major consideration for patients with heart conditions other than coronary heart disease is that many of them are not overweight. Wasting is common among patients with cardiac failure and cardiomyopathy. This is particularly so in developing and transitional countries where infectious diseases such as rheumatic fever and acute myocarditis underlie widespread prevalent chronic rheumatic heart disease and cardiomyopathy (5). Thus, for many of these patients, nutritional advice concerns how best to maintain weight and muscle mass through adequate protein and fat intake in addition to a diet based upon grain foods and vegetables.

SEPARATE PACKAGES

Patients with impaired cardiac function or heart failure due to cardiomyopathy, hypertensive heart disease, Chagas disease, Kawasaki's disease, and rheumatic heart disease are not interested in learning much about coronary artery disease. Similarly, patients and parents of patients with congenital heart disease, or recent rheumatic fever, are not interested in hearing about coronary heart disease. Further, the patient with coronary heart disease is equally uninterested in other forms of heart disease.

It is widely accepted that patients with coronary heart disease of all types, together with patients and families at high risk of coronary heart disease, can beneficially be enrolled in the same educational programs. This does not apply to special groups with cardiac disability that is not due to coronary heart disease. The latter groups of patients require different educational packages to satisfy their specific needs for learning. Interactive group discussion is the best means whereby patients improve their learning and understanding. It is therefore desirable that group discussions be held for these patients and their families, separate

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from those with coronary heart disease. Further, it is desirable that each of the special patient populations is separated from each other for at least part of their guided education.

BEHAVIORS

The emphasis on weight loss and control of cholesterol levels is irrelevant to many patients with severe heart disease from causes other than coronary heart disease. The two important adverse behaviors in common are physical inactivity and cigarette smoking. Among noncoronary patients, the aim of physical activity is to assure preservation of, or maximal recovery of, muscular strength for the activities of daily living, maintenance of general fitness, and for the resumption of work. All patients merit specific education about the hazards of cigarette smoking, including the progressive development of respiratory disease additional to the already existing cardiac disease. Smoking may increase disability and chance of death through aggravation of heart failure, or through pulmonary complications of cardiac surgery.

MEDICATION

In all societies one of the major problems is nonadherence by patients to regimens of medication prescribed by physicians for defined purposes. Thus it is necessary that patients understand fully the reasons for their medication and their intended effects, together with their adverse possible reactions. Regimens of treatment should be explained and the need for adherence fully understood. The regimen has to be uncomplicated and affordable for the patients.

HEART FAILURE

Patients with heart failure from any cause have to understand the nature of the underlying condition, the basis for the diagnosis, maintenance of stable weight, control of fluid intake, and the need for avoiding salt. They further have to accept the desirability of vaccination against influenza and pneumonia. They must understand the need to see their doctor at regular intervals and to adhere to medication. They have to learn the adverse effects of medications, to discuss the possibility of such adverse effects with their doctor, with a view to modification of treatment.

Modification of treatment may be to change from a short-acting, powerful loop diuretic such as frusemide (or furosemide) to a more bland thiazide diuretic. This change may enhance compliance because the diuresis is less obvious and imperative. Patients have to understand about the dosage schedules with drugs. Should a beta-blocker (such as carvedilol) or other drugs with vasodilator effects be added (such as felodipine or amlodipine, nitrates, prazosin or hydralazine), these drugs must be introduced under careful medical supervision. Patients have to know that improvement is usually expected in their condition and that the degree of improvement cannot be determined at the beginning of drug treatment. They further have to know that medication must be continued on a long-term basis, rather than regarded as a course of treatment. They also must understand the significance of increasing weight, ankle swelling, breathlessness, and fatigue.

HYPERTENSIVE HEART DISEASE

The progressive development of left ventricular hypertrophy and dysfunction leading to congestive heart failure was common among patients with severe hypertension in the past. In some societies, particularly among the disadvantaged, this problem is still sometimes seen, either with or without associated coronary heart disease. Progression of hypertensive heart disease is preventable, even reversible, with modern and adequate therapeutic management of high blood pressure. Patients must know that permanent medication is required, although the medication may be modified over time as better agents become available. The other healthcare measures to be learned are similar to those for patients with coronary heart disease or with heart failure. However, the need for control of blood pressure to prevent stroke should be highlighted.

RHEUMATIC HEART DISEASE

Patients with rheumatic heart disease may require any of the above medications to control heart failure, but additionally require, for years or decades, prophylactic treatment with penicillin to prevent rheumatic fever recurrence. This may be taken orally or, if more suitable to the family, to assure better compliance, taken by intramuscular injection of long-acting penicillin.

Patients with rheumatic heart disease and atrial fibrillation have to learn that they should take permanent treatment with digoxin or other medication to control ventricular rate and to avoid consequent recurrent congestive heart failure. Such patients also, together with most who have had prosthetic valve replacement surgery, have to understand long-term management with anticoagulant treatment, usually with warfarin. The consequent need for regular blood tests and awareness of the possibility of bleeding complications must also be learned and followed.

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The need for antibiotic prophylaxis against infective endocarditis from dental extraction and other surgery has to be stressed repeatedly.

CONGENITAL HEART DISEASE

Patients and families of patients with congenital heart disease have to understand that surgery for congenital heart disease is expanding and improving and that facilities for surgery are becoming more widely available, thereby offering hope to them and to their families.

In patients with congenital heart disease, the same considerations apply as to those with rheumatic heart disease, concerning control of heart failure, arrhythmia, dental hygiene and antibiotic prophylaxis and, sometimes, anticoagulation. Children with congenital heart disease and their parents may require future career and job counseling.

HOPE AND DESPAIR

Patients with heart failure from any cause know that they have a poor prognosis. They are frequently aware of significant and disabling symptoms. They may be anxious about their future or the future of their families and hence commonly have associated depressive symptoms. The depression is more subtle than in patients after acute coronary events. This masking of depression is because the pattern of disability has often appeared gradually, rather than appearing abruptly after an acute illness. Patients need reassurance that their condition can be controlled with medication or, under favorable circumstances, reversed through valvular or other cardiac surgery. In the light of these possibilities, it is important that all patients should have some understanding of their own condition, its cause, its anatomy, and its modifiable rather than inexorable progress.

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Quality-of-Life Assessment in Secondary Prevention

Laura L. Kee
University of California, San Francisco, California

The ultimate goals of cardiac rehabilitation are to maximize patients' functional ability and to enhance their sense of well being through prescribed exercise, education, counseling, and behavioral interventions (1). These goals can be assessed through the evaluation of quality of life.

What is quality of life? The concept of quality of life is extremely complex, eluding a universally acceptable definition. While quality of life encompasses a broad spectrum of dimensions, including social and environmental issues, clinicians and health science researchers are particularly interested in those aspects of quality of life that are directly affected by alterations in health. This aspect of quality of life is referred to as health-related quality of life (HRQOL). Despite the lack of consensus on a definition of quality of life, authors agree upon the properties of the concept: that it is multidimensional, subjective, and variable with time (2,3). Scientists evaluating HRQOL initially focused on morbidity and mortality; but as interest in the concept grew, they included the major dimensions of physical health, daily functioning, psychological and social functioning, and perceptions of satisfaction and a general sense of well being (3). Table 1 illustrates various issues addressed in HRQOL assessment.

Quality of life attributes may differ for subgroups of patients with various cardiac diseases. The concerns and responses of patients with stable angina (predictable exertional chest discomfort) differ from those with unstable angina (frequent chest discomfort, death). When treatments have marginal differences in morbidity and mortality, measures of HRQOL as outcomes may be more helpful in guiding the choice of therapy. Assessment of HRQOL may reveal information on how illness and recovery are affecting patients' lives, which is not typically

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Table 1 Components of Health-Related Quality-of-Life Measures

Dimension	Indicators	Examples
Physical	Activity level	Ability to perform activities of daily living
	Mobility	Ability to ambulate freely, need for assistance
	Strength, energy	Level of endurance
	Symptoms	Limitations due to discomfort
Psychological	Affective states	Psychological distress/well-being, anxiety, depression, behavioral/emotional control
	Cognitive	Memory, alertness, problem solving, comprehension
Social	Social interaction	Desire for and frequency of contact
	Role functioning	Ability to function in normal social roles in family, community
	Intimacy	Sexual interest and ability
General sense of well-being		General self-rating or perceptions of health and well-being

obtained during outpatient visits. Patients may not consider particular issues ''important enough'' to tell their physician or nurse practitioner, or they may forget about them unless specifically asked. Assessment of HRQOL can also assist with monitoring the effect of treatments or screening for patients requiring specific interventions such as psychological treatment. In addition, when clinicians are concerned about quality-of-life issues, patients most often feel that their clinicians are interested in how they are feeling and responding to the healthcare offered to them. The questionnaire may also bring to the attention of the physician or nurse difficult issues such as compliance and sexual dysfunction and provide an avenue to discuss them.

Many instruments have been developed to measure HRQOL and can be categorized into disease-specific and generic instruments. Disease-specific instruments focus on particular disease states, problems, or patient populations and can detect small, clinically significant changes. The advantages of disease-specific instruments are their focus on particular problems of interest and the sensitivity of the measures to change within individuals. However, the applicability of disease-specific instruments is limited, addressing issues related only to the particular population for which the instrument was developed (4).

Generic instruments are designed to cover a wide spectrum of conceptions of HRQOL and to allow global assessments of patients. Health profiles are single instruments with multiple items that cover a broad range of quality-of-life issues. They address the primary dimensions including physical, mental, and social function. For example, the Sickness Impact Profile can yield specific category scores, dimension scores, or a global total score. The advantages of using a health profile are that one single instrument rather than multiple instruments can be administered, which saves time of both patients and investigators and provides comprehensive assessment. In addition, incorporation of many dimensions of QOL into one instrument contributes to its utility in many situations (4). In fact, the breadth of the instrument leads to the potential of uncovering unexpected findings (5). The disadvantage of health profiles is that the instrument may take longer to administer and may not focus on the specific interest of quality of life. The lack of specific focus can result in lack of sensitivity, particularly if the intervention does not specifically affect an area of quality of life measured by the instrument.

There are practical ways in which to incorporate quality-of-life assessment into clinical practice. HRQOL can be assessed in the outpatient setting without significant burden to the patient or clinician. Patients can fill out questionnaires while waiting for their appointment. These can all be self-administered or administered as an interview to the sensory-impaired, very sick, or frail elderly person by a clinical nurse specialist. If it is difficult to make assessments during office visits, clinicians can coordinate assessment with the cardiac rehabilitation team.

While the literature about HRQOL in cardiac patients is growing, there are major limitations in the studies reported due to the deficiencies in study designs and the breadth of the issues addressed. Authors of one meta-analysis of HRQOL in cardiac patient research found a small, but significant, positive effect of pharmacological, mechanical, surgical, nursing, or other interventions on HRQOL in the 84 studies they reviewed (6). However, they cited concerns of narrow focus on physical limitations and the use of inadequately tested instruments. In addition, the analysis revealed a lack of longitudinal data beyond 3 months.

The Medical Outcomes Trust, a nonprofit private corporation that reviews outcome measures and publishes newsletters relevant to issues of medical outcomes, has recommended the Medical Outcomes Study (MOS) and the Sickness Impact Profile (SIP) as being solid and reliable instruments (7). The instruments have been designed to minimize the efforts of the patient and clinician to complete and analyze the questionnaires. The most commonly used version of the MOS is the SF-36, with 36 items scored on a Likert scale. The SIP is a 138-item questionnaire that is simple for patients or families to complete, as it requires endorsement of statements with a check mark if the statement is true and is related to the cardiovascular condition. Both instruments have undergone extensive testing for validity, reliability, and sensitivity to change. If the clinician has specific concerns about a patient, such as depression, there are other instruments that address the specific problem more thoroughly and can be used selectively to make additional assessments.

Most studies evaluate change of HRQOL over a relatively short time span of three to six months. One randomized clinical trial evaluated HRQOL over 10 years in a cohort of 258 patients who had sustained acute myocardial infarction

(8). The data showed that overall HRQOL and physical functioning were similar at baseline and 3 months, improved at 6 months, and worsened at 10 years. Data showed that impairment in psychosocial functioning occurred soon after acute myocardial infarction. Despite improvements in HRQOL at 6 months, 6-month scores of the Physical Dimension, the individual categories of Home Management, Mobility, and Work, and the total score of SIP were predictive of increased risk of death by 10 years. Data showing that psychosocial function is an issue early after acute myocardial function and physical function later in the course of the illness provide insight to clinicians in determining appropriate interventions and resources at the time that they would be most beneficial to patients.

The benefits of cardiac rehabilitation can be evaluated largely through assessment of HRQOL (9). Assessment of HRQOL can be incorporated into clincial practice to evaluate outcomes beyond functional performance and symptom assessment. Clinicians can obtain revealing information of patients' HRQOL with the use of well-developed, yet simple instruments that obtain patient responses about their physical function related to daily life and psychosocial issues.

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SUGGESTED READING

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The New Infrastructure for Cardiac Rehabilitation Practice

Patricia McCall Comoss
Nursing Enrichment Consultants, Inc., Harrisburg, Pennsylvania

INTRODUCTION

Looking back from the threshold of the year 2000, cardiac rehabilitation practice has a long history with a deep foundation. It began subtly with inpatient changes nearly 50 years ago (1), became a distinct outpatient entity in the 1970s (2), gained scientific credibility in the 1980s (3), and experienced accelerated evolution in the 1990s (4). During this decade, multiple forces converged to shape and reshape contemporary practice. Together, voluminous scientific evidence, decades of practice experience, and the increasing pressures of health care economics dynamically redesigned the external boundaries and the internal specifications of cardiac rehabilitation. Figure 1 illustrates the impact these forces have had on major structural features of outpatient cardiac rehabilitation.

As a result, the current challenge for cardiac rehabilitation specialists is to assure that their practice meets established expectations and that their programs emerge into the new era recognized for the quality and value of the services they provide. New programs must be based on contemporary models. Existing programs have to be remodeled to match. Conceptually, most of today's cardiac rehabilitation practitioners understand the urgency of updating their programs; practically, many do not know where to start. The answer begins in this chapter.

As a backdrop for the subsequent chapters in this section, the purpose of this chapter is to outline the general framework of contemporary cardiac rehabilitation and specifically to emphasize the new infrastructure that has emerged to support how outpatient cardiac rehabilitation is currently practiced. Compatible

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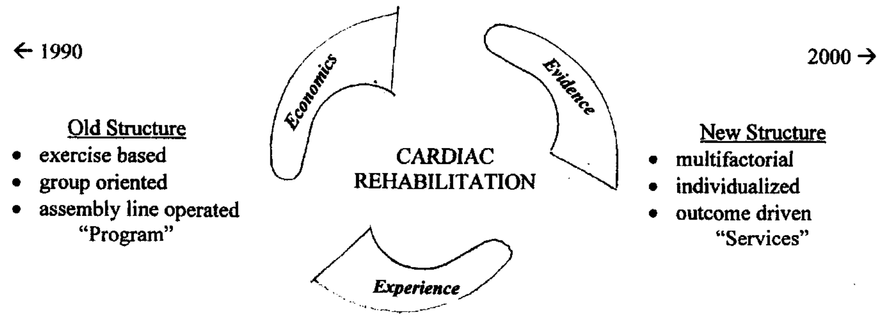

Figure 1 Forces of change reshaping contemporary cardiac rehabilitation practice.

with this new structure, this section is intended to provide practical advice and actual examples to help move cardiac rehabilitation forward. Emphasis is on how to integrate this information into daily practice.

DESIGNING PROGRAMS

Like any construction initiative, the building of a solid cardiac rehabilitation program begins with a purpose and a vision. Both are inherent in the definition expressed by the panel of national experts that participated in the recent project to develop the Clinical Practice Guideline on Cardiac Rehabilitation for the Agency for Health Care Policy and Research (AHCPR).

> Cardiac rehabilitation is characterized by comprehensive long-term services involving medical evaluation; prescribed exercise; cardiac risk factor modification; and education, counseling, and behavioral interventions. This multifactorial process is designed to limit the adverse physiologic and psychological effects of cardiac illness, reduce the risk of sudden death or reinfarction, control cardiac symptoms, stabilize or reverse the atherosclerotic process, and enhance the patient's psychosocial and vocational status. Provision of these services is physician-directed and implemented by a variety of health care professionals. (Ref. 5, p. 1.)

Thus, the implicit purpose of cardiac rehabilitation is secondary prevention and the explicit goal is optimal outcome achievement. Clearly, the vision is of a process that has available a collection of services to address each and every cardiac risk factor (multifactorial) and that applies appropriate services to each patient's particular set of identified and prioritized rehabilitation needs. Converting the vision into reality requires some engineering.

The Foundation

For over 25 years, the basis of cardiac rehabilitation practice has been formed by the collective wisdom of professional groups involved in the field (6). Chief among these architects today are the American Association of Cardiovascular and Pulmonary Rehabilitation (AACVPR), the American College of Sports Medicine (ACSM), and the American Heart Association (AHA) each of which continues to produce standards, guidelines, and other directives that refine and reinforce the form and function of cardiac rehabilitation. These documents are the foundation upon which cardiac rehabilitation programs must be built. Table 1 provides a source list of the most recent documents.

The Framework

Once the foundation is laid, next comes the overall framework that houses cardiac rehabilitation. Historically, cardiac rehabilitation was framed in sequential, numerically labeled phases. Currently, while the general sequence remains intact, the use of phase numbers is less common and can be confusing. Varying lengths of stay and alternate sites of service can result in overlapping and interchanging rehabilitation ''phases.'' Therefore, verbal descriptors are now more useful. Additionally, new transition zones have developed in response to shifts in the cardiac rehabilitation timeline. Transition zones serve as bridges between traditional phases of rehabilitation.

Figure 2 illustrates the new framework. Functional characteristics are listed for each major rehabilitation segment.

The first of the new transition zones connects inpatient and outpatient cardiac rehabilitation by providing options for post acute care recovery services. Many patients leave the hospital a few days after cardiac events or interventions but are not yet able to completely care for themselves. Obviously, their inpatient cardiac rehabilitation program was equally short. To provide skilled care and continue early rehabilitative efforts, those patients who qualify may be transferred to a subacute facility, such as a skilled nursing unit or a rehabilitation hospital, or they may be referred to a home care agency for follow-up. In contrast, those patients who do well and do not require transitional care can enter the outpatient program within 1 to 2 weeks of hospital discharge to continue their low-level recovery (pretraining phase) under professional guidance.

Following the outpatient cardiac rehabilitation period, the second transition zone provides a step-down option for those patients who have participated in a monitored outpatient program. This weaning phase eases the transition from a monitored through a supervised to an unsupervised independently managed main-

Table 1 Suggested Standards Documents for Cardiac Rehabilitation Program Library

Guidelines for Cardiac Rehabilitation and Secondary Prevention Programs, 3rd ed. American Association of Cardiovascular and Pulmonary Rehabilitation Human Kinetics Publishers, Champaign, IL 61825 800-747-4457	1999
Clinical Practice Guideline on Cardiac Rehabilitation (96-0672) U.S. Department of Health and Human Services, Public Health Service, Agency for Health Care Policy and Research (AHCPR) 800-358-9295	1995
Core Components of Cardiac Rehabilitation Secondary Prevention Programs American Heart Association (AHA), and the American Association of Cardiovascular and Pulmonary Rehabilitation 800-AHA-USA1	1999
Preventing Heart Attack and Death in Patients with Coronary Disease American Heart Association, National Center (71-0070) 7272 Greenville Ave., Dallas, TX 75231 800-AHA-USA1	1995
Guidelines for Exercise Testing and Prescription, 5th ed. American College of Sports Medicine (ACSM) Williams and Wilkins, Publishers Rose Tree Corporate Center 1400 N. Providence Road #5025 Media, PA 19063 800-486-5643	1995
Core Competencies for Cardiac Rehabilitation Professionals Position Statement of the AACVPR Journal of Cardiopulmonary Rehabilitation, March 1994	1994
The Scope of Cardiac Rehabilitation Nursing Practice American Nurses Association (ANA) American Nurses Publishing 600 Maryland Ave. NW, Suite 100 West Washington DC 20024 800-637-0323	1993

tenance program. Emphasis is on reinforcing self-management skills and evaluating options for exercise maintenance. Mainstreaming patients back into the community is the goal.

Within this framework, flanked by the two transition zones, is outpatient cardiac rehabilitation. Externally, only superficial refurbishing may be evident. However, inside, the outpatient space is being transformed.

INPATIENT	TZ	OUTPATIENT	TZ	LIFETIME
• Provide aggressive ambulation • Emphasize survival education • Do predischarge preparation	Refer to subacute facility or home recovery program or early outpatient program	• Encourage early start • Adjust length of stay • Choose surveillance options	Offer short-term weaning program instead of ongoing maintenance involvement	• Teach self-management skills • Mainstream maintenance • Schedule regular follow-up

Abbreviation: TZ= transition zone.

Figure 2 Framework for cardiac rehabilitation programs.

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DEFINING PRACTICE

In addition to providing scientific validation of the benefits and value of cardiac rehabilitation, the AHCPR Clinical Practice Guideline presented a new model—a blueprint—for cardiac rehabilitation practice. Figure 3 provides a complete reproduction. The blueprint clearly reflects the secondary prevention purpose of cardiac rehabilitation. Moving the blueprint from paper to practice to fulfill that purpose requires the installation of a new infrastructure in the outpatient setting.

Recognition of two themes that are woven into the Guideline blueprint provides a starting point for converting the design into action. First, the blueprint illustrates the coequal placement of education, counseling, and behavioral interventions with exercise as essential cardiac rehabilitation services. No longer can cardiac rehabilitation be characterized as solely an exercise program. No longer can exercise programs label themselves as cardiac rehabilitation.

Second, through its decision tree sequence, the blueprint emphasizes the importance of individualizing services to meet each patient's specific needs. No longer is cardiac rehabilitation a one-size-fits-all program. No longer is any service component mandatory for every participant.

With these themes in mind, two action steps are needed to expand and individualize services to meet blueprint specifications: (1) prepare the new infrastructure; and (2) apply its components to each patient's case.

Preparation

Since exercise and education/counseling are now viewed as equally important to achieving secondary prevention goals, modeling/remodeling of cardiac rehabilitation requires the development of tools and techniques to support expanded practice. Two of these tools are major cornerstones of the new outpatient infrastructure: service menus and intervention modules.

Service Menus

Each program, new or old, has to develop an itemized list of services that will be offered. The list should be organized according to the two main functional headings of education/counseling/behavioral services and exercise services. Table 2 provides a sample. The number of services any program can offer is dependent upon available resources. All programs will not be able to provide all the services suggested. Regardless of the number, some services in each category are essential to meet described expectations. Part II of this book provides the rationale and recommendations for a number of exercise services listed on the menu. And, as emphasized in Part III, education/counseling/behavioral services must focus on risk factor reduction if optimal outcomes are to be realized.

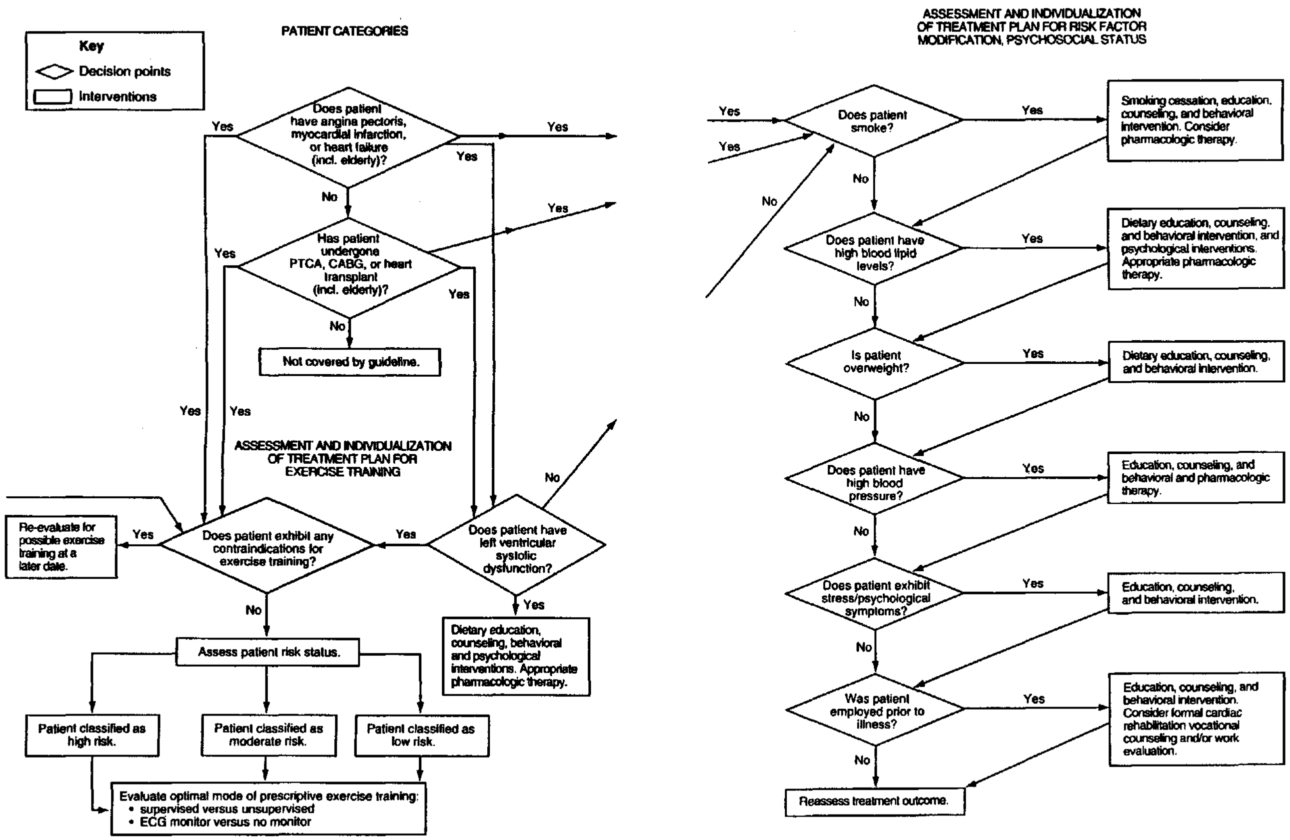

Figure 3 Decision tree for cardiac rehabilitation services. (Reprinted from Ref. 5.)

Table 2 Sample Menu of Services: Outpatient Cardiac Rehabilitation

Exercise services	Education/counseling/behavioral services
Emphasis on risk stratification	Emphasis on risk reduction
☐ periodic exercise "check-ups"	☐ blood pressure monitoring/management
☐ prescription/instruction for independent maintenance	☐ complementary therapies
☐ prescription/instruction for unsupervised training	☐ diabetes education
☐ pretraining exercise orientation	☐ lipid monitoring/management
☐ professionally supervised exercise training	☐ medication teaching/compliance monitoring
☐ resistance/strength training	☐ periodic risk factor "check-ups"
☐ submaximal fitness testing	☐ psychological referrals
☐ symptom-limited exercise stress testing	☐ self-monitoring skills
☐ telemetry-monitored exercise training	☐ smoking cessation program
☐ telephone follow-up of home-based exercise	☐ support groups (patients, spouses)
☐ transtelephonic ECG monitoring of home-based exercise	☐ stress management class
☐ weaning/transition program	☐ vocational counseling
	☐ weight loss program

Intervention Modules

A module is a collection or package of materials, policies, protocols, and other resources that will be used to perform each item on the service menu. It establishes the standard of care or practice guideline for that specific service. For example, each exercise option will require a descriptive policy and a how-to protocol while modules for education/counseling/behavioral services should include: (1) content outline (lesson plan); (2) samples of handouts and audiovisual materials to be used; (3) documentation tools required; and (4) options for how the service will be delivered (1 : 1 teaching, small group classes, referrals to experts, and/or self-learning opportunities).

Supporting references should also be included. Most importantly, national guidelines, available for each of the major risk factors, should be used as the source documents for the educational content and behavioral counseling strategies included in each module. Table 3 provides a coordinated list of current national risk reduction guidelines.

Table 3 National Documents Supporting Risk Reduction Efforts in Outpatient Cardiac Rehabilitation

Risk factor	Education/counseling service	Supporting documents
Diabetes mellitus	Diabetes education	American Diabetes Association (ADA): 1. Diabetes Education Goals, 1995 2. The Health Professional's Guide to Diabetes and Exercise, 1995 ADA, Alexandria, VA; 800-ADA-ORDER
Dyslipidemia	Lipid monitoring/ management	National Institutes of Health (NIH): Adult Treatment Panel (ATP) II = Second Report of the Expert Panel on Detection, Evaluation, and Treatment of High Blood Cholesterol in Adults, 1993; 301-251-1222
Hypertension	Blood pressure monitoring/ management	National Institutes of Health (NIH): Joint National Committee (JNC) VI = The 6th Report of the Joint National Committee on Prevention, Detection, Evaluation, and Treatment of High Blood Pressure, 1997 301-251-1222
Obesity	Weight control	1. National Heart, Lung and Blood Institute (NHLBI): Expert Panel on the Identification, Evaluation, and Treatment of Obesity in Adults, 1998 301-251-1222 2. American Heart Association (AHA): Guidelines for Weight Management Programs for Healthy Adults, 1994; 214-373-6300
Physical inactivity	Exercise training	1. Agency for Health Care Policy and Research (AHCPR) Clinical Practice Guideline on Cardiac Rehabilitation #17, 1995; 800-358-9295 2. NIH Consensus Statement: Physical Activity and Cardiovascular Health; 1995; 888-NIH-CONSENSUS 3. U.S. Department Health and Human Services (HHS): Surgeon General's Report on Physical Activity and Health, 1996
Smoking	Smoking cessation	AHCPR: Smoking Cessation Clinical Practice Guideline #18, 1996; 800-358-9295

Application

Once this new infrastructure of menus and modules is in place, its operational steps quickly become apparent. Having identified a patient's rehabilitative problems and needs through comprehensive intake assessment: (1) select services needed from each column of the menu; and (2) implement the predesigned modules to deliver the selected services.

Matching services to needs means that each cardiac rehabilitation patient's program will be unique. No two patients will receive the same combination of services. Instead of an assembly-line approach, programs will be individually created from the menu of services as part of planning each patient's care.

Case management, generally recognized as a method of care coordination that assigns expert clinicians to manage individual patients and follow them through the most appropriate course of interventions (7), is the practice strategy that works best with this new infrastructure. A modified case management role is typically used in outpatient cardiac rehabilitation to assign a defined group of patients (a caseload) for each practitioner to follow from rehabilitation entry to exit and beyond through periodic follow-up. The therapeutic relationship thus established focuses efforts, promotes the most appropriate use of services, and assigns accountability for effective and efficient rehabilitative care.

DESCRIBING OPPORTUNITIES

With the new infrastructure securely in place, not only will a cardiac rehabilitation program be able to meet current expectations but it will also be positioned to expand its options and offerings to grow into the future. The chapters in this section of the text are the building blocks that support both efforts.

Chapter 34 highlights the case management strategy briefly suggested above as the best practice method for delivering individualized cardiac rehabilitation services. It compares and contrasts two distinct applications of case management—one in a traditional cardiac rehabilitation setting and the other as an alternate approach. Home-based applications are detailed in Chapter 35, and each of the three examples presented strengthens a section of the framework outlined in Figure 2. From recovery to rehabilitation to lifelong exercise, the home setting is an attractive, affordable, and appropriate setting for many cardiac rehabilitation patients.

Chapters 36 to 38 provide the nuts and bolts to firmly establish the education/counseling/behavioral interventions of the Guideline blueprint (Fig. 3). They explain how to individually assess learning needs and apply teaching interventions to optimize both short- and long-term results. Chapter 36 presents and applies the transtheoretical model for readiness to change. Chapter 37 reviews selected motivational theories with an emphasis on how to involve patients in self-learning. A thorough discussion of adherence factors and compliance promoting strategies is offered in Chapter 38. Together, these three chapters help activate and individualize use of the menu of services recommended previously.

Once construction/reconstruction of a cardiac rehabilitation program is complete, attention shifts to assuring that ongoing operations meet expectations and continue to produce the results for which the updated design was intended. Chapters 39 to 41 focus on quality and effectiveness issues. Two means of process assessment are outlined in Chapter 39; documentation suggestions and samples are provided in Chapter 40; and rationale for and examples of increasingly important outcome measurement are presented in Chapter 41.

Finally, what is all this remodeling worth to the program and practitioners who must do the work? In addition to optimizing rehabilitative patient care, as suggested in all these chapters, keeping programs and practice up to date minimizes risk, as discussed from the legal perspective in Chapter 42 and maximizes value in the ever-changing healthcare economy described in Chapter 43. Patients, physicians, and payers alike look for up-to-date programs that can demonstrate safe, effective, and affordable services.

SUMMARY

This chapter has described a new framework and infrastructure within which to provide outpatient cardiac rehabilitation services. The framework is anchored in a solid foundation comprised of national standards and guidelines. The infrastructure is based upon the blueprint developed by the best scientific experts in the field. Conversion of these designs into practice begins with practical tools. Service menus and their implementation modules are key to changing practice, to establishing new modes of operation so vital to continuing rehabilitation success.

Moving forward across the threshold into the new millenium, the practice of cardiac rehabilitation looks like the vision described at the outset of this chapter—a dynamic process that utilizes a collection of multifactorial services to fashion a unique program for each patient individually. It is the live performance of the Guideline blueprint. Programs and practitioners that have begun the work suggested in this chapter will be counted among the future performers, keeping pace with the continuing evolution that is contemporary cardiac rehabilitation.

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Case Management in Cardiac Rehabilitation

Barbara Tate Unger
Itasca Medical Center and Grand Rapids Clinic, Grand Rapids, Minnesota

Deidre A. Warren
Kaiser Permanente, Oakland, California

INTRODUCTION

Case Management and Disease Management

In the healthcare environment of the late 1990s, case-management terminology is both ubiquitous and ambiguous. Every healthcare practitioner, including those who work in cardiac rehabilitation, has a different idea about what case management is or should be. Many associate it with managed care efforts to control delivery of healthcare services. While the growth of managed care has rapidly increased the use of case management, such approaches have historically preceded and currently exist outside of the managed care domain as well. Primary care models in the nursing field were early predecessors of modern case-management approaches (1). Today, the American Nurses Association recognizes case management as a specialty field of practice and offers nurses the opportunity to become certified as case managers as well as cardiac rehabilitation nurses (2).

Generically, case management is a process of planning, providing, and monitoring care of a designated group of patients over an extended period of time. Specific definitions include:

1. A systematic approach that provides quality healthcare along a continuum, decreases fragmentation of care across many settings, enhances the client's quality of life, and controls costs (3).

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2. An integrated system of care with preventive efforts to guide, monitor, and track over time those individuals who are at highest risk (4).

The single function that most distinguishes case management from other healthcare delivery approaches is centralized coordination of all aspects of care by one professional. Table 1 lists some of the major purposes of such focused care coordination. One of those purposes is to more effectively manage chronic disease.

The concept of disease management has also come into vogue recently. Definitions of disease management echo the preceding descriptions of case management. "Disease management is planned, organized, and systematically delivered care designed to improve outcomes and lower costs for a population of patients with a given condition. It encompasses the entire spectrum of managing, rather than just treating, a given disease" (5). Based on prevalence, cardiovascular problems are at the top of the list for diseases and cases to be managed.

Cardiac Rehabilitation and Secondary Prevention

Cardiac rehabilitation has evolved in the past decade from an exercise-based model to one that more completely addresses comprehensive risk reduction. Secondary prevention, not just functional restoration, is now the goal. Achievement of that goal requires planning and coordination of many patient care services over an extended period of time—case management. Therefore, this chapter discusses how the case-management process can be used to deliver cardiac rehabilitation services. Two distinct examples will be presented: one that places the case-management function in the traditional outpatient cardiac rehabilitation setting; one that provides an alternate approach in a managed care organization. While the physical location of the case managers in these descriptions is different, the care process that each utilizes to achieve secondary prevention goals is remarkably similar.

Table 1 Purposes of Case Management

Control costs
Coordinate appropriate use of resources
Educate/empower patients and families
Evaluate and document outcomes
Facilitate communication and collaboration among providers
Improve quality of services
Integrate care across the continuum
Manage chronic disease
Satisfy customers

CASE MANAGEMENT IN THE TRADITIONAL CARDIAC REHABILITATION SETTING—WITHIN THE HOSPITAL WALLS

Background Description

Two overarching issues in contemporary cardiac rehabilitation increase the attractiveness of case management:

1. Shift in the scope of practice away from an exercise-only program toward one that provides comprehensive risk reduction services.
2. Demand from purchasers and payers to simultaneously increase quality and decrease costs of rehabilitative care provided.

When appropriately used in outpatient cardiac rehabilitation settings, case management can effectively produce individual outcomes that contribute to risk reduction and collective outcomes that improve a program's value. Therefore, existing programs seeking to redesign their delivery mechanisms should consider a case-management approach. Due to the nature of cardiac rehabilitative care, it is likely that some of the pieces of a case management model are already in place in most hospital-based outpatient settings.

The feasibility of a case-management approach can be explored by considering its major components as listed in Table 2. For many programs, the newest functions involved will include the use of care plans and protocols, the focus on outcomes, and the integration of care across the healthcare continuum.

Protocols and outcomes relative to this application are discussed below. Regarding the healthcare continuum, in a pure case-management model, nurse-patient contact begins at the time of hospital admission, continues through recovery and rehabilitation, and follows the patient for an extended period of time. However, innovative variations are increasingly common. For example, in Minneapolis, Abbott Northwestern Hospital, a large tertiary care center, developed

Table 2 Components of Case-Management Process

Comprehensive initial assessment
Individualized treatment plan
Standardized protocols
Family involvement
Self-responsibility
Multidisciplinary resources
Measured outcomes
Long-term follow-up

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an Interregional Cardiovascular Project in collaboration with a consortium of small community hospitals in southwestern Minnesota. At the core of their efforts to improve continuity is a cardiac rehabilitation nurse as case manager from each originating community hospital. That nurse's role is to coordinate patient care from the initial encounter at the community hospital to the tertiary center for intervention and back to local rehabilitation participation. This interfacility linkage has decreased duplication in testing, increased effectiveness of patient education, and improved timeliness of postdischarge follow-up (6).

When utilized in outpatient cardiac rehabilitation, the case-management relationship is typically established when the patient is referred to the outpatient program, is maintained throughout rehabilitation participation, and, most importantly, continues through follow-up for 1 to 2 years after program discharge.

Structural Overview

Activation of this modified case-management approach can be most clearly visualized by picturing the operation of an outpatient cardiac rehabilitation program in a small hospital where one nurse functions as the coordinator and provider of all the rehabilitative care each patient needs. That nurse is the case manager and caregiver for those patients. The process that the nurse works through involves the components described in Table 2. He or she either does or delegates related functions. Obviously, in this scenario, patients know who their case manager is and the nurse knows who and how many patients comprise the caseload. Expanding this vision to a larger facility is simply a matter of duplicating the role the necessary number of times to handle the volume while maintaining the primary relationship. That is, each nurse is responsible for managing the rehabilitative care of a set number of patients—a caseload. The number of patients in an assigned caseload varies with two major factors:

1. Patient acuity and related risk stratification. A case mix dominated by high-risk patients who require multiple rehabilitation services, individual instruction, and close surveillance increases the amount of time spent with each patient and decreases the total number of patients one nurse can manage.
2. Multidisciplinary resources. Access to risk reduction specialists (nutrition, mental health, exercise specialists, behavior counselors) on a routine or referral basis decreases the amount of time the nurse case manager needs to spend with each patient and increases the number of patients that can be managed.

Given these factors, a range of 15 to 25 patients per nurse case manager per quarter (an average of 80 patients per year) is recommended.

The case-management process begins on admission to the outpatient reha-

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bilitation program. As part of intake assessments, the case manager collaborates with each patient's physician to determine the most appropriate rehabilitation placement. Using published criteria (7), patients are stratified into one of three rehabilitation tracks:

1. Home recovery program—home health nurses provide low-level activity progression as tolerated and cardiac education as needed.
2. Monitored program—traditional group exercise and educational programs provided by cardiac rehabilitation staff.
3. Independent program—managed through a prearranged schedule of telephone calls between patient and assigned rehabilitation case manager.

Figure 1 further illustrates this triage and placement process.

In all three tracks, patients are followed by a series of telephone calls once the initial rehabilitation period is completed. A preoutlined list of questions is used to check on the status of behavior changes. Each telephone contact includes time to offer support and education as well. Such follow-up is an opportunity to

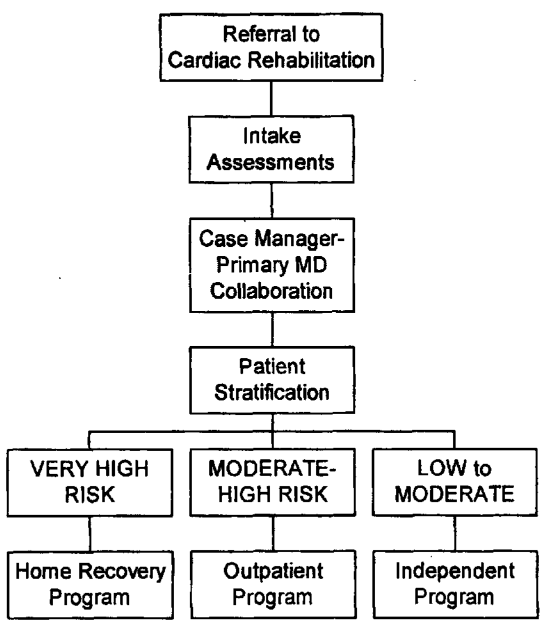

Figure 1 Patient placement for cardiac rehabilitation case management.

continue the case-manager–patient relationship by answering patient questions and reinforcing the rehabilitation plan.

Operational Features

Tools

To help achieve the goals of consistent quality, efficient delivery, and optimal results, a case-management approach relies on the use of internally developed guidelines that direct patient care. While they take many forms—algorithms, pathways, protocols—such guidelines provide a means of standardizing how patient care is to be delivered. As discussed in Chapter 33, it is imperative to build these internal plans upon the latest scientific evidence and to assure that they remain compatible with pertinent national standards.

Outcome data sheets are the report cards for cardiac rehabilitation case management. They document the degree of success of each service rendered. Appropriate forms with which to collect and record patient data at program entry and exit are integral to good case management. Choices of outcome tools are discussed in Chapter 41 and samples of charting forms are included in Chapter 40. The following example illustrates how an outcome tool activates a case-management intervention.

The Dartmouth COOP System of assessing a patient's functional status (8) includes a chart for the patient to rate the extent of their social activities on a scale of 1 (no limitations) to 5 (extremely limited). Recognizing that patients with little social support have a high rate of readmission and death within the first year after a cardiac event, a high rating on the social activities chart indicates social isolation and triggers early intervention. Depending upon the specific circumstances, the case manager may choose to involve Social Services, contact the patient's family, refer the patient to appropriate community resources, or simply schedule a number of telephone contacts between rehabilitation visits to offer support and encouragement. The assessment is then repeated at the end of rehabilitation, and again 1 year later to see if the intervention was successful in both the short and long term (9).

Strategies

In addition to the risk stratification strategy described earlier (Fig. 1), case management emphasizes the active involvement of three parties in cardiac rehabilitative care.

1. The patient. Self-responsibility is promoted through interactive participation, education, and encouragement. Patients are given "homework" to complete, tasks to perform in rehabilitation (such as taking

and recording weekly weights, doing and reporting preexercise blood sugars, etc.), and are asked to participate in completing their plan of care.

2. The family. Strong and consistent family support increases the likelihood of successful lifestyle change. Therefore, family members are invited to observe exercise sessions in action, to attend group classes, to participate in behavior changes with their loved one, and to make appointments with the nurse case manager for private discussions as needed.
3. The multidisciplinary rehabilitation team. The case manager is responsible not only for identifying the needs and problems of each patient in his or her caseload, but also for seeing that problems identified are addressed effectively, efficiently, and expeditiously. The percentage of time a case manager functions as caregiver versus coordinator of care depends upon the program's operational structure and professional resources. Delegation of services to other disciplines provides patients with the best available expertise to meet their rehabilitation needs. Coordination of those services by the nurse case manager helps assure appropriate use and timely delivery.

Patient Outcomes

Outcome measurement is an inherent element of case management in any healthcare setting, including cardiac rehabilitation (see Chap. 41). Table 3 displays selected outcome results from one author's (BTU) case-managed cardiac rehabilitation program in a small community hospital. As shown, the case-management approach discussed here has produced dramatic improvements in the health, clinical, and behavioral outcomes measured.

Practice Observations

The majority of outpatient cardiac rehabilitation programs in the United States are hospital owned and operated. These programs are strategically positioned to improve outcomes and reduce costs for the hospital's cardiovascular service line. Use of a case management approach enhances achievement of those goals. With their background in acute cardiac care, their extensive assessment skills, and their ability to coordinate multiple resources, most cardiac rehabilitation nurses are well suited to the case management role. New tools such as pathways and protocols coupled with computer-based data tracking are now available not only to support case-management efforts but to improve their efficiency. Patient-focused secondary prevention is the essence of case management and the key to cardiac rehabilitation success in the traditional setting.

Table 3 Sample Outcome Results from a Case-Managed Cardiac Rehabilitation Program in a Small Community Hospital

	Sample size	Rehab entry	Rehab exit	Change (%)	12 Months post	Change (%)
Patients smoking (No.)	$n = 77$[a]	77	17[c]	78% quit	3[d]	96% quit
LDL cholesterol level	$n = 89$[a]	136.8 mg/dL			96.3 mg/dL	41% improvement
Quality of life/Dartmouth COOP score	$n = 60$[b]	23.51	18.33	22% improvement		

[a] Timeframe = September 1996–September 1997.
[b] Timeframe = January 1997–August 1997.
[c] By self-report and clinical observation.
[d] By self-report only.

CASE MANAGEMENT AS AN ALTERNATE APPROACH—CARDIAC REHABILITATION WITHOUT WALLS

Background Description

Several trends in the healthcare environment have contributed to the utilization of the case-management process outside of traditional cardiac rehabilitation settings. While escalating costs have mandated the restructuring of cardiovascular care delivery, managed care competition has created the demand for high-quality, cost-effective care with healthcare professionals using the most appropriate resources in the most appropriate setting. Additionally, there has been a dramatic shift from illness to wellness/health promotion and disease prevention. As stated in the AHA Scientific Statement, ''application of risk reduction tactics to people with coronary disease will improve overall patient outcomes and should reduce the economic burden of heart disease'' (10). Although primary care physicians have been designated as gatekeepers, Pearson and coauthors describe the barriers to implementing preventive services and suggest nurse case-management programs as one solution (11). Therefore, nurse case-management systems are viewed as an effective alternate mode of care delivery to provide comprehensive risk reduction services within a cardiac rehabilitation operating structure, but without the traditional walls of a hospital-based facility. As described in the Clinical Practice Guideline on Cardiac Rehabilitation (12):

> Alternate approaches to the delivery of cardiac rehabilitation services, other than traditional supervised group interventions, can be implemented effectively and safely for carefully selected clinically stable patients.

The pioneering research that reported successful use of an alternate approach to hospital-based outpatient cardiac rehabilitation was conducted in 1988–1991 by the Stanford Cardiac Rehabilitation Program in cooperation with San Francisco/Bay Area Kaiser Permanente under a grant from the National Institutes of Health. Some of the research data from that study are reported in Chapter 35. This section focuses on current clinical applications.

Dubbed MULTIFIT for multiple risk factor intervention (13), this physician-directed case-management system uses specially trained nurses as caregiver/case managers to concurrently manage multiple risk factors (14). The MULTIFIT model was successfully implemented from research to clinical practice in 1992 under the auspices of Kaiser Permanente Medical Care Program, the largest health maintenance organization in the United States (14,15). MULTIFIT is now utilized in 15 northern California sites: one site in the Northwest Division of Oregon, one site in the Rocky Mountain Division of Colorado, and six more in the Northeast Division across four states.

Presently, program eligibility extends beyond the research model of acute myocardial infarction (AMI) to patients with other presentations of coronary artery disease (CAD), including angina, postangioplasty (PTCA), stent, and coronary artery bypass graft (CABG) surgery. Contact may begin in the hospital or occur through an outpatient cardiology or primary care physician (PCP) referral. Patients are strongly encouraged to begin the program within 1 month after discharge, although this timeframe may be individualized (15).

Structural Overview

The MULTIFIT program illustrated in Figure 2 shows that interaction occurs through convenient channels of communication (15). A computerized database provides the nurse case manager with multiple functions: data collection, patient contact prompting, clinical care management, medical decision-making assistance, report and letter generation, and patient and program outcomes. A full-time nurse has the capacity to enroll 120 to 150 patients per year depending upon the extent of his or her involvement with exercise testing. The nurse case manager's office may be located in the cardiology department of the managed care facility, in its medical clinic, or in the health education department.

This 12-month home-based program offers up to four face-to-face clinic visits and uses telephone contacts (up to 10) and mail (food reports, exercise logs, lab requests/results) for patient follow-up and surveillance. Following an initial face-to-face assessment, an individualized plan is prepared and the most appropriate interventions/strategies are selected. Goals focus on smoking cessa-

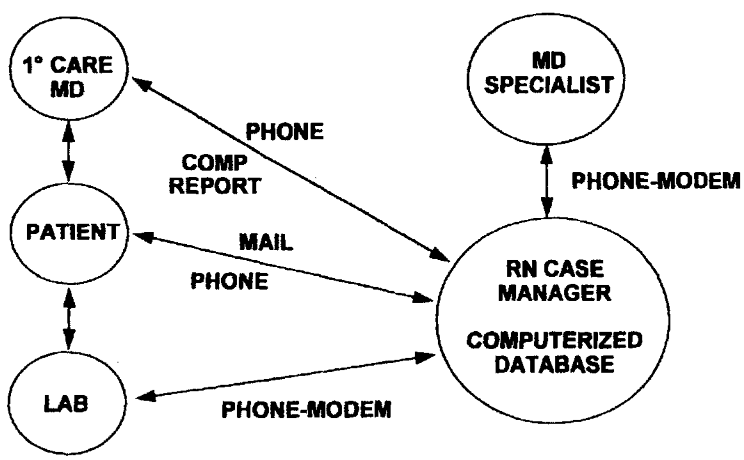

Figure 2 The MULTIFIT System. (Adapted with permission from Ref. 15.)

tion, home exercise training, lipid management via diet counseling and drug therapy (when needed), and stress management.

Operational Features

Tools

Approved treatment algorithms and standardized procedures assist the nurse in providing individualized, well-structured interventions. For example, the need to initiate lipid-lowering drug therapy is based on lipid values at week 8 and one of five treatment algorithms. A lipid counseling visit includes a review of goals, written and verbal medication instructions (ways to maximize drug efficacy and minimize side effects), self-monitoring tips, and follow-up lab tests. Future lipid management (monitoring side effects, evaluating drug responses, and titrating doses to goal) can be conveniently handled through patient telephone interviews.

The telephone is perhaps the most important tool in the MULTIFIT program. Initiating and maintaining lifestyle changes can be difficult and an average 10-min call can effectively provide support, instruction/education, counseling, positive reinforcement, reminders, problem solving, as well as answer questions, collect data, or recommend triage or surveillance. This method of contact can save travel and/or clinic time and/or cost. Standardized telephone interviews can increase efficiency and uniformity of this intervention (13). In clinical practice, patient satisfaction with the MULTIFIT program has been extremely high, especially noted in the area of telephone follow-up (15).

Strategies

As Wenger notes, "active participation of patients is pivotal in the management of their disease" (16). And, since there are no cures for coronary artery disease on the horizon, "without risk factor management, the natural history of coronary stenosis is progression" (17). Various behavioral strategies may be employed to help motivate and improve adherence. Patients contract with the MULTIFIT nurse to make lifestyle changes to enhance commitment to the program. The need for self-responsibility and cooperation is emphasized as the patient and nurse establish a partnership to work together (13). Also, since social support is critical in facilitating the adoption and maintenance of health behavior changes, the patient's spouse or partner is included in the educational counseling sessions (15). Other strategies enlisted to assist patients in changing behavior may include: assessing readiness to change, relapse prevention training, and teaching self-assessment skills so they can identify high-risk behavior.

Home exercise training is another feature of the MULTIFIT program. The safety and efficacy of this intervention has been documented both in research and clinical practice (13–15). Nurses clinically evaluate patients for medical eligibility for symptom-limited treadmill testing, which occurs between 3 and 8 weeks from the cardiac event. Approximately 90% of patients are found eligible to proceed with testing and subsequent home-based exercise. Of those high-risk patients who are not eligible for MULTIFIT enrollment, most are followed in a separate Heart Failure program.

Patients are initially given specific verbal and written instructions regarding a light home walking program. After the exercise test, an individualized exercise prescription is prepared and related exercise counseling is provided. Self-monitoring skills including symptom recognition and response are reviewed. Heart rate monitors are loaned, daily exercise logs are provided, and telephone follow-up is scheduled. After 6 months, patients return for follow-up treadmill testing.

Psychosocial functioning and other risk factors (i.e., hypertension, diabetes, etc.) are assessed and interventions initiated as appropriate. Beyond educational materials, available health education services (library and classes) and behavioral programs (mental health/stress management and support groups) are offered at the medical center as an adjunct to assist in lifestyle modification (15). Smoking cessation counseling, lipid management with nutritional assessment and counseling, and drug treatment algorithms are detailed interventions with significant outcomes as described below.

Patient Outcomes

The focus of the original MULTIFIT research was to evaluate a case-management system for coronary risk factor modification after acute myocardial infarction. Therefore, Table 4 shows the clinical outcomes at 12 months from the research (post-AMI), intervention, and usual care, and from current clinical practice (includes post-AMI, CABG, PTCA, stents, and angina) representing 2182 patients from 10 northern California Kaiser Permanente Medical Centers, 1992–1997. As the MULTIFIT program was disseminated to more sites, some variations in data collection occurred compared to the research data. All adherence to prescribed exercise is self-reported and refers only to those eligible for home exercise training—85% of intervention compared to 90% of clinical practice. Though not listed, functional capacity at 6 months was 9.3 METS for intervention, 8.4 METS for usual care, and 10.6 METS for clinical practice. These changes represent an improvement of 2.1 METS for intervention and 1.5 METS for clinical practice of those who were tested at 6 months. The smoking cessation rate, also self-reported in clinical practice, is similar to research and continues to demonstrate the effectiveness of this extremely important intervention. LDL results apply only to those patients who were eligible for (baseline LDL > 100 mg/dL) and started lipid-lowering medication—83% of intervention, 21% of usual care, and 88% of clinical practice. Overall results demonstrate successful risk factor modifica-

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Table 4 MULTIFIT Outcomes (12 Months)

	Research		Kaiser clinical practice: all patients (n = 2182)
	Usual care (mean ± SD)	Intervention (mean ± SD)	
Adherence to prescribed exercise	55%	71%	81%
Smoking cessation rate	53%	70%[a]	74%
LDL cholesterol	132 ± 30 mg/dL	107 ± 30 mg/dL[b]	106 mg/dL
Achieve LDL <100 mg/dL	15%	42%	47%

[a] $p<0.03$.
[b] $p<0.001$.
Note: Adherence to prescribed exercise is self-reported. Smoking cessation rate is cotinine confirmed in research and self-reported in clinical practice.
Adapted with permission from Ref. 15.

tion by the MULTIFIT nurse case-management system in clinical practice with similar and in some areas even slightly better outcomes than in the research results. Obviously, aggressive lipid management is key; 47% of treated patients achieved an LDL goal of less than 100 mg/dL.

Practice Observations

The MULTIFIT system for case management in cardiac rehabilitation has been successfully disseminated from research to clinical practice as witnessed by the 5-year data briefly cited here. Strong evidence exists for improved cardiac risk factors, compliance, patient and physician satisfaction, extended access due to the home-based feature, and cost-effectiveness. Pearson et al. validate the efficacy of case management with nurses instructing patients to self-monitor weight, blood pressure, symptoms, smoking relapse, and to take appropriate action in response to new or worsening symptoms. These efforts have been beneficial in maintaining self-care and self-support especially for older adults (11).

The most common concern raised about MULTIFIT's home-based feature is that it provides little "face-to-face" patient contact, which some view as impersonal. Involvement in community programs is encouraged for those expressing this concern and those preferring group exercise support. Some patients have difficulty with self-responsibility and cooperation and require closer supervision. A 10 to 25% dropout rate indicates that compliance is an ongoing issue.

From a program standpoint, as the number of dissemination sites increases, so does the individualization of the program at the facility level. Therefore, there may be the potential for data collection variability that could ultimately affect the validity of outcomes (for example, 6-month treadmill tests are not performed at all sites). Additionally, as programs expand, facilities have to prepare for higher caseloads. To accommodate this increased demand, the concept of group appointments is being explored.

As discussed above, MULTIFIT nurses acting as case managers and operating under standardized protocols, are functioning in an expanded nursing role. The MULTIFIT project has demonstrated that this new role provides a cost-effective system for delivering rehabilitative care and produces improved patient outcomes and enhanced quality of life.

SUMMARY

Cardiac rehabilitation, secondary prevention, and disease management are interrelated concepts with similar purposes. Through coordination of long-term cardiac care, case management provides a means for integrating all three perspectives for the care of patients with chronic heart disease.

The case-management process can be internally applied as the method of practice within an existing cardiac rehabilitation facility. Alternatively, case management can provide the external structure through which cardiac rehabilitation services are delivered. In both settings, the tools and strategies utilized are similar and the patient care goals are the same. While each approach presented in this chapter has produced positive outcomes, research is needed to compare/contrast the effectiveness of these and other case-management models used for cardiac rehabilitation. As we move into the twenty-first century, the field of cardiac rehabilitation is already evolving to include a combination of case-management approaches (18). Internal hands-on case management is likely to continue. External telephone management is likely to grow. Placing the right patient in the right cardiac rehabilitation case-management system will be the new challenge.

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Home-Based Cardiac Rehabilitation: Variations on a Theme

Susan Rogutski
Columbia Montour Home Health, Bloomsburg, Pennsylvania

Kathy Berra and William Haskell
Stanford Center for Research in Disease Prevention, Stanford University School of Medicine, Palo Alto, California

INTRODUCTION

As the depth and breadth of cardiac rehabilitation services continue to evolve, the concept of home-based programs has become increasingly popular. However, confusion exists in the practice arena about the meaning of "home-based" terminology. Similar labels are applied to several aspects of rehabilitation that occur in the home setting at various times during the patient's recovery. As a result, recurring questions about so-called home-based cardiac rehabilitation include: Where do these services fit into the continuum of cardiac care? Who should coordinate and deliver home-based rehabilitation services? How can home-based rehabilitation be integrated with existing facility-based programs? Therefore, the purpose of this chapter is to: (1) define home-based cardiac rehabilitation; (2) delineate when such services are delivered; and (3) discuss why home-based applications are an important component of today's comprehensive approach to cardiac rehabilitative care.

Three distinct varieties of home-based services are discussed. Research-based rationale for home-based services is reviewed and practice recommendations are emphasized.

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HOME-BASED CARDIAC RECOVERY

Rationale for Home-Based Cardiac Recovery

Nationwide, managed care efforts have forced healthcare institutions to evaluate services and reduce medical care costs (1). As a result, medical and surgical cardiac patients are discharged from the hospital to home sooner than ever, yet with more acute conditions and more ongoing care needs (2). This dramatic shortening of hospital stays has resulted in dilemmas for healthcare providers, patients, and families (3). Shorter stays mean less time for healthcare providers to teach necessary information to help patients understand and accept their cardiac condition. The result may be cardiac patients and families who are overwhelmed and underprepared to carry out treatment plans or to resume activities of daily living at home (4).

Historically, participation in inpatient and outpatient cardiac rehabilitation programs has assisted patients and their families to better understand, cope, and comply with cardiac conditions and treatment plans. But when cardiac patients are discharged ''quicker and sicker'' (5), they may not have received inpatient cardiac rehabilitation services and, once home, they may not be medically stable enough to participate in an outpatient rehabilitation program. One solution to this dilemma lies in the ability of cardiac rehabilitation programs of the twenty-first century to go into the patient's home.

In the past, when cardiac patients were discharged from the hospital, they received little rehabilitation intervention until they were able to enter a structured outpatient program weeks later. Today, cardiac rehabilitation services started in the hospital can be continued after discharge through cardiac disease management programs offered by home health agencies. These specialty cardiac programs were developed in the late 1980s and 1990s in response to shorter hospital stays and the need for skilled cardiac care in the home. Generally referred to as ''cardiac home care'' or ''cardiac recovery,'' these specialty home health services ease the transition from hospital to independent functioning. Because they build on interventions started by inpatient cardiac rehabilitation, such programs can help bridge the gap that exists between inpatient and outpatient cardiac rehabilitation.

Use of cardiac rehabilitation principles as part of a home health disease management program is a timely concept. Cardiac rehabilitation provided in the home setting is not reimbursed by most third-party payers because it does not meet their requirements of a hospital-based, physician-supervised program. However, home-based rehabilitation services can be provided to cardiac patients by home health nurses and therapists as part of their skilled visits. In addition, cardiac home care does not interfere or compete with traditional outpatient cardiac rehabilitation programs since it serves only the homebound patient. According to Medicare, the ''homebound'' patient is one who is unable to leave his or her residence without assistance due to illness or injury, or one for whom leaving home is medically contraindicated. When the cardiac patient is no longer considered to be homebound, he or she is discharged from home health services and referred to outpatient cardiac rehabilitation.

Goals of Home-Based Cardiac Recovery

The overall goal of cardiac home care is to provide a continuum of cardiac care and rehabilitation for the postacute cardiac patient who is homebound. This is accomplished through several services: (1) provision of skilled cardiac care by a multidisciplinary team; (2) identification of and intervention for disease complications; (3) reinforcement of education for patient, family, primary caregiver; (4) assistance with performing activities of daily living and maintaining mobility; and (5) prevention/reduction of hospital readmission.

These goals and objectives are accomplished through use of a comprehensive care plan and clinical pathway. The care plan outlines the overall treatment and identifies desired patient outcomes individualized to each patient. The clinical pathway is a visit-to-visit guide to the assessment, education, and activity progression services to be provided. Use of such pathways has been shown to focus nurse/therapist care and potentially reduce the number of visits needed (6).

Components of Home-Based Cardiac Recovery

Service components of cardiac home care include assessment, education, and activity progression. The cardiopulmonary assessment is provided by a skilled cardiac care nurse who is competent in both EKG interpretation and cardiopulmonary assessment skills. Cardiac rehabilitation experience for the nurse/therapist providing cardiac care in the home is also strongly recommended.

In addition to nursing skills, proper assessment tools are needed to optimize at-home patient evaluations. The nurse assesses the patient's heart rate and rhythm, blood pressure, and pulse oximetry at rest, with activity, and during recovery with the use of a portable cardiac monitor. The primary purpose of the monitor is to detect cardiac arrhythmias and to evaluate activity progression tolerance. A multidisciplinary team of home health professionals including physical therapists, occupational therapists, social workers, and home health aids, works in conjunction with the cardiac nurse to carry out the agreed-upon treatment and activity plan.

The educational component of the cardiac home care program follows a structured clinical pathway. During the initial visit, the nurse evaluates the patient's understanding of his or her disease process and treatment plan. At each subsequent visit, the prior lesson is briefly reviewed and a new lesson is taught.

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Pathway Step	☐	*Goals*	*Interventions*
#1: Date ________ Notes: Signature: ____________	 ☐ ☐ ☐ ☐	Client/caregiver will: 1. State emergency telephone numbers 2. Name his/her heart condition 3. Review major hospital discharge instructions 4. Ask questions about proposed plan of care	**EXPLAIN** Plan of care **TEACH** • Name & nature of condition (CHF = heart failure) • Need for access to emergency telephone numbers **GIVE** CHF teaching packet
#2: Date ________ Notes: Signature: ____________	 ☐ ☐ ☐	Client/caregiver will: 1. Describe heart pumping weakness of CHF 2. Discuss need for fluid and sodium restriction 3. Explain how to use medication schedule	**REVIEW** Emergency instructions **TEACH** • Normal pumping function of the heart • Dysfunction in CHF • Need for fluid & sodium restriction **GIVE** Medication schedule
#3: Date ________ Notes: Signature: ____________	 ☐ ☐ ☐	Client/caregiver will: 1. Report correct & compliant medication use 2. Compare own symptoms to those described 3. Demonstrate how to weigh self and document	**REVIEW** Dysfunction of CHF **TEACH** • Related signs/symptoms • How/why to weigh self daily **GIVE** Calendar for recording daily weights, fluid intake, sodium

Figure 1 Excerpt from Sample Clinical Pathway for Home-Based Cardiac Recovery Program Heart Failure Education.

Figure 1 provides a sample pathway. This structured visit-to-visit format assures that each cardiac patient receives fundamental information about his or her specific condition. The nurse individualizes each lesson based on the needs of the patient and family. Basic educational topics include the coronary artery disease process, symptom recognition and response, medications, diet, activity, energy conservation, wound care, emergency procedures, and coping strategies. The home setting is ideal for identifying educational needs and providing necessary information to both patient and family. According to Steele and Ruzicki, shortened hospital stays and reduced use of inpatient services allow less opportunity for effective education in the hospital (7). Patients may be more relaxed and able to learn, and the family may be more available for teaching in the home setting

(8). In addition, home healthcare providers find that education efforts are easier when family dynamics and home situations are visualized.

The activity evaluation and progression of the cardiac home care service is based on heart rate and rhythm, blood pressure, pulse oximetry, and rate of perceived exertion responses. Patients who have been discharged from the hospital early may not have had an exercise stress test to guide their exercise prescription. Therefore, home activity guidelines are conservatively recommended. The physiological goal of home-based activity is the same as it is for progressive activity in the inpatient cardiac rehabilitation setting—to prevent or minimize deconditioning. Early discharge may result in patients being at a ''very low'' level on the MET (metabolic equivalent) scale (9). Target heart rates can be determined using resting heart rate plus 20 beats. However, symptom and perceived exertion ratings (RPE) have been found to be more useful in the home since many patients are on beta-blocking medications and/or cannot accurately count their pulses independently. Walking, sitting stretches, and breathing exercises are the recommended activities for the first 1 to 2 weeks. Later, the patient may be progressed to stair climbing, standing stretches, lifting 1- to 2-lb weights, and/or performing other activities necessary for home living. The nurse, physical therapist, and occupational therapist teach energy conservation techniques for activities of daily living, such as ''preparing breakfast without wasting steps.'' Learning these new skills is especially important for patients with diminished cardiopulmonary endurance. Contraindications for exercise/activity in home-based cardiac programs are based on standard criteria recommended by the American College of Sports Medicine (ACSM) and the American Association of Cardiovascular and Pulmonary Rehabilitation (AACVPR) (10).

Role of Traditional Cardiac Rehabilitation in Home Recovery

Cardiac home care programs with skilled cardiac nurses and advanced monitoring technology are considered extensions of hospital care. Ideally, the home health nurses and therapists they employ have prior cardiac rehabilitation experience. Realistically, this may not be the case. Therefore, traditional cardiac rehabilitation programs should seek to play a cooperative role in the development and implementation of cardiac home care programs. Experienced cardiac rehabilitation professionals can provide leadership and mentorship to home care professionals through education and sharing of materials. Representatives from both settings can engage in joint efforts to develop treatment plans, educational materials, and teaching techniques. Development of a broad-based clinical pathway that would encompass inpatient, home, and outpatient rehabilitation would help improve continuity of care. Furthermore, hospitals which have their own home health agency may want to cross-train cardiac rehabilitation nurses and therapists to rotate between the hospital program and home visits, enhancing consistency and quality in both settings.

As healthcare trends continue to shorten hospital stays, cardiac rehabilitation program personnel must find new and innovative ways to deliver their services. By combining components of traditional cardiac rehabilitation, skilled cardiac nursing, and advanced technology, home-based cardiac recovery programs not only bridge a gap in service to the patient, but also offer a new opportunity for cardiac rehabilitation professionals in the twenty-first century.

HOME-BASED CARDIAC REHABILITATION

Hospital, community facility, and physician office-based outpatient cardiac rehabilitation programs have become a standard of care for people with coronary artery disease. However, only 11 to 38% of all people with stable coronary disease are referred to these formal facility-based programs (11). Although gaining popularity in the 1990s, outpatient programs (sometimes referred to as Phase II programs) totally based in the patient's home are less well studied than their longer-standing facility-based counterparts but are also underutilized. This lack of referral to rehabilitation programs has been reported to be more true for women, minorities, and the elderly (12,13). Reasons for under-referral patterns are many. Physician bias, program cost, lack of reimbursement, program location, social support, work outside the home, transportation, gender, age, psychological and emotional factors all influence referral rates (12–14). In addition, formal cardiac rehabilitation programs are generally found in urban areas as opposed to more rural environments. Clearly, home-based programs provide an important option for patients unable to attend facility-based medically supervised programs. In addition, they should be considered as an adjunct to participation in those more traditional programs.

Efficacy and Safety of Home-Based Cardiac Rehabilitation

The Agency for Health Care Policy and Research (AHCPR) recently reported on the clinical benefits of cardiac rehabilitation (11). As part of that report, the safety and efficacy of home-based cardiac rehabilitation programs were evaluated. Seven randomized controlled trials and four nonrandomized trials have been reported in the literature since 1982 (15–21). Populations included in the randomized trials were postmyocardial infarction (MI), postcoronary artery bypass graft surgery (CABG), and postpercutaneous transluminal coronary angioplasty (PTCA) patients. The patients were stable and without significant ischemic symp-

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toms. Home-based programs included exercise at 60 to 85% of symptom-free heart rate determined on standard treadmill exercise testing. Periodic transtelephonic electrocardiographic (ECG) monitoring was used in five studies (16–20). Portable heart rate monitors were used in one study to signal patients when they exceeded or fell below their heart rate guideline (21). In these seven studies of home-based cardiac rehabilitation programs, most patients increased their exercise capacity without an increased risk of cardiovascular complications when compared to patients randomized to formal class-based exercise programs. Compliance was found to be excellent in the home-based program participants. Most of the home-based programs studied utilized regular telephone or other type of communication/follow-up between the cardiac rehabilitation staff and the participants. This type of communication was designed to evaluate clinical signs and symptoms as well as encourage compliance to the rehabilitation program.

Two important home-based randomized trials evaluated multifactorial risk intervention versus usual care (19,21). DeBusk showed significant improvement in smoking cessation, lipoprotein levels and exercise capacity in patients randomized to home based rehabilitation compared to usual care (21). Haskell demonstrated that aggressive coronary risk reduction including home-based exercise resulted in significant improvement in angiographically measured atherosclerosis. Hospitalization for coronary events during the 4 years of follow-up was also significantly reduced (19). Neither of these studies demonstrated an increase in exercise-related coronary events during home-based exercise training. In the AHCPR report, four nonrandomized trials which included home-based exercise were also evaluated (22–25). In all four trials, the home-based exercise groups derived similar benefits when compared to the facility-based groups. No significant differences in coronary events were reported in any of these trials.

Ades and colleagues recently reported the safe and effective use of transtelephonic ECG monitoring of home-based exercise programs for post-transplant patients (26). These data support the work of Fletcher on the use of transtelephonic ECG monitoring during home-based exercise in male post-CABG patients (16). In Fletcher's study, no life-threatening abnormalities were observed during the 12-week home-based program. However, 19.5% of patients required evaluation of ischemic or arrhythmic abnormalities. Sparks, Squires, and Shaw reported, in low-to-moderate risk post-MI and post-CABG patients, an increase in functional capacity without an increase in the incidence of clinical coronary events during transtelephonic monitoring of home-based exercise (27–29).

Methods designed to regularly evaluate patient safety and compliance during home-based exercise, such as telephone-based follow-up, transtelephonic ECG monitoring, and other methods of patient self-monitoring are integral components of a comprehensive home-based program. Patient self-monitoring of ischemic signs and symptoms during formal facility-based programs is a key safety measure that becomes even more critical to the safety of patients exercising without the benefit of direct medical supervision. By using well-established risk stratification guidelines and by educating all patients to recognize untoward signs and symptoms, patient safety during home-based cardiac rehabilitation can be maximized.

High-risk and moderately high-risk cardiac patients should be referred to a facility-based medically supervised program whenever possible. However, many of these patients will be unable to attend such programs for the reasons listed earlier. Sparks and colleagues evaluated 10 high-risk patients during home-based exercise therapy utilizing transtelephonic ECG monitoring. They found a high rate of complications requiring emergency medical services or physician consultation in 8 of the 10 patients (30). This study demonstrates the need for more research in the area of nonfacility-based rehabilitation including exercise therapy in moderate to high-risk coronary patients.

Recommendations for Home-Based Cardiac Rehabilitation

Participation in home-based cardiac rehabilitation must be based on careful evaluation of residual myocardial ischemia, left ventricular function, presence and severity of arrhythmias, symptoms of angina, cardiovascular exercise capacity, and pulmonary function. In addition, social and economic factors, psychological status, concurrent diseases and medication regimens must all be taken into account. Identifying those patients at highest risk for a clinical cardiac event—risk stratification—is critical to prescribing a safe and effective home-based rehabilitation program (see Chap. 6 for a full description of risk stratification guidelines and rationale). For high- and moderately high-risk patients who are unable to attend facility-based programs, careful, very low-level exercise emphasizing activities of daily living should be advised. Specific clinical practice guidelines are not available for these higher risk patients to exercise at home. Therefore, their care must be based upon knowledge of the patient's medical condition and comorbidities, their social support, and the physical demands of their living situation as well as their ability to self-monitor signs and symptoms.

Patients considered eligible for home-based programs should be provided with specific written guidelines that include

1. An exercise training prescription
   - individualized guidelines for the intensity, duration, frequency, and type of aerobic exercise to be performed
   - additional exercises to improve muscular strength and mobility
   - exercises to avoid such as heavy isometric lifting or strenuous sports
   - specific instructions on recognizing and responding to symptoms of cardiovascular problems

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2. a comprehensive risk reduction plan
   - identification of patient's actual risk factors
   - specific goals for aggressive risk reduction
   - resources available for self-learning

Risk reduction goals have been well described by the American Heart Association (AHA) and the American College of Cardiology (ACC) (31,32). Strategies to achieve these goals are discussed elsewhere in this volume. Patient record keeping using logs such as those shown in Tables 1 to 3 can help record program participation as well as safety. In addition, such record keeping promotes patient involvement and self-responsibility.

Because of the loss of close professional supervision and social support provided by facility-based programs, home-based programs must adhere to systematic monitoring of behavioral as well as clinical issues. At-home follow-up includes evaluation of clinical, physiological, and behavioral status to maximize medical and lifestyle therapies and evaluate program safety. However, one of the major problems facing home-based cardiac rehabilitation is a lack of reimbursement for this important supervision as well as for related periodic visits with cardiac rehabilitation professionals. Further research is needed to evaluate the design, safety, and cost effectiveness of medically prescribed and professionally supervised home-based cardiac rehabilitation programs. While the patient's program (comprehensive risk reduction including exercise therapy) occurs in the home, the role of the cardiac rehabilitation professional in prescribing, tracking, evaluating, and adjusting services is pivotal to the safety and success of cardiac rehabilitation in this new venue. The leading model of that role—MULTIFIT's case-management approach—is discussed in detail in Chapter 34.

Future Issues

The AHCPR Clinical Practice Guideline supports the use of home-based rehabilitation for properly selected cardiac patients:

> Alternate approaches to the delivery of cardiac rehabilitation services, other than traditional supervised group interventions, can be implemented effectively and safely for carefully selected clinically stable patients. Trans-telephonic and other means of monitoring and surveillance of patients can extend cardiac rehabilitation services beyond the setting of supervised, structured, group-based rehabilitation. These alternate approaches have the potential to provide cardiac rehabilitation services to low and moderate risk patients who comprise the majority of patients with stable coronary disease, most of whom do not currently participate in supervised, structured rehabilitation (Ref. 11, p. 138).

Table 1 Sample Log for Patient Self-Reporting of Angina

Dear Cardiac Rehab Participant,
This is your log sheet for marking frequency and circumstances of when you get angina/chest discomfort. Most of the entries simply require a number or check-mark to be entered in the box for that day. Please call us is if you have any questions about how to use this log or how to respond if you get angina/chest discomfort.

DATE →							
	Sun.	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.
Number of episodes today							
Triggered by: (√)							
exercise							
eating							
emotions							
other: (write in)							
no obvious trigger							
Grade: (√)							
1 = mild, just starting							
2 = moderate, spreading							
3 = severe, take NTG							
4 = most severe, more NTG							
Lasts for # minutes:							
Your Response: (√)							
stop activity							
rest (sit/lie down)							
take NTG (nitroglycerin)							
call doctor							
call ambulance							
other: (write in)							

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Table 2 Sample Log for Patient Self-Reporting of Arrhythmias

Dear Cardiac Rehab Participant,
This is your log sheet for marking the frequency and circumstances of when you get extra or irregular heart beats. Most of the entries simply require a number or checkmark to be entered in the box for that day. Please call us if you have any questions about how to use this log or how to respond if you get extra/irregular heart beats.

DATE →							
	Sun.	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.
Number of episodes today							
Triggered by: (√)							
exercise							
emotions							
coffee, tea, cola							
smoking							
stress							
other: (write in)							
no obvious trigger							
Related symptoms: (√)							
lightheaded							
fainted							
weak							
short of breath							
other: (write in)							
Number of odd beats/min:							
with exercise							
at rest							
Do odd beats go away when you stop exercising?							

Table 3 Sample Log for Patient Self-Reporting of Exercise Performance

Dear Cardiac Rehab Participant,
This is your log sheet for marking the frequency and details of your home-based exercise performance. Most of the entries simply require a number or check-mark to be entered in the box for that day. Please call us if you have any questions about how to use this log or how to follow your exercise plan.

DATE →							
	Sun.	Mon.	Tues.	Wed.	Thurs.	Fri.	Sat.
Minutes of warm-up/stretching GOAL = 5–10 min							
Minutes of aerobic exercise GOAL = 30–40 min							
Minutes of strength training GOAL = 15–20 min							
Minutes of cool-down/stretching GOAL = 5–10 min							
Symptoms during exercise: (√)							
NONE							
angina/chest discomfort							
shortness of breath							
extra/irregular heart beats							
lightheaded/dizzy							
Other: (write in)							
Minutes of relaxation/ Stress reduction GOAL = 15–30 min							

However, at this stage in the evolution of home-based cardiac rehabilitation, several cautions are in order. Standardized and authoritatively endorsed guidelines for patient selection, extent of surveillance, and optimal program design have not yet been well established for home-based cardiac rehabilitation. In addition, medical–legal issues and reimbursement for home-based services are not clearly defined. Studies described in this chapter have shown that home-based cardiac rehabilitation programs can be implemented safely and can result in improvements in both physical function and coronary risk reduction for low-to-moderate-risk coronary patients. High- and moderately high-risk patients who cannot attend facility-based, medically monitored programs are a vastly understudied group and, as a result, are an underserved population in great need of rehabilitative services.

HOME-BASED EXERCISE MAINTENANCE

> Cardiac rehabilitation exercise training promotes increased participation in exercise in addition to rehabilitation exercise training in patients after myocardial or CABG. This effect does not persist long-term after completion of exercise rehabilitation. Long-term cardiac rehabilitation exercise training is recommended to provide the benefit of enhanced physical activity and exercise habits (Ref. 11, p. 49).

Regardless of where a patient undergoes cardiac rehabilitation—at a facility-based program or at home—completion of the structured phase of rehabilitation requires planning for where and how exercise will continue. Choices commonly offered to patients about to ''graduate'' from cardiac rehabilitation include exercise continuation at one of the following: commercial fitness club; community facility (e.g., YMCA, JCC, college campus); hospital-sponsored wellness center; independent home-based program; or maintenance program at the rehabilitation site.

A variety of factors such as access, cost, and personal preference for either a private or group environment influence the patient's choice. As part of discharge planning, the cardiac rehabilitation professional has a twofold role related to exercise maintenance: (1) to assist the patient in evaluating choices for exercise continuation; and (2) to prepare the patient for assuming self-management responsibility.

Figure 2 provides a sample checklist used for this discharge preparation.

In contrast to years past when the trend was to keep graduates enrolled in the rehabilitation facility's program indefinitely, current emphasis is on ''mainstreaming'' patients into other long-term exercise options. Rather than creating dependence, rehabilitation professionals need to promote independence by helping patients to cultivate a self-directed life-long commitment to exercise. Even for those who choose a group setting in which to continue, an independent maintenance plan is recommended to supplement exercise at the facility and to provide a portable option for vacations, business trips, and other occasions when attendance at the selected facility is not possible.

As discussed in Chapter 38, long-term adherence is enhanced by consistent professional follow-up. Therefore, every exercise maintenance prescription should include a schedule of either periodic exercise checkup visits at the rehabilitation facility or telephone appointments to follow-up on home performance.

Prior to initiation of a home-based exercise maintenance program, patients should be able to.

1. Demonstrate Self-Monitoring Skills
   - ☐ accurately count their exercise pulse
     and/or
   - ☐ accurately rate perceived exertion with exercise
   - ☐ correctly state their prescribed exercise guidelines
   - ☐ describe adjustments to be made in exercise performance to achieve/maintain prescribed level of exercise

2. Select Appropriate Exercise for Self-Performance
   - ☐ choose a primary mode of exercise for home use
   - ☐ identify an alternate mode of exercise for use in place of the primary program (e.g. if outdoor bike riding is primary program, what alternate will be used during inclement weather?)
   - ☐ discuss recreational activities that may be performed in addition to primary exercise
   - ☐ list specific exercises to be avoided

3. Assess Their Own Cardiac Signs/Symptoms
   - ☐ identify warning signs of cardiac distress
   - ☐ state a plan of action to take if/when distress occurs
   - ☐ confirm access to nitroglycerin and correctly describe its use

4. Take General Precautions Before/After Exercise
   - ☐ schedule exercise before or at least 2 hours after meals
   - ☐ describe appropriate attire for selected exercise & related weather conditions
   - ☐ avoid hot showers, whirlpools, spas, saunas, etc. for 2 hours after exercise

5. Document Exercise Performance
   - ☐ choose a method (calendar, diary, computer log) for recording home exercise performance & responses
   - ☐ take documentation to physician visits & rehab follow-up to show compliance, discuss concerns, and make adjustments

6. Schedule rehab follow-up
   - ☐ telephone appointment with rehab center: date/time ____________________
   - ☐ onsite exercise check-up visit at rehab center: date/time ____________________

Date ___________

_________________________ Patient Signature

_________________________ Cardiac Rehab Staff

Figure 2 Sample patient education checklist home-based exercise maintenance.

Table 4 Relationship Between Traditional Cardiac Rehabilitation Programs and Home-Based Services

Service	Relationship	Professional role
Home-based cardiac recovery	Low-level phase *Before* usual outpatient program Serves as a bridge between inpatient and outpatient programs for high-risk homebound patients	Educate home health staff in principles and application of cardiac rehabilitation exercise and education Assist with development of clinical pathways Develop a system for referral to outpatient rehabilitation upon completion of home care
Home-based cardiac rehabilitation	Training phase *During* usual outpatient program Provides an alternate approach to facility-based programs in low-to-moderate risk patients	Risk stratify outpatients to identify home-based candidates Individualize exercise prescriptions for home use Develop a system of regular follow-up during home performance
Home-based exercise maintenance	Maintenance phase *After* usual outpatient program Offers an option for independent long-term exercise continuation to all cardiac rehabilitation graduates	Offer a number of maintenance options to patients graduating from rehabilitation Update exercise prescriptions for self-use Develop a system of periodic follow-up of long-term maintenance

Other coronary risk reduction efforts, such as medication compliance, weight loss, smoking cessation, stress management, control of hypertension, diabetes, and dyslipidemia, will continue under the direction of the patient's primary care physician. However, as discussed in Chapters 34 and 41, and others, cardiac rehabilitation professionals have to participate in long-term tracking of outcome results. For programs, such follow-up is an opportunity to show that benefits can last. For patients, staying connected to the advice and support of cardiac rehabilitation professionals is likely to improve compliance with their life-long rehabilitation plan.

SUMMARY

Three applications of ''home-based'' cardiac rehabilitation are increasingly common in today's continuum of cardiac care—home-based cardiac recovery, home-based cardiac rehabilitation, and home-based exercise maintenance. They are distinguished by when they occur in time and by the populations they serve—high risk, low risk, and all cardiac rehabilitation graduates, respectively. They are united not only by their physical location in the patient's home but more importantly by their connection to cardiac rehabilitation professionals whose guidance optimizes participation safety and exercise effectiveness. Table 4 summarizes the roles and relationships between these emerging home-based programs and traditional facility-based cardiac rehabilitation. While further research and additional reimbursement are needed to standardize and optimize home-based efforts, cardiac rehabilitation programs of the future will most certainly offer home-based components to extend their service reach. This chapter has discussed early efforts in that direction.

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Behavioral Change—Getting Started and Being Successful

James Prochaska and Karen Congdon
University of Rhode Island, Kingston, Rhode Island

INTRODUCTION

For most of the twentieth century, an action paradigm has dominated behavior change. Patients were seen as changing when they quit smoking, started to exercise, or switched to a low-fat diet. Cardiac rehabilitation clinics were action-oriented in their approaches, assuming that all patients could and would change at their caregiver's urging. Often, rehabilitation professionals were disappointed when their well-designed action plans and educational classes resulted in too few patients signing up, showing up, finishing up, or ending up better off (1). As a result, patients were unfairly labeled noncompliant, resistant to change, or unmotivated.

In recent decades, both patient and professional frustration with limited success has led to increased research on behavioral change. As a result, professional practice settings such as cardiac rehabilitation programs can now benefit from increased knowledge of behavior concepts and related patient management strategies that are more likely to produce successful behavioral change. The science and practice of behavioral change is currently focused on a stage paradigm, often referred to as the Transtheoretical Model (TTM), that recognizes change as a process that unfolds over time and involves progress through six stages (1,2): precontemplation; contemplation; preparation; action; maintenance; and termination.

This chapter provides a conceptual overview of each stage of the model and suggests how cardiac rehabilitation professionals can apply this new understanding of behavior to their secondary prevention efforts.

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THE STAGES OF CHANGE MODEL

Stage 1: Precontemplation

In the precontemplation stage patients do not intend to take action in the next 6 months. Three reasons typically keep patients mired in this stage:

1. Lack of knowledge. For example, regarding physical activity, millions of ''couch potatoes'' are in precontemplation and cannot imagine that their couch could kill them. How could that warm comfortable place possibly be the source of chronic disease and premature death?
2. Knowledge gaps. Patients may know 3 to 4 benefits of quitting smoking but do not understand that there are 30 to 40 more. Limited knowledge lessens the impact of the behavior and the perceived need to change.
3. Demoralization. Weight management is a familiar example. Many people have tried to lose weight many times and their frustrations and failures have caused them to give up on their ability to do so. Patients in precontemplation prefer to avoid reading, talking, or thinking about their problem behaviors. They are likely to resist pressure to take action when they are not ready to do so. If they respond to professional pressure, they are likely to relapse as soon as the pressure is off.

Recent research across more than a dozen of the most serious physical and mental health behaviors indicates that patients in the precontemplation stage underestimate the benefits of changing to a healthier lifestyle and overestimate the costs (3). Furthermore, they typically are not conscious of making mistakes in their evaluation of the pros and cons of changing. Without appropriate professional help, these patients are likely to remain at this stage rather than progressing to the next level. Advancement to the contemplation stage only occurs if the patient perceives that the pros of changing are increasing in number. For example, when asked to list all the advantages of regular exercise, the average patient in precontemplation will list four or five. To help more patients toward the next stage, rehabilitation professionals can inform them that there are more than 50 benefits of regular exercise and challenge them to double their list of benefits over the next few rehabilitation visits. Such challenges can start them reading, talking, or thinking more actively about their lifestyle rather than avoiding new information. A growing list of reasons that support exercise indicates progression to the next stage.

Stage 2: Contemplation

In the contemplation stage, patients intend to take action in the next 6 months. They now are more cognizant of the benefits of changing, but are also acutely

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aware of the costs. Change is not free. The balance between the pros and cons can produce profound ambivalence. Such feelings can lead to indecision or crisis. Should I take action or should I put it off? Is it worth the effort? If pressured into premature action, behavioral change will be short-lived. Once the pressure is off and the crisis has ended, their action attempts may end as well.

For patients to move from the contemplation to the preparation stage, reasons *not* to change must decrease (3). Fortunately the cons have to decrease only half as much as the pros have to increase (4). Therefore, twice as much emphasis has to be placed on increasing the pros as on decreasing the cons. Sometimes the negatives decrease only because patients appreciate all the positives of changing. For example, the number one reason most patients cite for not exercising is time (i.e., they are too busy). If patients believe there are only five benefits to regular exercise, lack of time is a huge barrier. However, a longer list of benefits makes finding time less problematic. Other costs, such as financial ones, can be reduced through enlightened managed care coverage.

Stage 3: Preparation

Patients in the preparation stage are ready to take immediate action. They are convinced the benefits clearly outweigh the costs. Their biggest concern is that they may fail. Unfortunately, such fears have a basis in reality since the majority of people do not succeed on any one action attempt. Patients have to know that successful change may require several attempts. Cognitive restructuring of potential relapse to equal a learning opportunity reduces fears of failure, shame, guilt, and embarrassment.

Stage 4: Action

Patients have to be prepared for how long the action stage usually lasts. Many believe the worst will be over in a few weeks or a few months. If action efforts are reduced too soon, relapse is likely. Patients should be encouraged to commit to 6 months of concerted effort. Suggest that they think of their change program as the behavioral equivalent of having surgery. They have to let others know that for the next 6 months they will need support and that they may not be at their best cognitively, interpersonally, or occupationally, while placing much of their physical and emotional energies into action to achieve the desired behavioral change.

Stage 5: Maintenance

After about 6 months, patients progress into the maintenance stage. Their confidence increases and temptations to return to unhealthy habits decrease. They do

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not have to work as hard to prevent relapse but they have to work to keep progressing. Most importantly, they have to be prepared for coping with times of emotional distress—times when they are stressed, depressed, anxious, angry, or bored. These are times when they are at their psychological weakest and will be more tempted to return to unhealthy habits. Relapse is likely unless positive coping strategies are in place. Many patients return to old, negative ways of coping when under emotional distress. They eat more, smoke more, drink more, and take more drugs (5). Patients who have been plagued by such unhealthy behaviors are tempted to return to such behaviors as a way to cope with their worst of times. Cardiac rehabilitation programs have to prepare patients to rely on healthy ways of coping with distress. Seeking social support, engaging in physical activity, and use of prepared relaxation techniques are positive options.

Stage 6: Termination

Few patients actually progress to the sixth stage of behavioral change. The termination stage is characterized by 100% confidence across all high-risk situations that a person will not revert back to old habits. At this point, patients report zero temptation to return to previous patterns. When they are anxious, angry, bored, depressed, or distressed they have no temptation to rely on the couch, smoking, junk foods, or excessive alcohol. However, most patients have to continue with a lifetime of maintenance efforts, and must become expert at relapse prevention.

INTERVENTION STRATEGIES

Table 1 relates helpful clinical strategies to the stages of change. Use of these strategies in the cardiac rehabilitation setting facilitates progress from one stage to the next (1). A brief description of each follows.

Consciousness raising includes information, education, and feedback. Emphasis is on increasing awareness about the many benefits that can be derived from the particular change.

Dramatic relief involves emotional arousal as a means of motivating patients to progress. Inspiring, scaring, and exciting patients are some of the emotional arousal techniques that can help patients break through their complacency. Many patients become enthusiastic about the behavioral change paradigm itself because it counteracts their demoralization and fears of failure as they begin to appreciate that rehabilitation professionals will work with their stage of readiness to change on each of their high-risk behaviors.

Expectations, by either the patient or the professional, that patients are willing and able to take action on several risk-related behaviors simultaneously are both unrealistic and overwhelming. Experience with patients with multiple risk

Table 1 Relationship Between Stages of Change and Intervention Processes

Precontemplation	Contemplation	Preparation	Action	Maintenance
Consciousness raising				
Dramatic relief				
	Environmental reevaluation			
		Self-reevaluation		
		Self-liberation		
			Helping relationships	
			Contingency management	Counter conditioning
				Stimulus control

factors indicates that less than 10% are prepared to take action on two or more behaviors. Therefore, action is prescribed only for the highest readiness behaviors. Progressing to the next stage of change is the initial goal for the remaining behaviors. With this approach, patients are relieved to know they will be assisted to succeed at their own pace.

Reevaluation involves imagining how changes will affect others as well as themselves. Creating images that draw patients into the future prepares them for action. For example, many sedentary people perceive joggers as road hazards or public nuisances. Who wants to be one of those? But walking on the beach is an image that can draw many into preparing for a more active lifestyle.

Self-liberation is the belief in one's ability to change and the commitment to act on that belief. The public perceives this process as developing willpower. One effective strategy that strengthens willpower is going public with a behavioral change commitment rather than keeping it private. Another strategy is to offer the patient choices about how to make the desired change. For smoking cessation, for example, three of the best choices include "cold turkey," nicotine replacement (safe for most cardiac patients), or nicotine fading.

Reinforcement management involves rewards contingent on progress, such as resisting temptations to relapse. Many patients expect to be reinforced by others much more than others will reinforce them. This can feed into ambivalence as to whether their struggles are really worth the effort. Being prepared to rely primarily on self-reinforcements rather than social reinforcements is a good strategy for applying this process.

Helping relationships involve people who care, listen, and are available for support. Groups, counselor calls, and cards can provide such support, particularly for the growing numbers of older urban individuals who are more socially isolated.

Counterconditioning involves substituting healthier alternatives for unhealthy behaviors. Nicotine replacement for cigarettes and tasty low-fat foods are examples of such substitutes, as is talking rather than eating during times of emotional distress.

Stimulus control requires reengineering the environment to add cues for healthy action and remove stimuli that evoke temptations. Removing ashtrays from the car, having healthy snacks or exercise equipment available by the television can be cues for action.

SAMPLE APPLICATION

As discussed above, the transtheoretical model provides a framework for assessing each patient's readiness to change. In turn, the most appropriate strategies can then be utilized to support and assist the patient through the change process. Some components of the transtheoretical model are similar to other models related to behavioral change, as shown in Table 2 and discussed in more detail in Chapter 37. What makes this model unique is the structure of sequential steps that enables identification of each patient's readiness status and that facilitates application of appropriate interventions by health professionals. This structure integrates all relevant processes and principles from prevailing theories, resulting in the label transtheoretical model.

Before Cardiac Rehabilitation

At referral to the outpatient cardiac rehabilitation program, each potential participant (and spouse) meets with the cardiac rehabilitation nurse for an intake interview. Data collected at that time include demographics, family history, the patient's perspective of the present illness, daily lifestyle patterns and usual

Table 2 Comparison of Elements of Transtheoretical Model (TTM) to Other Contemporary Models of Behavior Change

	Health belief model	Self-efficacy model
Similarities	1. Importance of intention 2. Importance of pros and cons	1. Importance of self-efficacy 2. Some similar strategies
Differences	1. Stage vs. action model 2. TTM integrates processes and principles into stages	

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activities, beliefs and values, and social support. In addition, patients are assessed for signs/symptoms of depression, denial, or other psychosocial problems. At this early point in recovery, grieving is a common experience for which some patients need spiritual counseling and a few require more formal psychotherapy. Behaviorally, patients are questioned to determine their readiness to change. Examples of common questions used for this assessment are listed in Table 3. Readiness staging allows the nurse to plan and prioritize rehabilitation interventions.

Treatment and its timing must match the stage of each person to optimize results. It is not unusual for a patient to move through one stage during the interview itself. Such rapid advancement can result from the rapport established between the nurse and patient, the power and authority the patient ascribes to the nurse, or the emotions released through verbalization of recent cardiac events. However, rehabilitation professionals must be cautious not to hurry patients through the stages but to allow them to evolve at their own pace. Many special successes result from intake efforts to match staff interactions with patients' stages of readiness to change.

During Cardiac Rehabilitation

At the University of Rhode Island, a behavioral medicine doctoral student follows each cardiac rehabilitation patient once the admission process is complete. The student guides the patient as far through the stages of change as is possible in the 6- to 12-week program, using the techniques discussed. Consciousness-raising activities are often assigned as behavioral "homework." Some examples include:

1. "Don't try to change any of your ______ (smoking, eating, etc.) behaviors yet. Just keep a list of when you do it, what you're thinking at the time, and how you felt afterward. Let's keep that list all week, then next week we'll review it together.

Table 3 Sample Questions and Answers Identifying Stage of Readiness in a Smoker

Stage	Assessment question	Answer
Precontemplation	Do you intend to quit smoking in the next 6 months?	NO
Contemplation	Do you intend to quit smoking in the next 6 months?	YES
Preparation	Do you intend to quit smoking in the next month?	YES
	Have you quit for at least 24 h in the past year?	YES
Action	Did you quit smoking in the last 6 months?	YES
Maintenace	Did you quit smoking more than 6 months ago?	YES
Termination	Did you quit smoking more than 5 years ago?	YES

Name________________________ Date Started Rehab______________

Directions: Each week you will be asked to review the list of health related behaviors below and to put that day's date in the box corresponding to how you feel about changing your behavior related to that problem. Staff members are available to assist you to complete the form and provide any information about these topics that you may need.

READINESS→ RISK FACTORS↓	Not intending to take action in next 6 months	Intending to take action in next 6 months	Intending to take action in the next month	Took action in past 6 months	Took action more than 6 months ago
Poorly Controlled Diabetes					
Inconsistent Use of High Blood Pressure Medication					
High Fat Eating					
Overweight					
Physical Inactivity					
Poor Stress Management					
Smoking					

Figure 1 Participant self-assessment tool for readiness to change high-risk behaviors.

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2. Make a list of 12 benefits of ______ (eating less, exercising more, etc.).

If a behavioral specialist is not on the rehabilitation staff, other staff members following the stages of change model can initiate the same type of interaction. A simple checklist can be kept in the patient's chart to indicate where they are among the readiness to change stages. A sample is provided in Figure 1. It is helpful to have patients update this checklist themselves since it serves as a powerful tool to see personal progress.

After Cardiac Rehabilitation

Once the structured phase of the outpatient cardiac rehabilitation program is completed, patients can choose to enroll in the University's cardiovascular maintenance program, join a community fitness facility, or continue their exercise program independently at home. If they opt for the maintenance program, assistance with behavioral changes continues. The group support and the opportunity to compare notes with others as they return to work/or their usual social and recreational activities are an added benefit. Most patients in exercise maintenance are often in the maintenance stage for other behavioral changes as well.

At this point, relapse prevention is their behavior priority. Frank discussions are held to advise patients that, while relapse is likely to some extent, it is not usually catastrophic. Patients are informed that recycling through the stages is normal and that they should not place blame on themselves or their caregivers when they are not able to perfectly sustain their new behaviors. Perhaps all they need to get back on track is to rethink their strategies and reuse techniques that were helpful in former stages.

In a recent study, we compared stages of change in our cardiac rehabilitation patients to matched samples receiving usual care through a local health maintenance organization (HMO). Cardiac rehabilitation participants were more advanced in their readiness to change stages for several behaviors. We concluded that the difference was due to the facilitating interventions provided by the rehabilitation staff. A recent report suggests that exercise adherence can be predicted using the stages in an older population (6). Additionally, the model has been used in other cardiac settings to predict successful behavior change over time.

FUTURE DIRECTIONS

One ripe area for research related to behavioral change is the evaluation of computer-based "expert" systems designed to work with cardiac rehabilitation patients. Systems currently available involve subjects answering 35 to 40 questions for each high-risk behavior. They then receive a personalized report that provides feedback about what stage they are in and where they stand with the pros and cons of changing. Users are also given feedback on which of the relevant change processes they are using appropriately and which they are overutilizing or underutilizing. Over time they are updated on any progress they have made on the stages, pros and cons of changing, and temptation and confidence in high-risk situations.

These individualized and interactive programs have been tested in a series of clinical trials involving smoking, sedentary individuals, sun worshipers, and women needing mammography screening. In all these trials the expert systems have produced good outcomes. One of the provocative findings was that a participant's use of the computer alone produced results equal to the computer plus trained behavior counselors' interventions (7).

If these computer-based programs prove to be as effective with cardiac rehabilitation patients as they have been with normal populations, behavioral counseling in the twenty-first century will depend on self-administered high-technology tools. Such interactive technologies will be to behavioral medicine what medications have been to biological medicine: the most cost-effective way to bring the maximum science to bear on behavioral problems in an individualized, user friendly manner.

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Motivating and Empowering Patients for Self-Learning

Susan Herr Swails
Holy Spirit Hospital, Camp Hill, Pennsylvania

Barbara H. Southard
Health Management Consultants, Floyd, Virginia

INTRODUCTION

The delivery of healthcare services has changed over the past decade as healthcare providers are encouraged to deliver more extensive services at lower cost with fewer resources. Outpatient services are growing while inpatient lengths of stay continue to decrease. The emphasis is on decreasing the number of hospitalizations even further. In cardiac care, primary prevention efforts are essential to minimizing initial acute cardiac admissions. Likewise, treatments and programs focused on secondary prevention are needed to decrease readmissions in patients known to have cardiac disease.

One aspect of healthcare that has remained constant in the midst of this continuing change is the universal recognition that patient education is the foundation for both primary and secondary prevention of cardiac disease. This opinion was recently scientifically seconded by the Clinical Practice Guideline, *Cardiac Rehabilitation* (1), which clearly reinforces the need for and value of education, counseling, and behavioral interventions as standard components of cardiac rehabilitation.

Patient education sounds easy. Just give the information—the patient will listen, incorporate it into his or her lifestyle, and the desired health outcome will be realized. Of course, the reality is quite different from that simplistic scenario. Even when nurses teach patients what they say they want to learn, patients may not complete, comply, or otherwise cooperate with related educational instruction

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(2). Written information is not always utilized as healthcare providers assume. For example, in one recent study, a specialized leaflet was distributed to a group of patients; only 62% of those who received it actually read it (3).

What is the difference between those who read and follow through with their educational materials and those who do not? Why are some patients eager to learn while others resist? And, most importantly, what can cardiac rehabilitation professionals do to enhance their educational efforts to accomplish the goals of secondary prevention? The intent of this chapter is not to reiterate the basic principles of patient education, which are detailed in other texts (4). Instead, emphasis is on applying selected motivational models to enhance patient education and on exploring emerging opportunities to engage patients in self-learning activities.

Motivation, defined as ''the act or process of furnishing with an incentive or inducement to action,'' is the basis for learning (5). Learning is defined by what it produces: change (5). In the cardiac rehabilitation setting, the goal of education is to induce the patient to change high-risk behaviors to those known to be more healthful. There can be conscious or subconscious influences on this inducement to action that produce positive or negative behavior change. Motivation occurs within a person and enables learning to take place. If a person does not want to learn, any educational effort will be unsuccessful (6). The cardiac rehabilitation professional's challenge is to influence the patient's motivation to learn how to produce positive behavior change and to take responsibility for doing so.

In 1984, Malcolm Knowles stated that ''we become adults psychologically when we arrive at a self-care concept of being responsible for our own lives, of being self-directing'' (7). The educational models developed by Knowles define how adults learn differently from children (7). Implementation of the principles he describes will assist cardiac rehabilitation professionals to move patients closer to assuming self-responsibility not only for immediate learning, but also for longer term behavior change. However, applying such well-known principles of adult learning in isolation is usually not enough. To be effective, educational efforts must optimize motivation to learn, minimize barriers that make learning difficult, and maximize the use of strategies and tools for self-learning.

MINIMIZING BARRIERS TO LEARNING

In addition to knowing how to apply adult learning principles in patient teaching, cardiac rehabilitation professionals have to be equally adept at knowing what *not* to do in educational attempts. They have to understand and adjust for the major factors that can impede learning.

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Low Literacy

It is estimated that 40 to 44 million adults in the U.S. cannot understand written materials that require very basic reading skills (8). Reading and understanding medication instructions, consent forms, or educational booklets is more problematic for many patients than most practitioners realize. The average reading level of an American adult is at the eighth- or ninth-grade level with one in five reading at the fifth-grade level or below (6). Healthcare providers should not assume they can easily recognize patients with low literacy skills. Many people who struggle with reading are successful in hiding their deficiency (9).

Poor readers skip over uncommon words, often reading one word at a time, take instructions literally without interpreting them for new situations, and may miss the inferences from factual data applied to themselves. Such individuals do not lack intelligence; they just lack reading skills (6). Methods of evaluating the literacy skills of patients include WRAT, REALM, and Cloze testing (see Table 1). The use of these tests can verify patients' comprehension of educational content as required by the Joint Commission on Accreditation of Healthcare Organizations (JCAHO) for hospital accreditation.

Written materials used for cardiac rehabilitation education should be evaluated for reading level and used with the appropriate patients. Assessment of suitability of patient education materials can be done using the Fry Formula, Suitability of Assessment of Material (SAM) or a specialized computer program (6). A quick and easy way to obtain a gross estimate of readability is to read the item looking for multisyllable words. The greater the number of multisyllable words, the higher the grade reading level (10).

Psychological Distress

Anxiety and stress may inhibit the patient's ability to learn (11). Patients in acute distress need emotional support, not cognitive information. Problems must be resolved before learning can proceed.

Physical Instability

Patients must be pain free and in a physical condition that will allow concentration (11).

Sensory Impairments

Sight-impaired patients must have appropriate tools, such as large print handouts, audio books, and tactile tools (e.g., feeling the heart model as an explanation is made). As a result of recent mandates from the Americans with Disabilities Act

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Table 1 Methods of Evaluating Literacy Skills

Reading skills tests	Comprehension skills tests
Test the ability to transform letters into words and pronounce them correctly (decoding).	Test how much the person understands from reading (comprehension).
1. *Wide Range Acheivement Test (WRAT)* Patient reads aloud each of 42 words listed on a card—from easiest to hardest. The tester follows along with an identical word list making a check over each mispronounced word. The test is stopped when 10 consecutive words are mispronounced, or an alternative stop method is selected. A manual assists in conversion of test results to reading grade level.	1. *Cloze Test* Used to test reading comprehension of patients who score WRAT/REALM at the sixth-grade level or higher. Patient reads a passage with every fifth word missing and the patient must fill in the blanks. This test can be made up specifically for the patient population with frequently used healthcare materials.
2. *Rapid Estimate of Adult Literacy in Medicine (REALM)* Similar to WRAT, except the patient reads from a list of the medical-related words arranged in three columns with the first column containing the easier words. Scoring is done by taking the raw score and comparing it to a table that estimates the reading grade average.	2. *Listening Comprehension Tests* Used for those patients who score below the sixth-grade level on the WRAT/REALM tests. A passage is read to the patient and then the patient is questioned about the passage and the patient's answers are recorded.

Source: Adapted from Ref. 6.

(ADA), deaf patients must be provided with a professional interpreter. It is recommended that a professional interpreter be used for facilitation of communication between the healthcare team and the patient rather than relying on a family member. A nonprofessional interpreter, such as a healthcare provider who has taken a few classes in signing, may not interpret correctly and misinformation may result.

Language Differences

Appropriate instructional materials must be provided for the non-English-reading patient, as well as a professional interpreter for oral communication and assessment of literary skills. As mentioned above, an inexperienced interpreter or a family member serving as interpreter may lead to inaccurate information being conveyed between the patient and the healthcare provider.

OPTIMIZING MOTIVATION

Even when cardiac rehabilitation professionals do their teaching job well—applying adult education principles, decreasing obstacles, using appropriate materials—they are often frustrated with poor educational outcomes. Why don't 100% of the patients absorb the information and comply with the instructions given to them? The answer may be failure to recognize differences in health behavior motivation in the patients taught.

Recent publications by Prochaska and colleagues outline a functional framework for assessing readiness to change (see Chap. 36). In addition, self-efficacy theory, the Health Belief Model (HBM), and the concept of Health Locus of Control (HLC) provide behavior models helpful in identifying and intervening with a patient's motivational status.

Bandura's Self-Efficacy Theory

A person's objective ability to perform a specific behavior is called efficacy. It can be measured by observing if a person actually demonstrates the behavior (12). Two major concepts with this theory are efficacy (performance) expectations and outcome expectations. Efficacy or performance expectation is the patient's perceived ability to perform a behavior. The patient's belief that a behavior will produce a specific desired outcome is outcome expectation (13). Efficacy expectation seems to have a greater relevance for predicting an individual's action than outcome expectations (14) (see Table 2). Miller and Taylor stated that the most

Table 2 Sources of Information Influencing the Development of Personal Efficacy Beliefs

Performance	Success will occur with perceived self-efficacy. Failure will occur with decreased perceived self-efficacy.
Vicarious experiences	Comparison of one's situation and experiences with those of another.
Verbal persuasion	Influence of others' suggestions, especially those in authority.
Physiological feedback	Indicated by energy, stamina, and strength. Must rely on clues to access one's own capabilities.

Source: Adapted from Ref. 14.

widely recognized approaches to health behavior change are the social cognitive theory and self-efficacy analysis (15).

Bandura has suggested a two-step approach to measure an individual's self-efficacy (16): (1) ask if the patient believes a particular behavior should be accomplished; and (2) have the patient rate the strength of this belief for each designated task.

Health Belief Model

This model was developed in the 1950s by social psychologists of the U.S. Public Health Service. This psychosocial model is closely related to Bandura's theory of self-efficacy; however, Bandura's theory is more widely used (17). The HBM hypothesizes that behavior depends on two patient variables: (1) the value placed on a particular goal, such as the desire to avoid illness or get well; and (2) the estimate of the likelihood that a given action will achieve a goal, such as a specific health action will prevent illness (18).

The HBM consists of various perceptual dimensions as described in Table 3. Something must trigger a patient's decision to take action. This cue to action may be an internal cue, such as unexplained symptoms, or an external cue, such as suggestion by a significant other to take action (18).

Health Locus of Control

HLC is the expectation of the patient regarding the effects of behavior on personal health. It is measured using the multidimensional health locus of control scale (MHLC) developed by Wallston et al. in 1978. The scale measures the degree

Table 3 Dimensions of the Health Belief Model

Patient's perception	Description
Susceptibility	The patient's perception of the risk of contracting a condition.
Severity	The patient's feelings regarding the severity of contracting an illness or leaving an illness untreated based on evaluation of possible medical consequences, such as pain or death, or social consequences, such as the effects on family life.
Benefits	The patient's acceptance of a course of action to change health behavior, even with a serious condition, would depend on feasibility and efficacy.
Barriers	The possible negative aspects of taking a particular course of action, such as cost, side effects, or dangerous outcomes, may prevent a patient from changing health behavior.

Source: Adapted from Ref. 18.

to which the patient believes that health outcomes are under the control of self, powerful others, or chance (19).

The HLC describes patients as having internal or external locus of control. The internal patients believe they have a good deal of control over situations and events related to health behaviors. The external patients believe that the powerful others, such as healthcare providers, have control and the patient is not responsible for his or her overall health status. The chance patient believes that health status is the result of luck or fate and is beyond an individual's control (20).

A great deal of time, effort, and expense could be saved if health educators assessed for motivation *before* beginning a behavior change program. Once assessed, the health educator would be able to match programs or strategies with patients depending upon their varying levels of motivation. Such matching has been discussed in the readiness for change literature (see Chap. 36), a concept that is closely related to levels of motivation. Unfortunately, cardiac rehabilitation professionals may assume patients are motivated, when in reality many patients enroll in cardiac rehabilitation programs in an effort to please doctors, family members, and anyone but themselves. These unmotivated patients will go through the motions of participating in a program, but without true motivation, and their behavior will continue unchanged.

Motivation implies that patients are *empowered* to change because they can *envision* how their lives will be better as a result of a change. To assess for motivation, cardiac rehabilitation professionals have to determine whether or not the patient can envision a better life after making a change and whether or not the patient is empowered to make the change.

To find out if a patient has a "vision" of life with the changed behavior, the cardiac rehabilitation professional should ask the patient one or more of the following questions:

1. Why does he or she want to change the particular behavior?
2. Why does he or she wish to be healthy?
3. How will his or her life be different as a result of the change?
4. Will the patient be able to engage in a desired activity, have more energy, be happier, feel better?
5. Does the patient envision a higher quality of life while maintaining the change?

Being able to envision a higher quality of life is an essential part of motivation, but is not enough by itself to sustain a long-term behavior change. Patients must also be *empowered* to make a change. The patient must believe that he or she is in control of his or her own behavior and therefore can change it. This concept of empowerment, deeply rooted in a patient's self-concept and self-esteem, is similar to the concepts of internal locus of control and self-efficacy discussed earlier. To estimate a patient's level of empowerment, ask the patient to rate his or her confidence in personal ability to change a particular behavior on a scale of 1 to 100 (with 100 being extremely confident). If the patient is more than 70% confident that he or she can make the change, the patient is probably ready to begin the change program (15).

How can cardiac rehabilitation professionals motivate and empower patients? Motivation and empowerment cannot be given or taught. They are the result of a very personal, internal, experiential process. However, teachers can *enable* the empowerment and envisioning process by (21) providing a nurturing, supportive environment; encouraging a positive self-concept; facilitating thought-provoking discussions and experiences; allowing patients to take risks without fear; and encouraging patients to solve problems creatively and independently.

MAXIMIZING SELF-LEARNING SKILLS

Self-learning skills are a patient's ability to seek information, support, or other assistance with managing heart disease independently (e.g., to read a book about managing stress). Such skills allow patients to continue maintaining heart-healthy behaviors started during cardiac rehabilitation long after discharge from the program. Because maintenance of lifestyle changes is such an extraordinary challenge for patients following rehabilitation, it behooves cardiac rehabilitation staff to incorporate teaching self-learning skills beginning early in the rehabilitation process and continuing throughout. Promotion of self-learning need not take a great deal of staff time and can be incorporated into existing program structures. Most self-learning strategies can be grouped into two functional categories: (1) using traditional tools in innovative ways; and (2) using contemporary technology in appropriate ways.

Examples of how these strategies can be incorporated into cardiac rehabilitation programs are provided below.

Using Traditional Tools in Innovative Ways

Lending Library

Most cardiac rehabilitation programs have an array of patient education materials on hand, including books, health magazines, newsletters, audiotapes, and videotapes. Many programs make these materials available for patients to borrow through a ''lending library.'' However, it is not enough simply to *have* a lending library. The materials have to be viewed as important learning tools by staff and patients alike so they are not destined to stay neatly stacked on library shelves collecting dust. Suggestions on how to make a lending library more productive include:

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1. Have someone on the staff periodically say a few words about a certain book, video, audiotape, or other materials before beginning an educational or exercise session.
2. Have a brief "blurb" about a particular item in a newsletter.
3. Distribute flyers about each new item that is added to the collection.
4. Have patients provide reviews of their favorite book, videotape, or audiotape for the rest of the group.
5. If the book or videotape is about cooking, have a patient, family member, or staff member prepare one or two of the dishes for the group to sample.

Regardless of media format, no new material should be placed in the lending library until it has been thoroughly critiqued by one of the cardiac rehabilitation staff members. The critique should result in the determination that the content of the library item is correct, current, compatible with information given verbally, and comprehensible—that is, at an appropriate reading level for the patient audience as discussed earlier in this chapter. Once the content is deemed acceptable, patients can be engaged in the critique process by asking one of them to review the material for style and presentation. Review questions might include: Was the presentation interesting and entertaining? Did it keep their attention? Was the material attractively and appropriately presented? Was it readable and understandable? Would they recommend it to others? What did they learn from it? Did it answer their questions?

Program Newsletters

In addition to library media with which patients can be actively involved, some programs have found it rewarding to create their own newsletter for informational and educational purposes. Popular features of such newsletters include information about current trends in heart disease development and treatment, stories about a selected patient's experiences, low-fat recipes, jokes, and puzzles, questions and answers about heart disease, and so on.

However, production of a regularly scheduled newsletter is time-consuming for a cardiac rehabilitation staff that is already stretched to cover direct patient care priorities. Consideration could be given to recruiting a group of graduate patients to manage newsletter development on a volunteer basis. Some patients may have life skills that are directly applicable to a newsletter project, such as writing, editing, printing, and so on. Others may be experienced computer operators familiar with desktop publishing and other publication-related software. The intent is not to create more work but to empower patients to take charge of this educational endeavor. While some oversight from professional staff will be needed, this type of project is beneficial for patients and program alike.

Using Contemporary Technology in Appropriate Ways

Rehabilitation programs have a new resource at their disposal, the computer, which can be put to good use both on and off-site. Computer-assisted instruction has been used effectively in diabetes education (22), cancer education (23), in the management of hypertension (24), and in a variety of different settings (e.g., hospital, physician office, community). These types of programs generally are consistent with principles of adult learning in that the participant controls the direction and pace of the program and the programs actively involve the participant. In addition, computer-assisted instruction in some cases appeals to patients who are not comfortable in social settings or who are otherwise difficult to reach in traditional settings.

Interactive Multimedia

Many interactive multimedia programs are available on compact disks, including programs that measure, manage, and track risk factors. These programs could be made available on computers set aside for patient use at the program, and/or patients could borrow them from the lending library to be used at home. As is the case with other materials, patients appreciate information on how they can purchase their own copies.

The Internet

Web sites on heart disease and risk factor education abound on the Internet. These sites offer tremendous possibilities for providing patient education and support. However, it is important that rehabilitation staff make specific recommendations regarding Internet sites, since there are sites that provide misleading and/or inaccurate information. Despite this reservation, use of the Internet for patients should generally be encouraged as it can provide much needed continuing education, motivation, and psychosocial support long after patients have been discharged from the program. An increasing number of resources are available to help cardiac rehabilitation professionals improve their use of the Internet as well (25).

Cardiac Rehabilitation Website

One way rehabilitation programs can steer patients to the best, most accurate sites is to create their own websites and include hyperlinks to their favorite sites on heart disease and risk factors. It is fairly inexpensive to do so and, since the site is also an excellent marketing tool, it is probably well worth the expense. If there is no one on staff who can develop a website, there may be a patient or

Table 4 Suggested Components of a Cardiac Rehabilitation Website

Welcome and description of the program: Provide a general description and purpose of the program. Consider including a picture of building where the program is located. Add a few testimonials from patients, in their words, with photos of rehabilitation sessions in action.
Services provided: Outline types of programs, special services, and activities. Include cost, schedule, and how to enroll. Again, add photos of activities, classes, and/or special events.
Staff: Names, photos, and qualifications/roles of staff members.
Recommended patient education web sites: List titles with brief descriptions and hyperlinks to a variety of web sites for risk factor education and support. Include health risk appraisals and questionnaires, sites that teach about the heart and heart disease, sites that describe various procedures and surgeries, sites on medications, sites with patient-submitted success stories, and sites of organizations such as the American Heart Association.
Questions: Provide a section where patients can ask a rehabilitation professional, or perhaps the medical director, a question and have it answered (anonymously, of course) on-line.
Discussion/chat room: Encourage patients to talk with one another either using their true identity or using a code name. This is really another name for an on-line support group. It's great when rehabilitation professionals and physicians can periodically log on, too.
Directory of e-mail addresses: Develop a list of patients' e-mail addresses, with patients' permission, of course, to facilitate individual support and communication among patients.
Comments: Include either a form or a simple e-mail link for users to provide feedback and suggestions about your web site.

volunteer who would enjoy the challenge of creating one for the program. Table 4 outlines the content that could be included in a program's website.

SUMMARY

In the past, educational efforts in outpatient cardiac rehabilitation often consisted of mandatory classes that inundated patients with information and/or 1:1 nurse–patient sessions that spoon fed advice. At present, cardiac rehabilitation professionals are becoming increasingly adept at assessing patients for readiness to learn and change and at applying principles of adult learning. They recognize that education and motivation go hand in hand. The result is a greater emphasis on self-learning strategies that empower patients to take responsibility for life-long management of healthy behaviors. In an effort to help cardiac rehabilitation programs become more successful in providing education, counseling, and behavior interventions, this chapter has discussed how to minimize educational barriers, optimize individual motivation, and maximize the use of self-learning strategies.

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Adherence to a Heart-Healthy Lifestyle—What Makes the Difference?

Lora E. Burke
University of Pittsburgh, Pittsburgh, Pennsylvania

INTRODUCTION

Types of Adherence

By definition, cardiac rehabilitation is conducted in three sequential program segments: (1) an in-hospital based phase; (2) a supervised outpatient or a medically directed home exercise program; and (3) an ongoing lifetime maintenance plan aimed at sustaining physical fitness and risk factor reduction. Thus, adherence/compliance, the extent to which the participant follows the health professionals' advice (1), may be considered at two levels, to the organized program and to the recommended lifestyle. The first level, program adherence, has been the target of adherence-enhancing interventions (2,3). The second level, lifestyle adherence, includes maintaining the recommended behaviors. An important distinction between the two types of adherence is that one may be present in the absence of the other (i.e., an individual may discontinue attending the exercise sessions but adhere to the lifestyle changes, or the participant may attend the exercise sessions regularly but implement none of the lifestyle recommendations). The cardiac rehabilitation professional has to be cognizant of these differences to adequately prevent or remediate either type of nonadherence.

Significance of Nonadherence

The efficacy of risk-reduction therapy has been demonstrated within (4) and outside (5,6) of cardiac rehabilitation programs. Smoking cessation could reduce

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mortality by 40%; however, the best sustained abstinence has been reported to be 71% (7). Lipid-lowering therapy may reduce coronary mortality 42%, but the literature reports less than ideal adherence to lipid-lowering medication regimens (8). A 25% survival advantage has been reported for those exercising during the initial post-MI years, but 50% of patients discontinue participation in cardiac rehabilitation exercise sessions during the first year (9). It is not known what proportion of this group continues to exercise on their own. Medically directed home exercise programs have observed 72% participation rates at 26 weeks (10), but a second study reported a 4-year rate of 41% (11). These results indicate that less than optimal reduction in cardiovascular mortality can be realized in the presence of nonadherence to risk reduction therapy.

FACTORS CONTRIBUTING TO THE PROBLEM

In an attempt to identify the individual at risk for nonadherence, numerous studies have examined factors that may be associated with adherence. The factors are often categorized as those specific to the person, those related to the regimen, and those related to the clinical setting. Several factors, such as sociodemographic variables, are inconsistent in their association with adherence and, furthermore, are fixed and therefore not amenable to intervention. However, numerous remedial factors can be addressed.

Patient-Related Factors

Adherence at the outset of treatment was a predictor of subsequent behavior in the 2-year Medical Outcomes Study (MOS) (12), and in a 2-year weight reduction program (13). Indulging in behaviors that made one feel better (e.g., drinking, smoking, or spending more time alone), referred to as avoidance coping, predicted nonadherence (12). The availability of social support was a significant determinant of dietary (14) and cardiac rehabilitation adherence (2).

Cognitive-motivational models have guided several investigations (7,15–20). While intention and attitude were not consistent predictors of behavior (16), several prospective studies reported an association between self-efficacy and physical activity (17), smoking cessation (7,18), and dietary adherence (19,20). Motivational readiness (discussed further in Chap. 37) predicted exercise and smoking cessation maintenance (18). In summary, patient-specific factors that demonstrate predictive power most often among cardiac patients are initial adherence behavior, self-efficacy, and social support.

Situational variables have provided evidence for variation in adherence levels. An individual may be highly adherent to one component of the regimen (e.g., medication-taking), but nonadherent to the activity plan (21). Although behav-

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ioral risk factors are interrelated, health behaviors are largely independent of each other. Blair et al. reported that patients who increased their exercise were not more likely to change dietary or smoking habits (22).

Regimen-Related Factors

Regimen-related factors include the complexity and duration of the regimen (e.g., number of medications, disruption of daily routine to attend exercise sessions, long-term eating changes) (23). The typical adherence curve begins to decline early in the treatment course and continues the downward trend over time (23). Thus, regimen-related factors have to be considered in planning the rehabilitation process in its early and ongoing phases.

Provider-Related Factors

Similar to regimen-related factors, these factors are often under the control of the health professional, and include skills and attitude of the provider, such as the ability to listen, communicate, and convey respect for the patient's concerns (23). Process variables form another group of factors and include commuting distance to the rehabilitation center, flexibility of hours, and staff continuity (2). These variables suggest that home-based programs may enhance adherence for some patients, especially those with prior experience in exercise or with an adequate support system (10) (also see Chaps. 34, 35).

In summary, even though each factor may contribute to the prediciton of adherence, the predictive power of any one factor is limited (9,24). This emphasizes the necessity of conducting a thorough assessment of the individual's potential to adhere and planning a program that facilitates the individual's adherence initially and over the long term. Ongoing assessments can be incorporated into follow-up visits and identified problems addressed at that time. The reader is referred to other sources for a review of measures to assess adherence (23,25).

ADHERENCE ENHANCING INTERVENTION STRATEGIES

Based on findings that adherence during the initial phase of treatment predicts later behavior (12), there is value in initiating adherence-enhancing interventions at the outset. Daltroy targeted improvement in cardiac rehabilitation attendance by intervening with participants and spouses at enrollment (2). Although there was only a 2% difference between the groups' attendance at 3 months, an adjustment for baseline covariates revealed an increase of 11.7% in the treatment group.

Self-efficacy theory (26) provided the framework for risk-reduction studies that demonstrated improved adherence to lipid-lowering diets (20), smoking ces-

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sation (7), and improved exercise maintenance when the spouse expressed belief in the patient's capability of exercising (27). Several behavioral techniques were incorporated into the self-efficacy-enhancing studies [e.g., self-monitoring (28, 29), reinforcement (20,28,29), modeling, persuasive communication, or verbal persuasion (2,20)]. These strategies were employed initially and continued throughout the intervention period.

Behavioral skill training incorporates educational and behavioral strategies (i.e., teaching the person the ''how to'' of managing a condition or performing an activity, and providing opportunities to practice the behavior and receive reinforcement. These techniques were used for improving eating behaviors related to lipid-lowering (30), but not in preventing the predicted downward trend in exercise session attendance (10). A newer approach to improving exercise adherence was tested in weight reduction (31) and in cardiac rehabilitation (32). These trials evaluated six 10-min bouts of exercise per day vs. standard daily exercise sessions and showed higher weekly energy expenditure among the short-bout group (32) and a trend toward longer weekly exercise duration (31). In the latter trial, the self-report measure was corroborated by an accelerometer (31).

An important component of treatment that requires ongoing attention is medication compliance (25). Interventions shown to be effective include teaching patients self-management skills, utilization of cognitive strategies such as medication reminder charts or pill organizers (33), and prescription refill reminders and unit-of-use packaging (34). Interventions to promote adherence or remediate poor adherence can draw upon the combined use of educational and behavioral strategies.

Strategies shown to be successful in promoting adherence to risk reduction treatment include nurse-managed interventions that incorporate ongoing telephone contact, goal setting, and self-monitoring with feedback provided through phone contacts or mail, as well as the use of problem-solving strategies (5,6,20,35). Two studies did not include a comparison group for the adherence-enhancing intervention (5,6). The first study demonstrated improvement in lipids, smoking status, diet, weight, and functional capacity following a 4-year risk reduction program (5); the second study reported similar results at 1 year postmyocardial infarction (6). A 6-month study reported an improved diet compared to the control group, but no difference in smoking cessation or exercise status (35), and a 3-month study showed improved dietary adherence and reduced low-density-lipoprotein cholesterol in the intervention compared to the control group (20). Additional controlled studies reported improved adherence with ongoing phone contacts (29,36).

Since eating and exercise are paramount behaviors in any risk reduction program, it may be worthwhile to examine some strategies shown to be effective in the treatment of obesity. Daily self-monitoring of eating and activity is considered the sine qua non of behavioral programs (37). Long-term adherence to self-monitoring predicts weight loss maintenance (38). However, the single best pre-

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dictor of long-term success in maintenance of weight loss is a sustained exercise program (37). Other techniques include stimulus control, which is based on the assumption that antecedents in the environment control behavior (37). Therefore, individuals are taught to restructure their environment and provide for positive eating and exercise behaviors. Similar to a structured cardiac rehabilitation program, these and other strategies are implemented as a coordinated program over several weeks. A recent review reported a sustained 60% weight loss at 64 weeks, which represents an improvement in outcome (37).

An additional strategy that has long-term implications is relapse prevention. This approach helps individuals anticipate potential relapse problems in the habit-change process, emphasizing that a relapse begins with a minor slip or lapse (39). What determines whether it becomes a relapse is the person's ability to cope with the situation. Use of relapse prevention training has improved maintenance of weight loss (36) and smoking cessation (5).

Education or patient teaching is an integral part of cardiac rehabilitation. Important issues when teaching patients include consideration of the person's level of knowledge, the complexity of the regimen that has to be taught, the person's literacy level, the reading or vocabulary level of available materials, and the time frame in which learning has to be accomplished (23). Education should be delivered in limited amounts and time, with a focus on the regimen the patient has to implement, not the disease. Since increasing one's knowledge is insufficient to improve adherence, it is better to accompany it with one or more behavioral strategies, such as modeling the behavior being taught, providing opportunity for practice and mastery, giving reinforcement on successful accomplishment, and follow-up on comprehension and behavior in subsequent visits (23,25).

Although some of the strategies discussed were not tested in the context of cardiac rehabilitation, several lend themselves to this context and have potential for improving patient adherence to a heart-healthy lifestyle. Moreover, several techniques were tested over prolonged periods. The strategies that demonstrated significantly improved adherence or outcomes are summarized in Table 1.

PROMISING STRATEGIES

Most promising are strategies that achieve long-term adherence, are flexible for different settings and providers, and reasonable or low in cost. Continued contact through some form of transtelephonic communication has the potential to allow patients to report behavior periodically to and receive feedback from the provider in a timely manner. Depending on the resources available, this can be accomplished via the telephone or through the Internet. Additional strategies may include use of a hand-held computer to allow immediate recording with later downloading. Finally, a more flexible approach to cardiac rehabilitation has to be con-

Table 1 Behavioral Strategies to Enhance Program and Lifestyle Adherence

Tailor regimen: Arrange time and location of exercise sessions to better accommodate work/home schedules, plan diet modification with sensitivity to cultural preferences and available resources (5,6,20).
Goal setting: Have patient set proximal, attainable, very specific behavioral goals (e.g., will lose 1 pound per week; walk 8 blocks 3 times/week for 2 weeks; reduce milk fat to 1%) (5,6,20,31,37).
Self-monitoring: Record behavior related to goals (e.g., foods/beverages eaten, activities performed, cigarettes smoked; may include circumstances and feelings) (5,6,20,28,29,37).
Reinforcement: Review self-monitoring records, provide praise for attempts and accomplishments and encouragement to continue work toward goal (5,6,29,31,37).
Problem-solving: Teach patients to identify threats to adherence, generate solutions through brainstorming, select a solution and test it, evaluate its effectiveness (20,31,37).
Behavioral skill training. Incorporate educational and behavioral strategies (i.e., teaching the "how to" and using several of the above-mentioned behavioral techniques) (3,5,30–32).
Contracting: Have written agreement between patient and provider concerning how/when patient will reach set goal; may involve a reward when goal achieved, may use incremental steps in reaching goal, state specifics of behavior, and goal in contract (6).
Self-efficacy enhancement: Provide opportunities for successful performance of specific behavior, provide positive feedback to increase confidence; use verbal persuasion to convince patient he/she is capable of changing behavior or achieving goal; set short, specific goals; use realistic role models as examples of behavior, or provide opportunities for vicarious learning; reinforce positive physiological cues and the patient experiences (e.g., good feeling post-exercise) (2,5,6,20).
Social support: Enlist assistance of significant others as part of support system (e.g., invite spouse, friend, or coworker to attend sessions or be a partner for home exercise) (2,14).
Telephone contact: Provide regular contact for follow-up or feedback on diaries, setting of new goals, reinforcement on progress, or problem-solving; appointment made in advance, frequency determined by need and resources (5,6,20,29,36).
Cuing or cognitive strategies: Set up system of reminders to take medicine, refill prescription, exercise (e.g., reminder sticker, medication organizer) (33,34).
Stimulus control: Teach patients to change their environment so there are cues for appropriate exercise and eating behaviors and fewer cues for inappropriate behavior (e.g., have healthy foods visible and readily available, have exercise shoes or other exercise equipment visible; keep unhealthy foods out of sight) (37).
Relapse prevention: Teach patients to identify high-risk situations that may lead to a slip or lapse in diet, exercise, or smoking cessation program; anticipate situation and plan strategies to handle it so that if the patient falters a relapse does not follow (5,7,39).
Frequent short exercise bouts: Have patient exercise for 6- to 10-min periods as alternative to standard 30- to 45-min exercise session (31,32).

Source: Ref. 25.

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sidered, reinforcing that it is an approach to ongoing change in lifestyle, not a program limited to 12 or 24 weeks. Finally, incorporating relapse prevention training and increasing utilization of home-based programs or use of community facilities represent options for the long-term approach to improved program and lifestyle adherence.

SUMMARY

The potential for nonadherence is always present, regardless of the setting or patient population. Absence of contact between the patient and provider can be expected to result in reduced adherence. Therefore, providers have to be alert and sensitive to adherence on an ongoing basis, to question the patient about past and present behavior, discuss problems, and utilize educational and behavioral strategies to enhance adherence. Finally, it requires providers to examine how they communicate with their patients and to determine what factors within the providers, the regimen, or the patient might be altered to facilitate improved adherence to cardiac rehabilitation and to the behavioral changes.

ACKNOWLEDGMENT

Preparation of this chapter was supported by grant HL07560.

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Measuring Program Quality—Applying Standards and Guidelines

Dwight Davis
Pennsylvania State University College of Medicine, Hershey, Pennsylvania

William G. Herbert
Virginia Polytechnic Institute and State University, Blacksburg, Virginia

Carl N. King
Mission/St. Joseph's Health Care System, Asheville, North Carolina

INTRODUCTION

A relatively new phenomenon in management, the quality improvement movement, had its origins in the manufacturing centers of post-World War II Japan (1). Now, 50 years later, healthcare organizations have embraced the philosophies and strategies that have proven so successful in other venues. It is not just trendy to espouse quality improvement theory; it is as vital to the survival of today's healthcare institutions as it was to industrial enterprises decades ago.

Every day, cardiac rehabilitation professionals, like all healthcare workers, are challenged to improve the effectiveness and efficiency of what they do, to do a good job even better, and to do more with less. Change is the current anthem heard in hospital hallways, physician offices, and in outpatient cardiac rehabilitation centers. But exactly what to change and where to begin are difficult questions with often ambiguous answers. To bring some clarity to those answers and to set priorities for action, it is helpful to understand performance expectations in the field and to compare practice priorities with peers. This chapter will contribute to these efforts by: (1) reviewing recent developments in the quality movement that impact cardiac rehabilitation practice; and (2) introducing contemporary quality initiatives specific to cardiac rehabilitation.

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THE QUALITY CONCEPT AND HEALTHCARE

Contemporary Concerns

The healthcare system in the United States has undergone great change and continues to evolve. A number of issues have taken center stage in continuing the momentum for healthcare reform. There has been a heightened awareness of wide variations in clinical practice exemplified by patients with cardiac problems receiving different evaluation and treatment (2). Outcomes have not been consistently well defined and standards of care are often lacking. Historically, the system has not been geared toward ensuring continuous improvement of healthcare delivery and outcomes—status quo often prevails.

Against this background, there has been an increasing demand for a cost-effective, high-quality healthcare system with public accountability. While a comprehensive report on quality development is beyond the scope of this chapter, review of a few key events strengthens the message that quality improvement efforts are an integral part of modern healthcare and an imperative element of cardiac rehabilitation practice.

Evolutionary Changes

In the early 1900s, Dr. Ernest Codman, a prominent Boston surgeon, suggested that surgical outcomes be made available to the public. Codman was later joined by Dr. Edward Martin to help start the Hospital Standardization Program, which was the forerunner of the Joint Commission on Accreditation of Healthcare Organizations (JCAHO) (3,4), the first and still the most recognized leader in healthcare quality efforts in this country. During the early days of the Joint Commission, their mission centered around producing and enforcing facility standards with little emphasis on practice patterns or patient results. However, significant changes occurred in the early 1980s. Several published reports raised awareness about the quality of healthcare at a time when medical costs were rapidly increasing. In response to mounting criticism, the Joint Commission set forth its Agenda for Change initiative in 1987. This initiative oriented the accreditation process around standard-driven performance measures and clinical outcomes, and thus highlighted measurable parameters that could be used to indicate quality care.

At about the same time (in 1986), the Institute of Medicine (IOM) made an important contribution to the evolution of quality. While designing a strategy for quality review and assurance for Medicare, the IOM realized the importance of having a definition for quality of care and solicited input from many sources, including healthcare organizations, public hearings, focus groups, and the literature. Based on that work, the following definition was crafted (5):

> Quality of care is the degree to which health services for individuals and populations increase the likelihood of desired health outcomes and are consistent with current professional knowledge.

This definition advanced the general concept that quality in healthcare relates the effectiveness and efficiency of service delivery to health outcomes of individuals or populations. JCAHO quickly adopted and promoted the new definition.

Another important development in this area was the publication of ''The Measurement Mandate'' by The Joint Commission in 1993 (6). Until then, much of the information regarding clinical performance of individual providers and healthcare organizations was strictly confidential. This publication brought into focus the mandate not only to measure the performance of healthcare providers but also to share this information with the public and other interested parties. From this point forward, it was obvious that performance measurement would play an increasingly important role as a basis for making judgments about the evolving healthcare system. In addition, JCAHO correctly anticipated that quantitative measures of performance would serve as a basis for ongoing improvement of the healthcare system. The operating principle of performance assessment is that objective performance data about key components of the healthcare system could and should be used to identify variations in performance. Evaluation of such variations frequently identifies opportunities for improvement in the quality of care provided. This quantitative process assessment is applicable to both small care units, such as cardiac rehabilitation centers, and large healthcare systems overall.

The next important milestone toward assessment of quality of care was growing interest in the development of clinical practice guidelines (7). The U.S. government and a large number of medical organizations and specialty societies played important roles in this area. In conjunction with the IOM, the Agency for Health Care Policy and Research (AHCPR), a branch of the United States Public Health Service created in 1989, took the lead in determining important guiding principles for the development and use of clinical practice guidelines inlcuding that (8):

Guidelines are developed from a thorough review of all available scientific evidence for the topic under study using systematic, rigorous, and explicit methodology.

Guidelines are intended to be used by physicians, educators, and other healthcare providers to help determine how medical disorders can most effectively be prevented, diagnosed, and medically managed.

The purpose is to use the best available science and expert opinion to enhance the quality, appropriateness, and effectiveness of healthcare. As a result, guidelines provide recommendations for the processes of care that are most likely to be effective.

Current Guidelines

In 1995, the AHCPR supported by the National Heart, Lung, and Blood Institute (NHLBI) and in collaboration with the American Association of Cardiovascular and Pulmonary Rehabilitation (AACVPR) published its Clinical Practice Guideline for Cardiac Rehabilitation (9). The selection of cardiac rehabilitation as one of several guideline projects was recognition of the importance of rehabilitation services in the management of patients with cardiovascular disease. This work was the result of an extensive review and evaluation of the scientific literature in cardiac rehabilitation by a multidisciplinary panel using rigorous and explicit methodology set by AHCPR. The Guideline was written for cardiac health professionals and consumers and intended to optimize the quality, safety, effectiveness, and access to cardiac rehabilitation services. Its evidence-based recommendations were centered on the key components of cardiac rehabilitation—exercise, education, counseling, and behavioral interventions. The expected outcomes of related cardiac rehabilitation services were delineated and a new model for cardiac rehabilitation practice emerged (see Chap. 33 for further discussion of the Guideline-based model).

Several additional sets of Clinical Practice Guidelines of interest to cardiac rehabilitation professionals were also published by AHCPR in the mid 1990s, including (10–12): Unstable Angina: Diagnosis and Management; Heart Failure: Evaluation and Care of Patients with Left Ventricular Systolic Dysfunction; and Smoking Cessation.

During the same time period, the AACVPR was developing recommendations for the structure and operation of the growing number of cardiac rehabilitation programs across the country. The Association's first edition of Guidelines for Cardiac Rehabilitation Programs was released in 1990 (13) and extensively updated to include more of a performance perspective in 1995 (14). This second edition is the basis for national program certification discussed in the next section of this chapter. The third edition of AACVPR's Guidelines for Cardiac Rehabilitation and Secondary Prevention was released in late 1998 and is titled Guidelines for Cardiac Rehabilitation and Secondary Prevention Programs (15). As the new title suggests, recommendations have expanded to a broader philosophy and population.

QUALITY MEASUREMENT IN CARDIAC REHABILITATION

Clearly, the availability of national guideline documents—AHCPR, AACVPR—helps define quality expectations specific to cardiac rehabilitation. However, their existence alone does not guarantee that recommendations will be heeded in practice. Many factors may inhibit the adoption of recommendations including difficulty in interpreting and applying expressed expectations. Thus, the translation of guideline recommendations into formats that individual programs can use to evaluate and compare themselves to the published "standard" is essential. Making them useful tools rather than passive reports is a key step to integrating guidelines into practice.

Recognizing the need to activate recommendations to achieve the goals of increased quality and decreased variation, two quality initiatives have occurred as outgrowths of the guideline development efforts briefly reviewed in this chapter. Each project has taken their respective guideline recommendations and converted them into performance measurement tools. Each project uses review criteria derived from guideline recommendations to identify patterns of care and determine extent of conformance.

The AHCPR Cardiac Rehabilitation Criteria Project

From the beginning of the Cardiac Rehabilitation Clinical Practice Guideline work, the participating agencies foresaw the need to continue their collaboration to the next level—that of utilizing guideline recommendations by converting them into quality of care assessment tools including medical review criteria, performance measures, and standards of care. These tools could then be used to evaluate quality of care in any cardiac rehabilitation program.

The experts working on this phase of the guideline project agreed that the performance measurement criteria for cardiac rehabilitation evaluation fall into four areas of practice (16):

1. Documentation required in the cardiac rehabilitation medical record for the initial assessment.
2. Documentation required in the cardiac rehabilitation medical record prior to the first exercise session.
3. Education, counseling, and behavioral program to address specific risk factors.
4. Documented progress in quantified exercise targets between initial and last recorded visit.

Within these broad areas, the panel created 24 criteria that included acceptable alternatives and special instructions whenever appropriate. Criteria were based on consensus judgments of panel members on salient features of the Clinical Practice Guideline. It was decided that the cardiac rehabilitation medical record would be the only data source used to measure conformance to the performance expectations. Table 1 presents a synopsis of these guideline-based criteria.

It is recommended that, on a local level, the criteria listed in Table 1 be used as a self-administered performance measurement tool. In this context, measurement is the process by which data are collected using the tool. It is not an

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Table 1 Process Review Criteria Derived from the Clinical Practice Guideline on Cardiac Rehabilitation

Performance domain	Documentation criteria	Acceptable alternatives
Assessment		
By the completion of a baseline assessment, the cardiac rehabilitation medical record documents:	Admitting cardiac diagnoses	
	Presence or absence of any other cardiac events, diagnoses, or invasive procedures	Chart contains a copy of the patient's complete past medical history with no mention of other cardiac events, diagnoses, or procedures.
	Patient's current medications	
	Presence or absence of a diagnosis of hypertension or high blood pressure	Baseline assessment documents that the patient's blood pressure is normal or controlled
	Presence or absence of dyslipidemia	Baseline assessment documents a plan to obtain lipid values OR documents a referral to the primary care physician for assessment of lipid status
	Patient's smoking status	
	Patient's recent habitual level of physical activity	
	Presence or absence of a diagnosis of diabetes	Record documents that the patient's blood glucose is controlled on diet or medication
	Presence or absence of a diagnosis of obesity, excess body weight, or body fat	Baseline assessment documents both the patent's height and weight
	The patient's dietary habits	
	Presence or absence of relevant behavioral or psychological conditions	

	Presence or absence of adequate social support	
	Patient's work/occupational status or goals	Baseline assessment documents that the patient declined to provide this information
Prior to the first exercise session, the medical record documents:	Patient's baseline status with objective evidence of exercise performance levels and physiological and clinical measures	The first exercise session includes an objective assessment of hemodynamic, electrocardiographic, and symptom response data
	A quantified, patient-specific exercise prescription	The exercise prescription is documented after a first, monitored exercise session
Intervention		
For patients identified as having/being: ________ the cardiac rehabilitation medical record documents	*Hypertension or high blood pressure*—a specific education, counseling, and/or behavioral intervention	The record documents that the patient declined a recommended intervention OR that the patient was referred to the primary care physician for further assessment and management
	Dyslipidemia—a specific education, counseling, and/or behavioral intervention	The record documents that the patient declined a recommended intervention OR that the patient was referred to the primary care physician for further assessment and management
	Smokers—a specific education, counseling, and/or behavioral intervention	The record documents a prescription for nicotine replacement OR that the patient is attending a smoking cessation program elsewhere OR that the patient declined a recommended intervention
	Obese, excess body weight or body fat—a specific education, counseling, and/or behavioral intervention	The record documents that the patient declined a recommended intervention

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Table 1 Continued

Performance domain	Documentation criteria	Acceptable alternatives
	Behavioral or psychological conditions that warrant attention—a specific education, counseling, and/or psychosocial intervention	The record documents that the patient declined a recommended intervetion OR is already receiving intervention
	Inadequate social support—a specific education, counseling, and/or psychosocial intervention	The record documents that the patient declined a recommended intervention OR is already receiving intervention
Follow-up		
During participation, the cardiac rehabilitation medical record documents:	The patient received nutrition, dietary information	The record documents that the patient declined to accept recommended information
Between 1–3 months after initiation of cardiac rehabilitation sevices, the medical record documents:	The status of each risk factor identified as relevant was reassessed	
Prior to completion of the cardiac rehabilitation services, the medical record documents:	Reassessment of the patient's exercise capabilities and preparation of maintenance exercise prescription	

Source: American Association of Cardiovascular and Pulmonary Rehabilitation/Center for Clinical Quality Evaluation. Final Report: Cardiac Rehabilitation Criteria Project. AACVPR, Middleton, WI, 1995.

end in itself but rather a step that leads to assessment that transforms data into information that helps answer practice questions (17). The answers thus uncovered can be used to choose what actions are necessary to improve results. For example, changes in patient chart forms, clinic procedures, or patient treatment plans might be indicated from information learned. On a larger scale, like the Clinical Practice Guideline itself, these criteria are available in the public domain and are expected to be increasingly utilized by professional review organizations, accrediting bodies, policymakers, and third party payors in evaluating the quality of cardiac rehabilitation programs.

The AACVPR Program Certification Project

In 1990, the American Association of Cardiovascular and Pulmonary Rehabilitation (AACVPR) released a landmark document—the first consensus-based publication addressing the structure and operation of cardiac rehabilitation programs. That much-awaited first edition of Guidelines for Cardiac Rehabilitation Programs (13) almost immediately raised expectations and sparked early discussion of an Association-sponsored program review process as an outgrowth of the guidelines. A committee was formed to study the feasibility of such a national effort. In 1993, the Program Certification Committee of AACVPR was charged with developing a review process that would fairly and objectively measure an individual program's status against the published guideline recommendations.

Some precedent existed for such an ambitious project in that 3 states—North Carolina, South Carolina, Massachusetts—already had certification programs, with North Carolina's being required by state law. Although the process used by each state was different, the common theme was a standardization of care around a set of minimal or essential standards. However, in contrast to legislatively mandated review, AACVPR's constituents, both regional societies and individual members, insisted that participation in such a project remain completely voluntary. Work proceeded over the next few years to outline a process that would determine an individual program's compliance to a set of essential standards. The standards were derived predominantly from three recently published AACVPR documents (14,18,19): Guidelines for Cardiac Rehabilitation Programs, 2nd edition; Outcome Measurement in Cardiac and Pulmonary Rehabilitation; and Core Competencies for Cardiac Rehabilitation Professionals.

Expectations from the AHCPR Clinical Practice Guideline (9) were added as soon as that document became available.

Launched in mid-1998, specific goals for the certification process include:

1. Improvement of clinical practice through adherence to essential standards.

2. Advancement of the multidisciplinary rehabilitation process.
3. Promotion of standard outcome measures.
4. Potential improvement of third party reimbursement.

Achievement of these goals would, in turn, enhance the quality of cardiac rehabilitation care and reduce practice variations.

Performance areas identified for review include those listed in Table 2. A combination of structure, process, and outcome criteria are utilized. Since the criteria set represents essential standards, 100% compliance is required for certification to be granted.

The structure for review and evaluation revolves around a three-tiered arrangement of committees involving a state/regional committee, the national oversight committee, and the AACVPR Board of Directors who make the final decision regarding certification approval. These interrelationships are further illustrated in Figure 1.

The certification process begins with an individual cardiac rehabilitation program applying to the national office of AACVPR for an evaluation packet. After completing a thorough self-assessment that includes input and verification from every staff member and attaching samples of required documentation, the completed packet is mailed back to AACVPR, then sent for initial review to the appropriate state/regional society committee. If that committee favorably reviews the submission, recommendation for approval is forwarded to the national oversight committee. If deficiencies are noted at either state or national level, the submitting program will be required to remedy the problem and/or send additional documentation as requested. Once approved by both regional and national committees, a recommendation for certification is presented to the Board of Directors.

During the course of its development, the certification criteria document has undergone multiple peer reviews to assure content validity. Additionally, a pilot study of the review process was conducted at eight sites ranging from small

Table 2 Functional Areas Included in AACVPR Program Certification Review

Program Structure	Rehabilitation Process	Patient Outcomes
Personnel	Medical emergencies	Health
Facilities	Admission	Clinical
Equipment	Assessment	Behavioral
Medical records	Therapeutic plan	
	Medical follow-up	
	Discharge	

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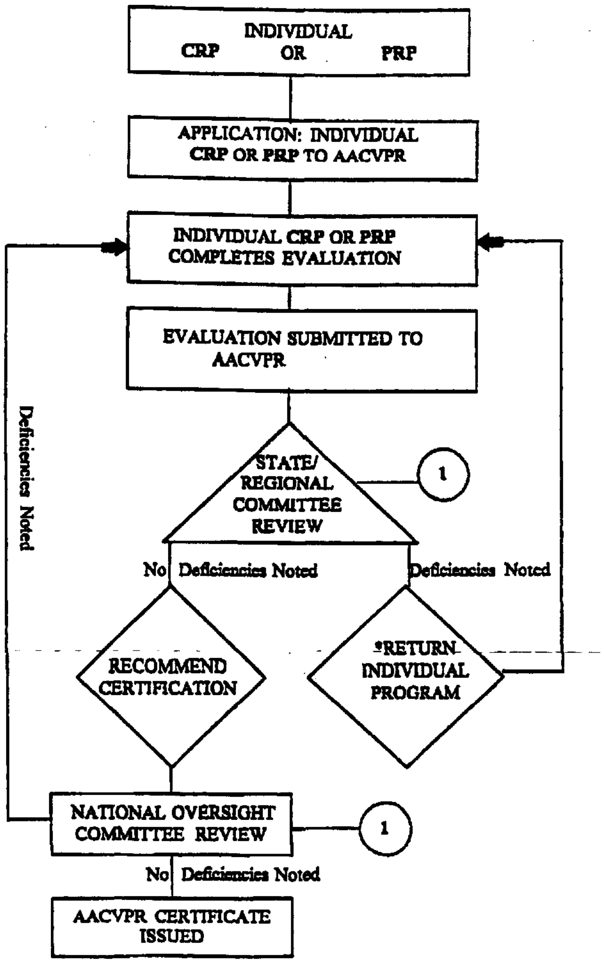

KEY:
AACVPR = American Association of Cardiovascular and Pulmonary Rehabilitation
CRP = Cardiac Rehabilitation Program
PRP = Pulmonary Rehabilitation Program
1 = Bi-directional communication between committees
* = If deficiencies are noted on 3rd review by State/Regional Committee, individual program may request a review by National Oversight Committee

Figure 1 AACVPR program certification.

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to large cardiac rehabilitation programs. Feedback and comments were also received from the general membership. While AACVPR reserves the right to conduct an onsite inspection of any applicant facility, onsite review is not a routine part of the certification process at this time. Revisions to certification documents and procedures will continue as the certification process matures.

CONCLUSION

Cardiac rehabilitation is an important component of care for millions of Americans with cardiovascular disease. The changing demographics of the population and trends in the healthcare delivery system imply an expanding role for cardiac rehabilitation services in the future:

1. The population is aging, which will increase the prevalence of heart disease.
2. Advances in cardiovascular procedures, medical therapies, and cost constraints will maintain the pressure for early hospital discharge and outpatient management.
3. Secondary prevention and avoidance of rehospitalization will continue to be mandates.

The demonstrated beneficial outcomes and cost effectiveness of cardiac rehabilitation fit well within this paradigm. Increasingly, programs are being asked to examine issues dealing with quality and to demonstrate a systematic approach to patient care with objective and measurable outcomes. An emerging concept is that performance measures based on published standards of quality should be an integral part of program design. Outcome measurement (discussed further in Chap. 41) is necessary to learn results of care provided. Process measurement is necessary to learn what caused those results (20). Both evaluations comprise performance measurement and are essential to quality practice. The two sets of cardiac rehabilitation performance measures now available are discussed in this chapter. They offer all cardiac rehabilitation programs the opportunity to measure and improve their services.

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Streamlining and Computerizing Cardiac Rehabilitation Charting

Patricia McCall Comoss
Nursing Enrichment Consultants, Inc., Harrisburg, Pennsylvania

Jody C. Heggestad
Heggestad Consulting Group, Boulder, Colorado

INTRODUCTION

A patient chart is to healthcare what an airplane's black box is to aviation—the official record of service rendered. In both cases, the facts, sequence, and outcomes of the respective services are recorded and preserved for interested parties to retrieve, review, and utilize for unforeseen future circumstances. Those circumstances may include additional service delivery, legal opinion, regulation compliance inquiry, quality monitoring, and more.

For centuries, healthcare workers have relied on accurate, concise communication of a patient's condition. From word of mouth to paper and pen to computer entries, the search for the perfect medical record continues. At the end of the twentieth century, in cardiac rehabilitation as in all of healthcare, effective documentation remains essential. Not only is reliable, consistent charting needed to support good patient care, but it is also required to fulfill the expectations of healthcare's special interests, including those listed in Table 1. However, recent resource constraints, most specifically decreased staff with decreased time, make paperwork completion, including charting, increasingly problematic.

Adding to the difficulty is the fact that no uniform data set has been defined for outpatient cardiac rehabilitation by any healthcare authority. What really is necessary to include in each patient's chart? How can it be recorded most efficiently? Other than the charting generalities recommended by the American As-

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Table 1 Rationale for Effective Documentation in Outpatient Cardiac Rehabilitation

Certification Requirements:
Facility = Joint Commission on Accreditation of Healthcare Organizations
Program = American Association of Cardiovascular and Pulmonary Rehabilitation
Compliance Issues:
Industry Standards
Professional Performance
Reimbursement Information
Cost Containment Concerns
Legal Considerations
Outcome Evidence:
Individual Patient
Aggregate Data
Periodic Reporting:
Patients
Payers
Physicians

sociation of Cardiovascular and Pulmonary Rehabilitation (AACVPR) (1), and the documentation related performance measurement criteria developed by the Agency for Health Care Policy and Research (AHCPR) (2) (discussed further in Chap. 39), no official mandate governs exactly what is to be recorded and when. The purpose of this chapter is to review recordkeeping expectations, to discuss recording options and opportunities, and to recommend a core charting structure for use in outpatient cardiac rehabilitation.

WHAT IS ESSENTIAL FOR PATIENT CHARTS IN OUTPATIENT CARDIAC REHABILITATION PRACTICE?

As the predominant credentialing body of hospitals and ambulatory care facilities in the United States, the Joint Commission on Accreditation of Healthcare Organizations (JCAHO) has provided recommendations on the content, use, and maintenance of medical records for decades. Since appropriate information management is currently among their highest priorities, and since their recommendations meet or exceed those of other review agencies (3), JCAHO generic charting standards are used as the template for the cardiac rehabilitation charting recommendations in this chapter.

From a functional perspective, cardiac rehabilitation services are delivered through a patient care process that consistently follows the steps of the scientific method. From a quality perspective, the JCAHO has identified a series of patient-

Table 2 Relationship Between Actual Cardiac Rehabilitation Patient Care and Joint Commission's Recommended Patient Focused Functions

Cardiac rehabilitation care	Patient focused functions
Safety	Safety; patient rights
Assessment	Assessment; reassessment
Planning	Appropriateness
Implementation	Care of patients; patient education
Evaluation	Efficacy; continuum of care

focused functions that are key to optimal patient care (4). The alignment of these two perspectives, as shown in Table 2, provides a useful framework for identifying and organizing core elements of recordkeeping in outpatient cardiac rehabilitation. The text provided under each of the five functional headings below:

1. Describes the rationale for recommended forms.
2. Explains related clinical considerations.
3. Connects charting with related practice issues.

Safety

JCAHO describes safety as "the degree to which the risk of an intervention and the risk in the care environment are reduced for the patient" (Ref. 4, p. 122). In the cardiac rehabilitation setting, risk is related to both the patient's condition and the facility itself. Therefore, documentation that confirms how risk is minimized is imperative before any rehabilitation services are initiated. Table 3 lists

Table 3 Safety Documentation Checklist for Outpatient Cardiac Rehabilitation

Initial Diagnosis/ Date of event	Ongoing (if/when) Change in patient's condition Variation from established clinical parameters
√ Referral/admission orders	* Physician's orders
√ Informed consent	* Nurse's note (assessment)
√ General orientation checklist	* Stat rhythm/12-lead ECG
√ Equipment safety checklist	* Code/cardiac arrest sheet
√ Baseline 12-lead ECG	* Patient event form

Key: √ = routinely recommended; * = as needed/indicated.

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safety-related chart forms. Two of the forms have legal as well as safety implications. Therefore, physician orders referring the patient to cardiac rehabilitation and the patient's informed consent to participate in this specialized form of therapy must be present on each patient's chart (5).

Two other forms help prepare for potential cardiac crises:

Standard 12-Lead ECG

As part of intake procedures, a new ECG should be performed unless a recent one is available (within the last 30 days) and the patient's condition has remained stable since that recording. This baseline ECG may be needed for future comparison in the event of emergency.

Patient Event Form

If and when a cardiac problem occurs, documenting the details on a special patient event form is helpful not only for recordkeeping but also for quality monitoring purposes. A duplicate copy of the form can be used to report the event and evaluate how it was handled. Joint Commission uses the term ''sentinel event'' to describe an unexpected occurrence that requires subsequent intensive evaluation to determine if any process improvement is indicated (Ref. 4, p. 124). A patient crisis that occurs during cardiac rehabilitation and requires immediate medical intervention qualifies for such quality review.

More specific to the environment of care, a checklist is recommended that records both the general facility orientation given to the patient and the specific instructions on how to properly use each piece of exercise equipment. Status of the patient's advance directives can be entered on the checklist as well.

Respecting patient rights inherently involves maintaining confidentiality of medical records. Since the atmosphere of cardiac rehabilitation tends to be friendly and informal, caution must be taken to assure strict protection of all patient information. In particular, patient charts should be stored in a lockable file cabinet at all times they are not in use. They should not be left lying around during lunch or after hours when they are not professionally attended. Information being faxed must be labeled ''confidential'' and should be sent and retrieved quickly to avoid unnecessary exposure. Additionally, steps must be taken to avoid displaying patients' names or photographs without their permission.

Assessment

Assessment involves ''the determination of what kind of care is required to meet a patient's initial needs as well as needs that change in response to care'' (Ref. 4, p. 57).

In outpatient cardiac rehabilitation, patient assessment occurs at least at three different points in time—two routine and one as needed.

Initial Assessment

Extensive routine assessment occurs as part of each patient's workup at entering the outpatient cardiac rehabilitation program. There are two major purposes of this data collection at program entry:

1. To help assure that the right patient has entered the program at the right time and is provided with the right services. That is, to confirm the presence of appropriate indications and the absence of contraindications for program participation and to begin stratifying the patient to the most appropriate exercise and education/counseling services within the program menu of options based on his or her individual needs.
2. To establish baseline data about the patient as he or she enters the rehabilitation program so that progress resulting from rehabilitation efforts can be subsequently measured and outcomes documented.

Table 4 outlines the subjective, objective, and supplemental elements that comprise the initial assessment. Clearly, it is helpful to collect and review the patient's medical records pertinent to the acute event prior to any intake assessment. Specifically regarding the interview, its purpose is to gather and record a subjective database on the patient. Therefore, while a self-administered medical questionnaire may be helpful for obtaining or confirming medical facts, some sit-down time for face-to-face dialogue is recommended to learn of each patient's perspective on the cardiac event as well as to collect baseline psychosocial data.

Elements of the objective assessment can be done at subsequent visits. Likewise, the surveys and diaries can be assigned as patient "homework" to be completed during the first few weeks of rehabilitation participation. However, to improve the reliability and accuracy of quality of life (QOL) data, it is recommended that QOL tools be completed in a controlled setting, such as the cardiac rehabilitation conference room, where the patient's focus can be directed to the task at hand and outside distractions can be minimized.

Ongoing Assessment

Brief assessment is done on each patient upon arrival for every exercise session to verify that his condition remains sufficiently stable to safely proceed with exercise performance. For diabetic patients, both cardiac and diabetic parameters are checked and recorded. Once exercise is completed, the same measurements are repeated to assure adequate recovery before releasing the patient.

During exercise, each patient's performance and responses are professionally monitored and recorded. Extent of surveillance used—continuous telemetry

Table 4

A. Entry Assessment Documentation for Outpatient Cardiac Rehabilitation

Subjective	Objective	Supplemental
Intake Interview: Patient's perception of cardiac event Psychosocial status Normal daily activities Culture/values	**Brief Cardiovascular Exam:** Incision inspection Heart sounds Lung sounds Pulses all limbs B/P both arms	**Copies of Pertinent Medical Records:** Confirmation of diagnosis All cardiac studies Hospital discharge summary
Learning Assessment: Needs/priorities Barriers/impairments Preferences Readiness	**Musculoskeletal Assessment:** Posture/alignment Flexibility Mobility Limitations	**Copies of Tests and Procedures:** Stress test Lipid profiles
Diet/nutrition survey and/or food diary (other diaries, such as smoking, stress, angina, as needed)	**Body composition measurements:** Height and weight % Body fat, or BMI, or waist/hip ratio	**Admission summary note including impression of rehab readiness**
Quality of life tool	**Functional capacity determination**	**Entry data recorded on outcome sheet**

B. Exit Evaluation Documentation for Outpatient Cardiac Rehabilitation

Subjective	Objective	Supplemental
Discharge interview: Report results Request feedback Answer remaining questions Confirm discharge plans	**Repeat tests:** Functional capacity determination Lipid profile (if indicated at this time)	**Discharge orders:** MD approval to exit Continuing exercise prescription Where Guideline
Diet/nutrition survey and/or food diary (repeat other diaries as indicated)	**Body composition measurements:** Height and weight % Body fat, or BMI, or waist/hip ratio	**Rehab treatment plan completion:** Check problems resolved Note those remaining
Quality of Life Tool	**Recheck self-monitoring skills:** Pulse taking Perceived exertion Sign/symptom recognition	**Discharge summary note including follow-up plan:** Medical care Exercise continuation Risk factor management Call-back schedule
Patient satisfaction questionnaire: Mailed 2–3 weeks after program completion Includes self-addressed stamped return envelope	**Data comparison and outcome computation:** Difference in values exit to entry Conversion to percent change	**Patient's outcomes entered into program database**

monitoring, intermittent paddle checks, heart rate monitor, manual pulse checks—varies with the patient's assigned risk stratification placement.

Assessing Change

Two scenarios prompt instant patient assessment and may involve use of any of the forms listed under ongoing safety documentation in Table 3.

1. Development of a new or different presentation of a sign or symptom—the extent of assessment performed is determined by the severity of the problem.
2. Variation from established/acceptable response parameters—if values recorded exceed established parameter limits, rehabilitation is discontinued, and the patient's physician is notified.

Patient rights imply, and the JCAHO explicitly requires, that patient privacy be protected whenever sensitive information may be expressed (verbally or in writing) and/or personal modesty may be compromised. By its very nature, assessment involves both possibilities. Therefore, efforts must be made and resources provided to assure visual and auditory privacy when assessments are conducted. Each cardiac rehabilitation facility should have examination rooms for physical assessments and an office or conference room for interviews and patient completion of written materials.

Planning

The provision of appropriate care—not too much, not too little—is fundamental to achieving desirable outcomes within the resource limitations of today's healthcare environment. Appropriateness is defined as ''the degree to which the care and services provided are relevant to the patient's clinical needs, given the current state of knowledge'' (Ref. 4, p. 122). The planning step of the rehabilitation process is where determination is made of what has to be done to address each patient's needs and priorities as identified from assessment data. The most appropriate services are then selected from the rehabilitation menu and a unique program is assembled for each patient. Therefore, no two cardiac rehabilitation patients receive exactly the same cardiac rehabilitation service package. An assembly line one-size-fits-all approach is inappropriate.

Since the planning step is assessment-driven and knowledge-based, it is an intellectual process performed by the cardiac rehabilitation staff. However, the result of that mental effort is communicated in the patient record through the use of a Rehabilitation Treatment Plan that summarizes the problems identified and priorities selected to be addressed during cardiac rehabilitation participation.

Figure 1 presents a sample that organizes patient issues into four categories of care that can be easily tracked as rehabilitation progresses.

JCAHO encourages the active involvement of patients in their healthcare whenever possible. Cardiac rehabilitation provides a prime opportunity for professional and patient to work together to plan and implement rehabilitative care that produces desired results. The Rehabilitation Treatment Plan is one example of a documentation tool designed to be interactive. It is expressed in lay language so that it can be presented to and negotiated with patients as active partners in their rehabilitation.

Implementation

As expressed in the Clinical Practice Guideline on Cardiac Rehabilitation (6), two equally important types of service are the core of outpatient cardiac rehabilitation patient care: exercise training and education, counseling, and behavior interventions.

The Joint Commission emphasizes that the goal of such patient care functions is ''to provide individualized care in settings responsive to specific patient needs'' (Ref. 4, p. 73). Specific needs were identified and expressed in the planning step discussed above. Implementation involves carrying out the plan—both the doing and the documenting of patient care provided.

The use of exercise and education flowsheets is well entrenched in cardiac rehabilitation practice and need not be further discussed here. However, there is a wide variety of opinions on if/how progress notes should be recorded for each cardiac rehabilitation visit. Historically, many cardiac rehabilitation professionals wrote narrative or SOAP notes detailing each patient encounter. Often, such notes quickly deteriorated into routine and redundant commentary. Recently, the use of more sophisticated flowsheets, with and without the support of computerized charting, has facilitated the use of ''charting by exception.'' As the name implies, charting by exception is a method of noting only those events that are out of the ordinary. That is, that are not expected to occur, that are variations from the practice norm. Charting by exception is a documentation option that enables more focused charting about the patient and thereby more efficient charting for the professional.

Several steps may be necessary to convert to charting by exception from previous recording methods:

1. Develop policies/procedures to support use of charting by exception.
2. Insert a section on exercise flowsheets or other patient encounter forms that forces a clinical decision about whether the patient's performance and responses were within acceptable parameters (according to internally established criteria). For example, at the end

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	BEHAVIOR CHANGES	Date Identified	Date Addressed*	Date Resolved*
1	Lipid levels			
2	Diabetes			
3	High B/P			
4	Inactivity			
5	Overweight			
6	Smoking			
7	Stress			
8	Adherence to plan			

	EMOTIONAL CONCERNS	Date Identified	Date Addressed*	Date Resolved*
1	Anger			
2	Hostility			
3	Depression			
4	Loneliness			
5	Anxiety			
6	Grief			
7	Dependence			
8	Denial			
9	Fear			
10	Coping skills			
11	Spiritual			

	PHYSICAL PROBLEMS	Date Identified	Date Addressed*	Date Resolved*
1	Arthritis			
2	Fatigue			
3	Swelling			
4	Breathing			
5	Poor fitness			
6	Leg cramps			
7	Headache			
8	Sleeping			
9	Chest pain			
10	Incision			
11	Muscle aches			
12	Joint pain			
13	Impotence			
14	Heart rhythm			
1	ST segment			
16	Daily actv'ty			
17	High B/P			
18	Low B/P			
19	Poor balance			
20	Dizziness			

	LEARNING NEEDS	Date Identified	Date Addressed*	Date Resolved*
R/t	**Heart Disease**			
	Signs/sympt.			
	Emergency			
	Diagnosis:			
	Procedures:			
	Tests:			
	Complications:			
	Medications	see medication sheet		
R/t	**Rehab Program**			
	Walking			
	Self monitor: __ pulse __ exertion			
	Weather			
	Exercise plan			
	Classes:			
	Referrals:			

This treatment plan has been reviewed and agreed to by: Date __________
(Patient) ____________________
(Staff) ____________________

✓/date in any box = see note

* Standards of Care that detail interventions to be used and expected outcomes are available in a reference notebook in the rehab department

Figure 1 Sample rehabilitation treatment plan for outpatient cardiac rehabilitation.

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of each session's record, one of the following boxes must be checked:

☐ performance and responses within acceptable parameters;
☐ see nurse's note for description of variation.

3. Use periodic chart audits to determine if the boxes are being properly utilized and variations detected and documented.

The multifactorial nature of heart disease is best addressed by multidisciplinary efforts. However, the number of disciplines involved in providing cardiac rehabilitation care depends upon each facility's resources. Whenever patients are referred to healthcare providers outside the immediate cardiac rehabilitation staff, notation must be made of the outgoing referral and a written report returned from the consultant after the patient has been seen/treated.

Evaluation

Efficacy can be defined as the degree to which the care of the patient has been shown to accomplish the desired or projected outcomes (Ref. 4, p. 122). Evaluating the efficacy of cardiac rehabilitation services is essential in today's healthcare environment. Patients, physicians, and payers alike want to know the extent to which rehabilitation interventions worked. Additionally, once a consistent format for individual outcome measurement and documentation is in place, it is an easy next step to gather outcome data across all rehabilitation participants to produce aggregate program results.

As shown in Table 4, the documentation components of the discharge evaluation are similar to those recorded during admission assessment of the patient. Both subjective and objective data are collected and supporting paperwork is finalized. Ideally, a separate face-to-face visit with the patient is scheduled to provide time and opportunity for the rehabilitation staff to report results to the patient and request feedback. As an alternative, the discharge interview can be connected to or substituted for the last exercise or education session the patient attends.

Discharge communication emphasis is on outcomes achieved thus far (see Chapter 41 for a thorough discussion of outcome measurement in cardiac rehabilitation) and on next steps from this point forward. The patient must understand that while involvement in a structured rehabilitation program is ending, risk reduction efforts initiated in rehabilitation must continue. Arrangements for continuing care are confirmed with the patient verbally and in writing.

WHICH METHOD OF DOCUMENTING IS BEST?

As described above and further detailed in other texts (7), content that addresses the patient care functions of assessment, planning, implementation, and evalua-

Table 5 Types of Software Products Available to Support Documentation in Outpatient Cardiac Rehabilitation

Pros	Cons
√ Commercial software systems designed specifically for cardiopulmonary rehabilitation	
Designed specifically for cardiopulmonary rehabilitation services	Potential cost
Ready for "turn-key" installation	Potential inability to integrate with hospital's exiting information system
Standardizes and makes consistent the documentation	
√ Software systems that have been developed by the hospital's own MIS department	
Product support right in house	Costly to develop because of immense time commitment
	Not designed by individuals with specific experience in designing cardiopulmonary rehabilitation databases
	Proprietary to hospital and is not standardized or compatible for external benchmarking
√ Software systems that have been developed by state cardiac rehabilitation societies	
Specific to individual state outcomes project	Questionable reliability of benchmarking
May be lower cost	Limited user customizability
	Generally limited product support options
	May not integrate with hospital information system
	Potential inability to integrate with hospital's existing information system
√ Commercial software which is tied to telemetry monitoring options	
Telemetry strips integrated into reporting features	Cost
	Generally tied directly to telemetry limiting data collection to patients being monitored
	Potential inability to integrate with hospital's existing information system

Table 6 Desirable Reporting Features of Cardiac Rehabilitation Software

Administrative reports
Departmental statistics
Outcomes tracking for:
individual patients
collective group
Progress reports for:
patients and families
referring and primary physicians
third-party payors, including managed care organizations
Quality improvement data

Table 7 Capabilities to Evaluate and Questions to Ask About Software for Cardiac Rehabilitation

User friendliness and slope of learning curve for all staff, regardless of computer competence
Easily integrated into existing program processes
Ability for user customization of fields and reports (i.e., ability to document and track what your program chooses, adaptability)
Compatibility with other systems
Ability to operate independently (i.e., without the need for another software application in order to function)
Ability to document daily information (i.e., exercise progression), as well as longer term outcome data (adherence, QOL, etc.)
Ability to export data into other software applications for expanded use of data as desired
Usable in all phases of cardiac rehabilitation
Reasonable cost
Availability and reliability of support
Ability to benchmark against other cardiac rehabilitation databases
Ability for use independent of telemetry monitoring
Applicable to expanding patient populations including heart failure and secondary prevention

tion is essential for charting in the outpatient cardiac rehabilitation setting. But how should the information be recorded? Is there one best way to fulfill charting expectations? As a general answer, the optimal method of charting is one that both effectively captures the desired content and efficiently uses program resources. Specifically, there are two choices—to document by hand or to use a computer or other electronic means.

With the growth of computerization in healthcare, all logic points to the fact that cardiac rehabilitation records will eventually be computerized. The beauty of computer documentation is that once it is adequately set up, it not only stores data in a nearly paperless system, but also enables computation, compilation, or other helpful manipulation of that information.

Regardless of which method is utilized, JCAHO strongly suggests that the documentation process meet certain criteria. *Standardization* and *consistency* mean that the same data are collected on all participants in the same manner and in the same time frame. *Effectiveness* refers to the ability to document what is necessary and *efficiency* refers to the ability to save staff time and thus healthcare dollars (4). Computerization assists with meeting these expectations (8).

Computer software applicable to cardiac rehabilitation charting is currently available from a number of different sources. Each software product offers different features and each has its own set of pros and cons (Table 5). Minimally, the software chosen should have the ability to track both daily and long-term data relevant to participant and programmatic outcomes. Optimally, it would not only be able to generate pertinent individual or aggregate reports for various interested parties but also would save staff time. Specific report features may include, but are not limited to, those listed in Table 6.

Given the availability of up-to-date computer hardware, the best way to select a software charting product is to identify the facility's general concerns and staff's specific expectations. Table 7 provides a useful list of checkpoints for evaluating software products for potential cardiac rehabilitation use.

SUMMARY

Effective professional communication is an expected core competency of cardiac rehabilitation professionals (9). Information in each patient's rehabilitation record is the foundation of that communication. Knowing what is essential to document and how it can best be done are key to optimizing the collection and use of patient data. While legal requirements for original signatures on physician order sheets, patient consent forms, and the like may preclude the development of a totally paperless chart, there is no doubt that computerized charting is rapidly becoming the documentation method of choice. Therefore, cardiac rehabilitation professionals are challenged to streamline their program's paper forms, improve their own computer skills, and begin to merge those two efforts. This chapter has attempted to identify the what and how of moving forward toward these goals.

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Patient Outcomes in Cardiac Rehabilitation: What, Why, and When to Measure

Peg Pashkow
Heart Watchers International Inc., Solon, Ohio

Cynthia L. MacDonald
Trident Medical Center, Charleston, South Carolina

INTRODUCTION

In order to move cardiac rehabilitation into the new millennium, clinicians must be prepared to evaluate patient outcomes considering a broad set of variables, translate outcome data into meaningful clinical information, and use this information to develop and refine clinical practice. The selection, measurement, and application of these outcomes are the subject of this chapter.

OUTCOMES DEFINED

Outcomes have been defined as those changes, either favorable or adverse, in the actual or potential health status of persons, groups, or communities that can be attributed to prior or concurrent care (1). The primary outcome—health—includes health status, functional status, and well being. Health status, assessed by evaluating morbidity and mortality, is generally reserved for large clinical trials where the sample size is sufficient to demonstrate statistical significance. Functional status is the ability to engage in important everyday behaviors physically, psychologically, and socially (2) and should not be confused with func-

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tional capacity, which is a clinical measure. Functional status and well being are measured by evaluating quality of life.

Quality of life is the multifactorial, functional effect of an illness and its consequent therapy upon a patient (3). Quality of life must be measured from the patient's perspective to fully reflect the significant effect of the patient's beliefs, values, and judgments on the results of the intervention (4). A positive outcome is demonstrated by patient-reported improvement in physical, emotional, and social functioning, as well as improvement in general well being. Generic measures of health quality of life apply to heterogeneous populations with potentially multiple issues related to limitations in health status whereas disease-specific measures are responsive to specific populations with issues related to clinical manifestations of a particular condition.

Secondary outcomes include the multitude of clinical and behavioral variables whose change has been shown to reduce the risk of morbidity and mortality as well as improve quality of life. These changes are the focus of most cardiac rehabilitation programs. Familiar clinical measures of importance include functional capacity, lipid levels, blood pressure, glucose levels, measures of obesity, and frequency and intensity of angina. Historically, these measures have been the main focus in cardiac rehabilitation programs because of the ease with which they can be objectively measured. Behavioral outcomes assess the lifestyle changes that may be the result of education and counseling efforts in the rehabilitation program. These may include symptom management, adherence to exercise and medication regimens, smoking cessation, diet management, and stress management. Standardized measurement of behavioral outcomes is more difficult to obtain objectively as evaluation is most often derived by patient report in food diaries, exercise logs, and questionnaires. Clinical and behavioral variables have a significant impact on health outcomes.

Because of the emphasis on controlling costs in all components of the healthcare system, economic variables are also important to evaluate. They include costs, outcomes, and trade-offs between alternative medical therapies (5,6). Components and standards for cost evaluations are complex and not yet widely accepted in medicine (6). Controversies exist about which types of costs to include (direct, indirect, fixed, variable, induced, averted, nonmedical, and/or intangible), how to evaluate them (long-term, short-term, costs, charges, payments), and whether to adjust for cost shifting and cross-subsidization of services (6). When these issues have been resolved and comprehensive economic data are available, cost-benefit, cost-effectiveness, and cost-utility analyses each can be used to assess outcome (7). Cost-related data are further discussed in Chapter 43.

When detailed economic information is not available to cardiac rehabilitation managers, charges and utilization of healthcare services have been used as a surrogate. Tracking of medical utilization often includes a comparison of the number of hospital days, emergency room visits, and unplanned physician visits pre- and postrehabilitation. Regardless of the economic outcome measures selected, each must be carefully defined for standardization and to ensure accurate comparative analysis over time and among groups of rehabilitation programs.

Patient satisfaction is another essential component of healthcare outcomes. Prior to the advent of managed care, satisfaction surveys in healthcare facilities were often found under the auspices of the marketing department. Although a multitude of healthcare satisfaction instruments have been developed, no one instrument is widely used and few have satisfactory psychometric properties (8). As managed care organizations have deemed satisfaction a benchmark for quality of care, standardization is essential. Without standardization among instruments, no comparison of patient satisfaction across programs is possible (9).

SELECTION OF WHAT TO MEASURE

In the past, clinicians have left the measurement of health outcomes to clinical researchers studying the efficacy of interventions over time and to health economists comparing two or more high-cost, widely utilized interventions. Today, the rationale for examining outcomes is also driven by accrediting agencies, payers, marketing, and administration, each of whom want to benchmark the practice or intervention. While scientific evidence has established the efficacy of cardiac rehabilitation as documented in the Cardiac Rehabilitation Clinical Practice Guideline, measurement in the clinical setting is needed to establish whether individual rehabilitation programs can demonstrate benefits through their own interventions. Benefits verified in the Guideline include (10): improved exercise tolerance; improved blood lipid levels; improved symptoms; improved psychosocial well-being; reduced cigarette smoking; and reduced mortality.

Accreditation and Certification

Outcome measurement is an essential component for program certification by the American Association of Cardiovascular and Pulmonary Rehabilitation (AACVPR). Measurement of at least one outcome in each of three domains (health, clinical, and behavioral) will be required (C. King, personal communication, 1998). These domains and examples of instruments for their measurement are described in an article by the AACVPR Outcome Committee in December of 1995 (11).

The Joint Commission on Accreditation of Healthcare Organization's (JCAHO) description of efficacy is the degree to which the care of the patient has been shown to accomplish the desired or projected outcomes (12). In order to pass accreditation, evidence of efficacy must be contained in each patient's

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chart. Supporting records usually include a discharge summary, an outcome comparison sheet, and a subsequent patient satisfaction questionnaire. Each patient's final evaluation must show the effectiveness of rehabilitation interventions and plans for continuity of care. Chapter 40 describes charting requirements and recommendations.

In 1998, the JCAHO implemented requirements for hospitals to measure two outcomes that are both significant and relevant to at least 20% of their inpatient population, with the plan to increase this number and percent of measures annually. Because the majority of hospital admissions today have a primary diagnosis related to cardiovascular disease, the role of the cardiac rehabilitation professional to not only provide secondary prevention but also to track patient outcomes becomes increasingly significant.

Selection Guidelines

Minimum outcomes that should be tracked to pass accreditation and certification, satisfy referral sources, and to meet general consumer demand are:

1. One health outcome measure—Quality of Life (QOL). While many QOL tools are available, none has yet emerged as the single best tool for use with cardiac rehabilitation populations. Therefore, programs have to determine whether a generic tool (such as the short-form, 36-item version of the Medical Outcomes Study; the Illness Effects Questionnaire, or the Dartmouth Co-Op rating scale) or a disease-specific measure (such as the Minnesota Living with Heart Failure Questionnaire) of health quality of life will meet their needs and select their measurement instrument accordingly.
2. One clinical measure. A measure demonstrating a change in a risk factor parameter such as blood pressure, lipid values, body composition, functional capacity, or symptoms that can be related to rehabilitation intervention.
3. One behavioral measure. A measure relating to lifestyle adjustment such as smoking status, physical activity patterns, and dietary habits, which can be related to rehabilitation intervention.
4. A measure of satisfaction. Until an instrument for measuring satisfaction emerges as the standard, cardiac rehabilitation programs must standardize their instrument and procedures within their organization or department.
5. A measure of cost effectiveness. Usually related to medical utilization such as hospital readmissions or emergency room visits, costs, or employment status.

Resources for administration, collection, and interpretation of data must be considered when selecting which or how many instruments can be used. Instruments that are easy for the respondent and staff, and can be scored and interpreted quickly and efficiently, are best. Standardized, self-report questionnaires are most popular and efficient. Many hospitals administer generic QOL questionnaires and satisfaction questionnaires to all patients receiving both in and outpatient care and have established protocols for administration, scoring, and tracking for comparisons over time. The cardiac rehabilitation staff should access, review, and utilize these data when available and determine whether additional information is needed and can be obtained. Further information about standardized instruments for measurement of outcomes discussed in this chapter is available in the Outcome Tools Resource Guide published by the American Association of Cardiovascular and Pulmonary Rehabilitation (AACVPR) (13).

USES AND APPLICATIONS OF OUTCOME DATA

The general purpose of collecting the data described is to document the extent of improvement in one patient or a group of patients as a result of cardiac rehabilitation interventions. Once that information is known, the process of delivering rehabilitative care can be adjusted as necessary to produce even better results. This feedback loop of evaluating outcomes, adjusting the process that produced them, reevaluating, and readjusting is the foundation of outcome management. Outcome management can be defined as the use of outcomes assessment to improve clinical, quality, and financial results through integration of exemplary practice and services (14). Government, corporate, and private agency mandates to evaluate the delivery of healthcare are all contributing to the outcomes management movement. Driven by healthcare costs, consumers and payers are increasingly interested in financial, physical, and psychosocial outcomes as well (15). As a result, outcome data are being used to judge and compare many aspects of care in today's highly competitive healthcare environment (16).

Specifically, most healthcare organizations have developed interdisciplinary teams charged with the role of outcome management (17). Cardiac rehabilitation personnel have to be part of every cardiac-related outcome team to assure that the potential impact of cardiac rehabilitation services on desired outcomes is recognized and that those services are appropriately integrated into treatment plans and pathways. At the rehabilitation program level, information gathered through the outcome measurement efforts described in the preceding section is utilized for both internal improvement and for meeting external expectations.

Internal Improvement

An intrinsic desire to improve, to do the best possible job, initially motivates most healthcare organizations to engage in outcome measurement as part of their

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overall performance improvement plan. Delivery processes and intervention strategies are changed when outcome measurement demonstrates results that fall short of internally established goals. However, the momentum of improvement efforts is often intensified when results are compared not only to internally set goals but also to "best practices" outside the immediate institution. Benchmarking is the description given to the action of comparing one program's performance and patient outcomes to those of other programs that are considered industry leaders (18). When other organizations demonstrate better outcomes, healthcare facilities are motivated to evaluate their practice and make changes to improve their results. Thus, outcome measurement and management are key elements of continuous performance improvement.

For an individual cardiac rehabilitation program, the process of benchmarking provides an opportunity to learn. It also provides a means by which the profession as a whole can be judged. Ideally, benchmark expectations would be derived from an ongoing national database. However, at present, no such source specific to cardiac rehabilitation exists from which to draw the collective experience. To fill that void, state, regional, and corporate organizations are collaborating to compare their outcomes and identify best practices in their area. Cardiac rehabilitation professionals should seek out such benchmarking projects in their own areas.

External Expectation

In addition to meeting the accreditation and certification requirements discussed earlier, healthcare organizations increasingly use their outcome results to negotiate contracts with managed care organizations. Most payers are not only interested in the short-term costs of a program but also in the potential long-term savings that program can produce. Their focus is on disease management over time, not just postacute recovery. Outcome measurement helps address the impact of cardiac rehabilitation services on both issues.

However, outpatient cardiac rehabilitation outcomes should not be viewed in a vacuum. Results must be evaluated in the context of the overall delivery system if cardiac rehabilitation is to become imbedded in the sequence of total cardiac care. Armed with clear and consistent data such as discussed in this chapter, cardiac rehabilitation professionals must become more active in promoting their patient and program outcomes to physicians, administrators, and payers alike. Most importantly, professionals must make themselves known to the person at their institution who is responsible for negotiating managed care contracts. The goal is to get cardiac rehabilitation included as part of the benefits package for all cardiac patients.

Jennings concludes that outcome measurement is a means for improving patient care, increasing professional accountability, and revising healthcare practices based on objective data (19).

WHEN TO MEASURE OUTCOMES

Once the importance of and rationale for outcome measurement is understood and the decisions have been made about what parameters to measure and what tools to use, the practical questions of when to measure—at what points in time and how often—and how to maintain outcome records arise. As shown in Table 1, the *minimum* recommended sequence for outcome measurement in cardiac rehabilitation is to collect data four times—at program entry; at program exit; several months after program completion; and about 1 year after program completion. Additionally, some programs reevaluate outcome status midway through program participation and an increasing number are tracking patients out to 2 years after program completion.

Data Collection Strategies

Outcome data are usually collected in one of three ways: (1) onsite encounter; (2) telephone interview; or (3) mailed survey.

Obviously, onsite encounters are the method of choice as the patient enters and exits a structured outpatient cardiac rehabilitation program. Ideally, postpro-

Table 1 Minimum Recommendations for Outcome Measurement in Outpatient Cardiac Rehabilitation

What	When			
	Rehab entry	Rehab exit	3–6 Months postrehab	1 Year postrehab
Quality of life	√	√	[a]	[a]
Selected clinical parameters	√	√	[b]	[b]
Selected behavior changes	√	√	√	√
Medical utilization		√	√	√
Patient satisfaction		√		

[a] If possible to readminister tool; may need to be mailed in advance of onsite or telephone appointment.

[b] Some parameters require hands-on measurement (such as body composition or functional capacity) and, therefore, may not be accessible on follow-up; for others, self-report may be an acceptable surrogate for actual measurement (for example, report of latest blood pressure or lipid values as recalled from recent physician office visit).

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gram follow-up data should also be collected onsite. For this purpose, some programs schedule patients to return for a 3- or 6-month "rehab check up visit."

In lieu of onsite encounters, either telephone interviews or mail surveys can be utilized. Experience indicates that telephone calls from familiar cardiac rehabilitation staff members produce better results both in quantity of patients responding and in quality of information received than telephone contact by strangers. The caveat, however, is that telephone follow-up is labor intense and difficult to schedule for busy cardiac rehabilitation professionals. Program managers have to understand the value of this telephone time and build in sufficient staffing to consistently cover periodic callbacks. Once the commitment to outcome follow-up is made, staff members have to implement the process through three specific actions:

1. Schedule specific telephone appointments with patients.
2. Limit phone time to 15-min appointments.
3. Use a script of questions to consistently solicit outcome information.

Some data, such as functional capacity or body composition measurement, will obviously be lost through either telephone or mail follow-up.

Use of mail surveys is attractive because it requires less staff time; however, the tradeoff is likely to be less response. Patient satisfaction surveys mailed shortly after completion of a cardiac rehabilitation program tend to have a high rate of return. Experience to date indicates that the response rate for subsequent mailings declines rapidly.

Documentation Suggestions

Once data are collected, they have to be documented in an understandable, easily retrievable format. A two-step documentation process is recommended to accomplish the outcome management goals discussed here.

Individual Patient Data Form

All outcome documentation begins with a single sheet in each patient's chart or electronic record. Figure 1 provides a sample of an Outcome Data Flowsheet. Typically, the cardiac rehabilitation professional assigned to a patient is responsible for completing baseline entry data after the first week of program participation and exit data at the time of discharge. Ideally, that same staff member collects the follow-up data as well through one of the methods discussed above. Data are entered concurrently with patient progression through the program, keeping the outcome flowsheet up to date and avoiding the pitfall of having to go back and retrospectively retrieve data.

Name ______________________ DOB ________ SS # ____________
Diagnosis ______________ Date of Event ________ Insurance ____________
Physician ______________ Program: ☐ monitored ☐ supervised ☐ maintenance

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Date →				
I. MEDICAL UTILIZATION				
Hospital Readmissions	XXXXXXX			
Emergency Room Visits	XXXXXXX			
Unplanned Office Visits	XXXXXXX			
II. HEALTH OUTCOMES				
Quality of Life/SF 36:				
physical functioning				
role functioning				
bodily pain				
general health				
vitality				
social functioning				
role emotional				
mental health				
III. CLINICAL OUTCOMES				
Functional capacity/METS				
Lipids:				
Total Cholesterol				
HDL				
LDL				
Triglycerides				
III. BEHAVIOR CHANGE				
Weight:				
pounds				
% body fat				
Dietary Patterns:				
food frequency score				
Smoking:				
# packs per day				

KEY:
SF36 = Medical Outcomes Study, Short Form (36 items)
METS = metabolic equivalents
HDL = high density lipoprotein
LDL = low density lipoprotein
DOB = date of birth
SS# = social security number

Figure 1 Sample patient outcome data form for outpatient cardiac rehabilitation program.

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Data from patients completing program in (month), 20xx												
	Clincial Outcomes:											
	Fucntional Capacity			Lipid Levels								
Patient #	in METS			Total Chol.			HDL			LDL		
	entry	**exit**	**% change**	**entry**	**exit**	**% change**	**entry**	**exit**	**% change**	**entry**	**exit**	**% change**
1												
2												
3												
4												
5												
6												
7												
8												
9												
10												
Average												

Figure 2 Excerpt from sample spreadsheet: aggregate program outcomes.

Aggregate Program Data Form

Each month duplicate copies (originals are always kept in the chart) of Outcome Data Flowsheets are collected on all patients who have completed the program or had a follow-up contact. Their information is entered into the program's collective outcome record so that aggregate data can be generated. Most programs use a spreadsheet format to store and manipulate data to generate aggregate reports on a monthly or quarterly basis. Figure 2 provides an excerpt of a basic spreadsheet layout that can be completed manually if computer resources are not available.

Alternatively, several computerized products tailored to cardiac rehabilitation data entry are now available to aid the collection and compilation of outcome information described.

CONCLUSION

The emphasis on data at the end of this century has created an important role for information technology in the delivery of healthcare services. As care becomes more and more coordinated across the continuum, management is challenged to track data across inpatient and outpatient settings. Professionals in cardiac rehabilitation practice can contribute by integrating outcome measurement with disease management and by participating in system-wide outcome efforts. Availability of data that record patient care outcomes and stimulate program change provides an important benefit to the healthcare system (20). There is no doubt that in the twenth-first century cardiac rehabilitation, like all healthcare, will be data driven. Outcome data in particular will be essential. Anticipating that future, the time to get started with outcomes measurement and management is now.

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Medicolegal Issues: Practice Guidelines—Friend or Foe?

Sue Dill
Ohio Hospital Association, Columbus, Ohio

INTRODUCTION

History will record that the biggest challenge facing the collective healthcare industry, as well as individual providers, at the turn of the century was how to ensure cost-effective, high-quality healthcare. In the past, cost and quality were viewed as opposing forces by those within healthcare. Now, their marriage is vital to that industry's very survival.

While many factors have influenced the need for merging economic and quality interests, the urgency of their merger is largely being driven by payers—both public and private. One response from providers on how to bring these interests together is to improve the standardization of care. One mechanism that helps move practitioners in that direction is the development and implementation of clinical practice guidelines. Since these are relatively new entities in the healthcare arena, clinical practice guidelines are often viewed with skepticism. Resistance to their acceptance and use may be due to: (1) lack of input by the end-user group; (2) fear of decreased autonomy as a result of "cook book" expectations; and (3) unknown liability implications.

The purpose of this chapter is to offer a legal perspective on clinical practice guidelines and to discuss their potential impact on liability issues.

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DEFINITION AND DEVELOPMENT OF CLINICAL PRACTICE GUIDELINES

Definition

Conceptually, a clinical practice guideline is an outline of standardized specifications for care of a specific clinical condition or performance of a medical procedure. Synonyms in common use include: standards; guidelines; practice parameters; treatment algorithms; and clinical pathways.

In practice, the latter two terms—treatment algorithms and clinical pathways—usually are procedure-based subsets of the broader standards and guidelines. They are used as tools to reach clearly defined clinical goals in an efficient and effective manner. Interestingly, the American Medical Association (AMA) prefers the term ''parameters'' to ''guidelines,'' viewing the former to be less prescriptive. The AMA defines parameters as strategies for patient management developed to assist physicians in clinical decision making (1). Similarly, some legal experts differentiate between standards as being mandatory and guidelines as providing recommendations (2).

The best-known definition comes from the Institute of Medicine (IOM) at the National Institutes of Health (3):

> Clinical practice guidelines are ''systemically developed statements to assist practitioner and patient decisions about appropriate health care for specific clinical circumstances.''

Further, such guidelines are intended to point the way to higher quality, more cost-effective care by making readily accessible the clinical knowledge distilled from outcome research. The IOM prepared this new definition in 1989 to clarify terminology for a new federal law, the Omnibus Budget Reconciliation Act (OBRA), which created the Agency for Health Care Policy and Research (AHCPR). A division of the Public Health Service, AHCPR's early mission was to develop federally funded clinical practice guidelines. Eighteen guidelines, including one on Cardiac Rehabilitation (4), were completed and published by AHCPR between 1990 and 1996. Their current focus is to partner with private organizations to promote and assist guideline development. Additional descriptions of AHCPR guidelines relevant to cardiac rehabilitation practice can be found in Chapter 39.

Development

In addition to AHCPR at the federal level, clinical practice guidelines are developed by professional associations, payer organizations, and local healthcare facilities, among others. Four methods are commonly used (5): informal consensus; formal consensus; evidence-based; and explicit development.

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Informal consensus involves the use of expert panels whose opinions are supported by some degree of scientific evidence. This approach is frequently used by specialty societies and governmental task forces to develop recommendations. For example, the American Association of Cardiovascular and Pulmonary Rehabilitation (AACVPR) uses informal consensus to develop its Guidelines for cardiac and pulmonary rehabilitation programs (6,7).

The AMA, Rand Corporation, and the National Institutes of Health (NIH) use the formal consensus method. While more structured procedures are used to compile and complete expert opinions in this approach, the extent of scientific evidence employed is still variable. In contrast, evidence-based guideline development requires the collection, review, and analysis of all outcome-based research pertinent to the guideline topic. Resulting recommendations are based on this extensive evaluation. The evidence-based approach is used by the American Heart Association (AHA) in some of its position statements (8) and by AHCPR in all 18 of its guideline products. It is because of the rigorous methodology required to produce evidence-based guidelines that those from the AHCPR are considered the gold standard.

Healthcare providers, trained in the scientific method, are more likely to change their practice when a guideline is based on solid outcome data. A recent article entitled, ''Guidelines You Can Follow and Trust,'' discusses many of the challenges faced by hospitals, provider groups, and federal agencies as they work to develop clinical practice guidelines (9). Despite the difficulties involved in developing evidence-based guidelines, a move away from unexamined reliance on professional judgment toward more structured support and accountability for recommendations made has been observed (3). Clearly, this is a significant cultural shift for the healthcare industry.

PURPOSE AND USE

General Purpose

The primary purpose of clinical practice guidelines is twofold: to decrease variations in practice and thus improve quality; and to control cost.

Initially, most practitioners focus defensively on the use of guidelines as a cost containment measure. One author even distinguishes between ''standard of care guidelines,'' which are intended to improve outcomes and ''appropriateness guidelines,'' which are oriented toward cost-effective care (10). From the quality perspective, use of appropriate guidelines can not only help to improve care across the health continuum, but also to meet accreditation expectations related to continuity of care. Notably, the Joint Commission on Accreditation of Healthcare Organizations (JCAHO) has proposed standards that facilitate organizational use of guidelines for inclusion in its 1999 Accreditation Standards.

According to the IOM there are five purposes for clinical practice guidelines (11):

1. Assist clinical decision making by patients and practitioners.
2. Educate both patients and practitioners.
3. Assess and assure quality of care.
4. Guide allocation of resources for healthcare.
5. Reduce the risk of liability for negligent care.

Contemporary guidelines are increasingly successful in merging both their quality-enhancing and cost-reducing messages. The AHCPR web site (*http://www.ahcpr.gov*) offers further information and examples on how the use of practice guidelines can simultaneously accomplish both of their primary purposes.

Specific Uses

Practitioner Education

The AMA asserts that practice parameters are valuable educational tools that enable physicians to (12): obtain the advice of recognized clinical experts; stay abreast of the latest clinical research; and assess the clinical significance of often conflicting research findings.

Such education can reduce variations in practice, which, in turn, can result in decreased liability exposure.

Dispute Resolution

The American Bar Association (ABA) Special Committee on Medical Professional Liability has endorsed the development of both practice guidelines and outcome assessments. In addition to their quality and cost purposes, the ABA sees guidelines as potentially helpful documents in the adjudication of medico–legal problems. However, the committee felt that most practice guidelines developed by medical organizations were too vague and ambiguous to set a clear standard of care, as discussed later in this chapter.

Coverage Determination

Many managed care entities, such as Health Maintenance Organizations (HMOs) and Preferred Provider Organizations (PPOs), not only endorse clinical practice guidelines but also require guideline compliance as a condition of plan participation and payment. The Health Care Financing Administration (HCFA) has also used guidelines as a measure of appropriateness of care and approval for related reimbursement. For example, HCFA established that Medicare would only reimburse physicians for pacemaker implants that satisfied the American College of

Cardiology's (ACC) guideline on pacemakers. HCFA's policy resulted in a decrease in the frequency of pacemaker implantation in Medicare patients.

Peer Review

Several of AHCPR's clinical practice guidelines, including the one on Cardiac Rehabilitation, have been translated into medical review criteria (see Chap. 39 for a detailed description of these criteria). Such criteria are used by peer review organizations (PROs) to evaluate appropriateness of care. Peer review findings are often tied to reimbursement decisions.

State Legislation

As the array of available clinical practice guidelines grows, some states have rushed to pass laws regarding their use. Others, recognizing that new legal ground was being forged, have put together legislative committees to study the issue. A brief review of the laws passed in two states illustrates how guidelines can impact the legal process through state action:

Maine Signed into law in April of 1990, the Maine Medical Liability Demonstration Project grants a complete defense to physicians who agree to follow specific practice guidelines (13). This means that, in the event of a lawsuit, patient-plaintiffs are barred from introducing guidelines as evidence of mistreatment at trial. However, physician-defendants are allowed to use guidelines to defend treatment rendered. Initially, the Maine project selected guidelines in the areas of obstetrics/gynecology, radiology, anesthesiology, and emergency medicine to be involved in the project. At the outset, physicians had to notify the Board of Registration in Medicine if they wanted to participate in the project and thus be granted the right to this ''affirmative defense'' in the event a medical malpractice suit was filed. The Maine statute has received the most attention of any state law related to guidelines and the project has reported positive results in altering practice patterns.

Minnesota In 1993, Minnesota passed the Health Right Law that authorizes the State Commissioner of Health to accept certain practice guidelines as an ''absolute defense'' in malpractice suits (14). The state selected two AHCPR guidelines to implement this law—Unstable Angina: Diagnosis and Management and Acute Low Back Problems in Adults. Physicians treating patients according to these guidelines are thus provided with an irrebuttable safety net akin to immunity.

Since these laws favor physician-defendants, some legal scholars believe that they raise questions of fairness that may violate constitutional law under the equal protection clauses of the Fifth and Fourteenth Amendments (15).

Most of the uses described above provide an economic incentive for practitioners to comply with locally acceptable guidelines. Certainly for physicians,

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exclusion from a payer source has been one of the strongest incentives to change practice patterns (16).

LEGAL IMPLICATIONS

A review of the legal literature shows that there is a wide variation of opinion regarding potential implications of clinical practice guidelines while there is an actual dearth of litigation experience to date (17,18). Therefore, the degree of legal impact is yet to be determined. However, if a patient wants to sue a healthcare provider based on a clinical practice guideline, that patient must establish that each of the four elements of negligence are present—duty, breach of duty, direct cause, and damages.

The Standard of Care

Generally, guidelines are not conclusive evidence that the standard of care has or has not been met. The standard of care must be determined in each case and is connected to the second element of negligence—breach of duty. The patient-plaintiff must show that the practitioner-defendant deviated from the acceptable standard of care to prove negligence.

Negligence is defined as conduct that falls below the standard of care and thus involves an unreasonable risk of harm. The standard of care is the yardstick by which the practitioner's performance is measured. It is established when an ordinary, prudent practitioner of the same discipline would have performed the service in question in the same or similar manner. The law presupposes some uniform standard of behavior among like practitioners. The practitioner owes a duty to the patient to possess the degree of knowledge and skill ordinarily possessed by practitioners in good standing within the same discipline. He or she must also exercise the same degree of care ordinarily executed by other members of the profession acting in similar circumstances. If another practitioner would have performed similarly, then the standard is established.

Expert Testimony

Expert testimony is generally the most important source of proving negligence. In the event of a lawsuit, the patient-plaintiff's attorney will obtain copies of the medical records related to the treatment in question. Then the attorney will seek the services of a practitioner from the same healthcare discipline as the accused to review the medical records and determine if the acceptable standard of care was met. This reviewing practitioner is known as an expert witness and he or she may be called upon to give a deposition or appear at trial to provide testimony.

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Unless there is a state law to the contrary (as in Maine and Minnesota), most states will probably require that clinical practice guidelines be introduced and authenticated by an expert. Generally, clinical practice guidelines constitute hearsay evidence because they were drafted by people who are not testifying before the court.

Learned Treatise Rule

Many states and the federal Rules of Evidence recognize exceptions to the hearsay rule. One common exception used in medical malpractice cases is the "learned treatise rule." Textbooks, articles, and other publications that are recognized by the expert as authoritative may be able to be introduced under this exception, including clinical practice guidelines. Likewise, a facility's internal policies and procedures have also been introduced into court to verify the standard of care (19).

Scientifically based studies, like clinical practice guidelines, are more easily accepted to establish the standard of care. However, since the majority of malpractice lawsuits are filed in state courts, state law and that state's specific case law will determine what documents are allowed.

Customary Practice

Customary practice is important because it has been used to show that if a treatment is performed by many practitioners it establishes a standard of care. If a substantial body of practitioners uses a clinical practice guideline and generates good outcomes, the court could view the guideline as conclusive evidence of customary practice in the field. Following a clinical practice guideline could, therefore, shield a practitioner from liability exposure. In fact, the guideline could roughly serve the same function as a well-qualified expert witness, providing the court with neutral, highly credible evidence of the standard of care (20).

Brennan and other authors suggest that initially guidelines will be used along with expert testimony. However, in the long run, they may stand alone to more clearly establish the standard of care than the current method of battle between experts. The result would be decreasing variations, better outcomes, and less litigation (10).

Negligence Per Se

Generally, negligence per se requires the existence of a statute or state law that sets the standard of care for practitioners (21). Violation of a state law that results in patient injury creates a presumption that the practitioner was negligent. Several authors see the possibility that patient-plaintiffs may argue that failure to follow

Table 1 Factors Determining the Evidentiary Weight of Clinical Practice Guidelines

1. Nature and purpose of the guideline.
2. Process used to develop the guideline.
3. Validity of the scientific evidence upon which the guideline is based.
4. Credibility of the organization that produced the guideline.
5. Endorsement by official government bodies (state or federal).
6. Adoption by professional organizations.
7. Acceptance among practitioners.
8. Specificity of the guideline to the case in question.
9. Use of the guideline in court (plaintiff or defendant).
10. Availability of additional guideline sources (complementary or competitive).

Source: Adapted from Refs. 20, 24–26.

a guideline is negligence per se (22,23). This presumption could be irrebuttable and create a situation where the defendant is presumed to be negligent. And, the reverse is also possible: the practitioner-defendant who complied with the guideline has created a presumption of acting correctly.

Evidentiary Weight of Clinical Practice Guidelines

If a clinical practice guideline can be introduced in a specific state, the next question is how much weight should it be given? Several authors have identified a number of factors by which a guideline may be weighted in court (20,24–26). Table 1 provides a summary list of those factors. Healthcare practitioners who

Table 2 The Legal Pros and Cons of Using Clinical Practice Guidelines

Pros	Cons
Decreases likelihood of litigation	Increases likelihood of litigation
Limits the use of medical expert witnesses	Expands the use of medical expert witnesses
Reduces the use of defensive medicine by eliminating inappropriate procedures	Discourages physician interest/involvement due to autonomy issues and litigation concerns
Discourages hindsight criticism of a provider's actions	Increases liability exposure: if not consistent with national standards; if not updated regularly
Encourages better communication among providers and with patients	Provides evidence against violations

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Table 3 Suggestions for Minimizing Risk of Liability Related to Clinical Practice Guidelines

Know Specific State Law

Most states that have a law pertinent to clinical practice guidelines provide that:

- EITHER following the Guideline is an affirmative defense, that is, the guideline document can be used to prove a defendant's practice constituted acceptable care
- OR the guideline cannot be used to establish a standard of care

Maintain an Archive of Guideline Documents

Each of the following organizations have published guidelines on cardiac rehabilitation practice:

- Agency for Health Care Policy and Research (AHCPR)
- American Association of Cardiovascular and Pulmonary Rehabilitation (AACVPR)
- American College of Sports Medicine (ACSM)
- American Heart Association (AHA)
- American Nurses Association (ANA)

Integrate National Guideline Documents into Internal Policies and Procedures

Referencing published guidelines as the basis of local policies helps establish that the procedure described is customary practice.

Follow Internal Policies and Procedures

Both local policies and the national guidelines on which they are based may be used as evidence to show whether the applicable standard of care has been met.

Make Certain That Claims Made About Guidelines Are Realistic

Do not exaggerate or make unrealistic representations about what the guideline says or supports. For example, do not tell patients that participation in cardiac rehabilitation exercise will help grow new blood vessels in their heart when it is clearly stated in the AHCPR Guideline that "exercise training has no apparent effect on development of coronary collateral circulation" (Ref. 4, p. 95).

Decrease Variations in Local Practice

In keeping with the purpose of guidelines, standardize local practice procedures as much as possible. Where appropriate, use clinical pathways or other protocols, based on guidelines, to assure that all staff members are providing similar care within the boundaries of their professional scope of practice.

Know the Expected Standard of Care

Guidelines will most likely be just one piece of evidence to define the standard of care in the event of a malpractice suit. The legal battle is fought over if/to what extent a defendant has deviated from the acceptable standard. Voluminous case law supports the importance of clinicians knowing and following the standards, guidelines, and recommendations of their respective professional associations.

Maintain Good Communication with Patients

Studies show that patients are more likely to sue over injuries or complications if they perceive poor communication, even when there is no actual breach of duty. A caring relationship anchored by consistent, respectful communication goes a long way toward reducing liability exposure.

Table 3 Continued

Emphasize Good Documentation
Good documentation in the patient's medical record is one of the most important strategies for keeping clinicians out of the courtroom. Charting is *the* means of documenting rehabilitative care rendered. Remember that the patient's medical chart is also a legal record. Concise, complete, and accurate charting can be the best defense in a malpractice suit.
Educate Defense Attorneys in Advance of Any Litigation
Since there is not yet a body of case law involving clinical practice guidelines, assume attorneys do not know much about their nature or use. Be prepared to explain:
• Who developed the guideline and when
• What the purpose of the guideline is
• If the guideline is officially recognized by the cardiac rehabilitation profession
• To what extent the guideline is followed by peers
• The source of the scientific evidence that supports the guideline

might be faced with a malpractice suit should prepare information about each of these factors and discuss it in detail with their attorney.

Disclaimer

A disclaimer is a statement used to convey that the clinical practice guideline does not claim to contain all possible medical considerations. Many hospitals that take national practice guidelines and integrate them into their own clinical pathways advocate using a disclaimer such as:

> Adherence to this clinical practice guideline is voluntary. The guideline should not be considered inclusive of all proper methods of care or exclusive of other methods reasonably directed toward obtaining the same results. The ultimate judgment regarding the appropriateness of any specific procedure must be made by the practitioner in light of the individual circumstances presented by the patient.

Such disclaimers have to be supported in hospital policies. They have had some value in the courtroom in that they make it clear that healthcare services are more complicated than following a simple recipe. As all healthcare practitioners know, there is often more than one standard and alternative courses of action may be equally valid.

Based on the above legal implications, Table 2 summarizes the major legal advantages and disadvantages of using clinical practice guidelines.

CONCLUSION

Licensed healthcare professionals, including those practicing in cardiac rehabilitation settings, are legally bound to know the acceptable standard of care in their field and to follow it. Clinical practice guidelines can significantly decrease liability exposure by changing practice habits to bring them into closer alignment with the legally required, medically acceptable standard of care. However, since to date there is little legal precedent to determine the extent of impact that guidelines will have in malpractice cases, Table 3 provides a preparatory checklist, based on information presented in this chapter, for minimizing legal risk.

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Economic Issues: The Value and Effectiveness of Cardiac Rehabilitation

Martha D. Livingston
Grant/Riverside Methodist Hospitals, Columbus, Ohio

Charles Dennis
Deborah Heart and Lung Center, Browns Mills, New Jersey

INTRODUCTION

Direct healthcare expenditures for heart disease in the United States in 1998 were nearly $98 billion. The costs attributed to lost productivity, or indirect costs, exceeded $76 billion (1). While advances in diagnosis and treatment of diseases have made medicine in the United States the best in the world, costs have escalated to the point where society's ability to sustain these costs is being questioned. The past 20 years have seen increasing scrutiny of costs as they relate to medical outcomes. Payers have instituted reimbursement plans, such as the Medicare DRG system and managed care capitation, in an effort to control costs. These plans force healthcare providers to use economics as at least one component of their decision-making process. Economic pressures have pushed organized medicine to focus on "cost-effective care" (2–4).

Cardiac rehabilitation professionals, especially program directors, deal with the economics of healthcare every day. On a microeconomic level, they are responsible for and responsive to revenue generated and expenses incurred for services rendered in their departments. As a result, changing patterns of reimbursement top the list of concerns for most program directors. Resources are available to help answer coverage questions and solve payment problems commonly encountered in the day-to-day business operation of cardiac rehabilitation (5). Ongoing information about the status of reimbursement for cardiac rehabilitation services can be found on the American Association of Cardiovascular and Pulmonary Rehabilitation's (AACVPR) web site at *http://www.aacvpr.org*.

The macroeconomic view is less familiar to many cardiac rehabilitation professionals. Concepts of value and cost effectiveness are often lost in the urgency of daily billing and budgeting. Financial pressure is intensely felt but not clearly understood. Yet, survival of all healthcare services in the future, including cardiac rehabilitation, depends on providers expanding their knowledge of payers and payment systems and improving their skills in evaluating the results and communicating the value of the services they offer.

As a step in that direction, the purpose of this chapter is to provide an overview of healthcare payment systems at the end of the twentieth century; present selected evidence of cardiac rehabilitation cost effectiveness; and suggest future directions that merge both quality and cost interests.

BROAD PERSPECTIVE: THE MANAGED CARE ERA

Business Efforts

The landscape of health insurance has changed dramatically over the last two decades. In the 1980s, managed care plans occupied a small niche in a marketplace dominated by indemnity insurance plans. The medical care price index significantly exceeded the U.S. Consumer Price index for all other items. Employers' cost increases for health insurance outpaced all other employee benefits including wages and salaries (6). Unable to shoulder the burden of double-digit health inflation, business and industry demanded an end to the runaway cost of healthcare. Employers needed ways to predict future healthcare costs to manage their expenses. Healthcare payers responded by introducing managed care plans (7).

By 1993, managed care plans accounted for a growing majority of health insurance plan enrollees. However, neither employers nor employees were prepared to make a rapid, wholesale shift from indemnity insurance to the restrictive staff model or group plans of traditional health maintenance organizations (HMOs). As a result, the number and complexity of contractual managed care relationships has increased exponentially. Preferred provider organizations (PPOs), exclusive provider organizations (EPOs), and point of service (POS) plans are a few examples. Table 1 outlines structural differences of some of the major managed care variations. Even traditional fee-for-service (FFS) health insurance companies have begun integrating elements of managed care into their free choice health plans to satisfy increasingly cost-conscious customers.

Table 1 Major Managed Care Variations

Structure	Description
Exclusive Provider Organization (EPO)	A health plan that contracts with physicians to provide care only for the plans' members
Health Maintenance Organization (HMO)	A health insurance plan that contracts with medical groups to provide a range of health services for enrollees for a fixed, prepaid per member fee; three operational models are most common: Group model—contracts with independent groups if physicians to provide coordinated care for large numbers of patients for a fixed, per member fee; groups will often care for members of several HMOs Staff model—employs salaried physicians and other healthcare professionals to provide care solely for members of one HMO Independent practice associations (see below)
Indemnity Plan	A payment plan that reimburses physicians for services performed (retroactive payment); in contrast, other structures listed receive a specified amount in advance to cover anticipated services for a specific population (prospective payment)
Independent Practice Association (IPA)	A group of independent physicians that comes together as an association to contract with an HMO to provide services for a negotiated fee; the association is paid by the HMO and, in turn, the association pays each physician on a per capita, fee schedule or other agreed-upon basis
Managed Care Organization (MCO)	An entity that integrates financing and management of healthcare services to an enrolled population; the MCO provides, offers, or arranges delivery of health services needed by members for a fixed, prepaid amount (prospective payment)

Table 1 Continued

Point of Service Option (POS)	A member's choice to receive a service from outside the plan's network of providers for an additional fee set by the MCO; less coverage is provided for use of outside (nonparticipating) providers
Preferred Provider Organization (PPO)	A health plan that encourages savings by establishing a network of providers who agree to deliver services to plan members at a discounted rate; members may go out of the network for services but generally incur a financial penalty (deductible, copayment, etc.), for doing so
Provider Sponsored Organization (PSO)	Local health plans formed by hospitals and physicians to obtain managed care contracts

From the payers' perspective, restructuring efforts began to pay off in the mid-1990s. The increase in employers' costs of employee health insurance fell to nearly zero in 1996 and premium rates for HMO and PPO plans decreased for the first time in years. Purchasers, payers, providers, and plan participants were all talking the new language of managed care. Table 2 lists payment terms commonly used in health insurance today, many of which are used in this chapter.

By 1996, 63% of Americans received their healthcare through some form of managed care plan—increased from 39.9% in 1993. A survey of employers in 1997 found that only 18% of employees were enrolled in a traditional indemnity plan. However, while urban sectors of the country are saturated with managed care providers, rural America is less penetrated. In 1995, just over 25% of the rural communities were served by four or more HMO plans—an increase of only 8.9% from 1992 (8).

Medicare Entry

Concerned with the rising cost of healthcare for the elderly, the Health Care Financing Administration (HCFA) introduced the Medicare Open Heart Surgery Demonstration Project in 1993. The seven participating centers demonstrated that, by streamlining processes, they could achieve cost savings while maintaining or enhancing quality of care and patient satisfaction (9). Pleased with the positive impact, HCFA has continued to encourage its beneficiaries to enroll in

Table 2 Common Payment Terminology

Term	Description
Bundled Fee	A lump sum amount that is provided to cover a cluster of services (e.g. cardiac rehabilitation); precludes itemized billing.
Capitation	A dollar amount established to cover the cost of healthcare delivered to a person during a specified period of time; usually refers to a negotiated per capita rate to be paid periodically (e.g., per member per month; pmpm) to a healthcare provider by a managed care organization; the provider is then responsible for delivering or arranging for the healthcare services required by the covered person.
Carve Out	Dissection of a particular service from the capitated package for separate payment.
Coinsurance	An amount of money paid out of pocket by plan members for medical services; usually consists of a fixed percentage of the total cost of a medical service covered by the plan (e.g., if a health plan pays 80% of a physician's bill, the remaining 20% is the coinsurance to be paid by the member).
Copayment	A cost-sharing arrangement in which a member pays a specified charge for a specified service rendered (e.g., $10 out-of-pocket payment for each cardiac rehab visit, in addition to negotiated fee).
Deductible	Sum of money the individual must pay out of pocket for medical expenses before a health plan reimburses.
Fee for Service (FFS)	A payment system by which healthcare providers are paid a fee for services performed; after the service is rendered, a bill is submitted for reimbursement (retrospective payment).
Out-of-Pocket Expense	Costs that must be paid by the member; not covered by the health plan (i.e., deductibles, coinsurance, copayments).
Per Member Per Month (pmpm)	Dollar amount prepaid on a monthly basis to contracted caregiver for each member enrolled.
Premium	Money paid out in advance (monthly, quarterly, or annually) to purchase health insurance coverage.

managed care plans. In 1997, about 14% of Medicare beneficiaries received their healthcare through an HMO (10). In the last few years, as Medicare capitation became more attractive to providers, and as HMO penetration began affecting lucrative Medicare fee-for-service business, hospitals and physicians began to form their own networks or provider-sponsored organizations (PSOs). The Balanced Budget Act of 1997 cleared the way for PSOs to contract with Medicare on a capitated basis. For Medicare recipients, this new Medicare-managed care product will be known as Medicare Part C or Medicare + Choice.

Financial Problems

Despite record growth, a number of large managed care plans have recently reported sharp declines in earnings. During the past decade, payers' profit margins had increased as a result of significant pricing concessions from providers. However, some discounts have cut too deeply. For example, Florida Hospital Healthcare System is the first Medicare PSO to be in financial trouble. Physicians' spending for cardiology care was double the budget. Additionally, the full impact of Medicare + Choice is not expected until 2003, when stringent payment curbs on traditional plans are completely phased in and beneficiaries are locked into their selected health plan for a minimum of 1 year (11). Moreover, some worry that the loose solvency rules granted to PSOs will result in dumping of patients, the need for financial bailouts and lost continuity of care for patients (12). While it is too early to know the full financial impact of these emerging problems, health insurance premiums across the country have begun to inch up once again. If there are remaining savings to be reaped from the healthcare delivery system, they must now be cultivated through real management of health (13).

Quality Concerns

With double-digit increases in cost of healthcare, price was the paramount factor influencing the purchase of healthcare insurance. Now, patient satisfaction and clinical outcomes are becoming more important influences. Clearly, HMOs have established lower costs, but there is an ongoing debate about the comparative quality of care provided. Data appear equivocal (14). Miller and Luft summarized quality of care evidence from 15 studies showing an equal number of significantly better and worse HMO results compared to non-HMO plans (15). In some reports, Medicare beneficiaries and other subpopulations of HMO enrollees with chronic conditions show worse quality of care (16). As a result, health plan ''report cards,'' that is, published summaries of health plan performance, are a new way to help consumers select a health plan on the basis of cost *and* quality.

The Health Plans Employer Data and Information Set (HEDIS) includes a set of health plan performance measures, standardized definitions, and methods of data collection. HEDIS is used as the basis for many report card initiatives and is the preferred tool of the managed care industry for measuring health plan performance. Quality report cards produced in Minneapolis and New York State have resulted in movement of enrollees between plans (17). However, it remains unclear whether the relationship between quality and market share is influenced by geography or if it can be sustained over time.

Data on enrollee satisfaction are variable. HMO participants are generally more satisfied if they had a choice in whether to enroll in an HMO or FFS product (18); a physician or healthcare professional provided health education (19); or out-of-pocket expenses were limited (8).

As consumers discover that their HMOs are not what they expected, they are actively negotiating changes in access to services and asserting their rights as patients (20). The importance of consumer choice will lead to many managed care products in many managed care plans (21). Value, best defined as the quality of a service divided by the cost of delivering that service, will increasingly become the deciding factor in selecting a healthcare plan:

Value = quality/cost

CLOSE-UP VIEW: THE VALUE OF CARDIAC REHABILITATION

In the tense economic environment described, cardiovascular preventive services, including traditional cardiac rehabilitation, have encountered increased scrutiny. During the past 10 years, there has been more professional consensus regarding the types of preventive cardiovascular services that can benefit patients. However, there is still no standardized medical approach to the delivery of secondary prevention services to patients with cardiovascular diseases. As reported in the Clinical Practice Guideline on Cardiac Rehabilitation, only 11 to 38% of patients who could benefit from cardiac rehabilitation services are referred to them (22). This lack of practice consistency limits efforts to define the value of cardiac rehabilitation, although data are available to evaluate the cost effectiveness of some service components.

Cost-Effectiveness Terminology

Cost is most simply defined as the value of resources used to produce a good or service, and is generally considered as direct cost (23). Cost is usually defined in monetary terms. Indirect costs are societal, such as the lost productivity of an ill or disabled worker and the costs of providing support for individuals not providing economic returns. In medical decision-making, cost must be clearly de-

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fined in context, as it has different meaning for the patient, physician, payer, employer, and society.

Effectiveness is the impact of an intervention on medical outcomes in generally accepted practice. In this respect, effectiveness must be distinguished from efficacy. *Efficacy* is a determination of whether an intervention is capable of favorably affecting outcomes and is most commonly analyzed under ideal circumstances in a randomized clinical trial. Effectiveness, on the other hand, is a determination of whether an intervention actually favorably affects outcomes in the less ideal circumstances of general practice in an outcomes study (23). While efficacy is the gold standard by which new interventions should be introduced to clinical practice, effectiveness should be used to determine the true value of the intervention in clinical practice. Unfortunately, there are few published effectiveness studies of secondary prevention because they are difficult to perform and are often unfairly judged by the same standards as efficacy trials.

Effectiveness and benefit are often incorrectly used as interchangeable terms. Effectiveness is an attribute of a test or treatment and the delivery system that brings it to a patient. Effectiveness is most easily expressed when objective outcome measures are available. *Benefit* is an attribute of the patient, relating to an improvement in symptoms or extension of life resulting from a particular diagnostic or therapeutic strategy. In simple economic terms, it relates to the impact of treatment on financial productivity of a patient, such as a reduction in disability. However, most benefit analyses do not rely simply on financial productivity because large segments of society, such as low-income patients and the elderly, would be valued less than others.

Cost-effectiveness analysis is a method in which costs for a medical service are related to a specific medical outcome to establish value (23). Examples of cost effectiveness might be expressed for smoking cessation as cost per smoking quitter or for exercise training as cost per MET increase in capacity. *Cost-benefit analysis* is a method that defines the relationship between the value of the resources used to produce a medical intervention and the value of the medical outcome produced. Cost-benefit is more complex than cost effectiveness in that it requires that a health benefit, including human life, be given a dollar value. These values are often adjusted for less than perfect outcomes using utilities, such as quality-adjusted life years (QALYs) (23).

The differences between cost effectiveness and cost-benefit are both subtle and complex, going beyond the scope of this chapter. To simplify the evaluation of cost-benefit, one approach recommends comparing cost-benefit, expressed in dollars per QALY, to accepted medical interventions, such as hemodialysis or treatment of hypertension. In this approach, very attractive interventions cost less than $20,000 per QALY. Attractive interventions cost $20,000 to $30,000 per QALY, while costs greater than $60,000 are considered expensive. Interventions costing more than $100,000 are considered unattractive (24). In further discussions of secondary prevention interventions, this approach will be used to classify the cost-benefit of specific interventions.

Cost-Effectiveness Evidence

There is a paucity of literature regarding the cost effectiveness of traditional cardiac rehabilitation, defined as exercise training and risk factor counseling for patients with coronary artery disease. Expanding the definition of cardiac rehabilitation to include more comprehensive secondary prevention provides access to cost-effectiveness literature about the components included in most modern programs (25,26). While a detailed review of each component is beyond the scope of this chapter, Table 3 and the subsequent text summarizes the cost-effectiveness literature on secondary prevention interventions. For purposes of this summary, each intervention is rated qualitatively on cost, effectiveness, and benefit. In addi-

Table 3 Cost Effectiveness and Benefit of Interventions in Cardiac Rehabilitation

Intervention	Cost	Effectiveness	Benefit	Data quality	Strength of literature
Exercise training in CAD	Low	Medium	Attractive	Weak	Limited
Smoking cessation	Low	High	Very attractive	Strong	Extensive
Nurse-mediated smoking cessation	Low	High	Attractive	Strong	Limited
Dietary therapy for hypercholesterolemia	Low	Low	Attractive	Strong	Extensive
Drug therapy for hypercholesterolemia	Medium	High	Attractive	Strong	Extensive
Nurse-mediated drug therapy for hypercholesterolemia	Medium	High	Attractive	Strong	Limited

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tion, the quality of the study designs and the strength of the literature (i.e., number of references and quality of journals in which they appear) are summarized.

Exercise Training

Exercise training became the mainstay of cardiac rehabilitation because of the need to reverse the deconditioning effects of bed rest prescribed during the recovery from myocardial infarction. Current approaches to treatment of patients recovering from myocardial infarction or cardiac surgery emphasize shorter convalescent periods, making deconditioning a less important problem (27–29). Therefore, in assessing the cost-effectiveness of exercise training, determining which outcome to analyze is a problem (30).

There is no question that exercise training accelerates the physical recovery and increases the functional capacity of patients with coronary disease (27,29, 31,32). Establishing the economic benefit of these outcomes is more difficult. If exercise training shortens the interval between myocardial infarction or coronary surgery and return to occupational work, cost effectiveness is easily calculated and is favorable. However, a large proportion of patients with these clinical problems are retired or retire as a consequence of their illness. Calculating the cost effectiveness for these patients is more problematic (33–35).

Meta-analyses suggest exercise training can decrease mortality by 25% in the first 12 to 24 months following myocardial infarction (36,37). Subsequent cost-effectiveness analyses using these data suggest a very attractive cost-benefit. However, such studies are limited by the effectiveness data used, which were reported 15 to 25 years ago. These studies were done in an era when interventional and surgical therapies were used less commonly; medications that improve prognosis in coronary patients, such as beta-blockers, aspirin, and angiotensin converting enzyme inhibitors, were either not commonly prescribed or were unavailable; and exercise training was more likely to be prescribed only to low-risk patients. Using the criteria described previously, exercise training appears to be in the favorable category because of its low-cost, broad-ranging effectiveness, and positive influence on other disease states.

Smoking Cessation

Smoking cessation after myocardial infarction lowers mortality by 50% in the 1 to 2 years following the event (38–41). A variety of techniques are available to induce patients to stop smoking (42,43). In the context of cardiac rehabilitation programs, models that include counseling with or without nicotine substitutes are most relevant. In general, the most effective programs combine counseling with nicotine substitutes (44–48). Such programs may be offered by physicians, nurses, or a variety of other health professionals (49–52). Cost-effectiveness studies of smoking cessation interventions in the general population have been shown to be in the very attractive category, with costs ranging from $1500 to $11,000 per QALY saved. The number of studies performed in a cardiac rehabilitation setting is limited, but suggest a similar, very attractive cost effectiveness.

Cholesterol Management

Recent literature has confirmed the effectiveness of lowering LDL cholesterol in decreasing mortality and morbidity in patients with coronary disease (53–57). Equally important is the finding that cholesterol lowering in coronary patients also reduces the need for rehospitalization and revascularization (58,59) Most benefits appear directly related to the degree of cholesterol lowering, that is, the lower the LDL cholesterol, the better the outcome.

Diet has been the recommended initial approach to cholesterol lowering (60). While professional dietary advice is inexpensive, it also has limited effectiveness in achieving target LDL goals. In patients with modest LDL elevations, professional dietary intervention has a very attractive cost-benefit (61). However, if the target LDL is assumed to be 100 mg/dL, patients with LDL levels above 115 mg/dL are unlikely to achieve the goal with dietary treatment alone (62). Unfortunately, limited data are available to evaluate the incremental cost-effectiveness of diet added to the potent effects of lipid-lowering medications. While the beneficial effects of a healthy diet should not be discounted in the overall care of a patient with coronary disease, pure economic analysis casts doubt on the cost effectiveness of dietary counseling with moderate or severe elevations of LDL cholesterol, except to decrease drug dosage.

Drug therapy has been shown to be highly effective in lowering LDL cholesterol with concomitant decreases in mortality, morbidity, and use of expensive medical resources, such as coronary angioplasty and coronary artery bypass surgery. Virtually any of the HMG Co-A reductase inhibitors can lower LDL cholesterol to goal in the majority of patients with coronary disease. Cost-effectiveness analysis suggests that intervention with these medications is in the very attractive to attractive range (63–65).

Studies show a high level of effectiveness of cholesterol management by nonphysician healthcare professionals, including dietitians and nurses. Programs using such patient counselors for both diet and drug therapy are both more effective and less costly than physician management alone. While data are limited, the cost-benefit of such an approach is in the attractive range (25,66).

In medicine, services should be provided only if they add value. Value will best be judged through the provision of a balanced scorecard of information: patient satisfaction, clinical and functional outcomes, and total financial cost. It is only through the continuous quality improvement opportunities that this information produces that one can be certain of the value added to the care of the patient population. This discipline of measurement and turning data into information is the essential foundation of a ''systems approach,'' which is needed in cardiac prevention and rehabilitation. The managed care arena is an information-intensive system and those providers who use information effectively will have an advantage in the competitive healthcare marketplace (67).

FUTURE VISION: ECONOMIC CHALLENGES EQUAL REHABILITATION OPPORTUNITIES

The national burden of cardiovascular disease is increasing. Heart disease currently accounts for approximately 750,000 deaths each year in the United States. Moreover, there are alarming indications that the decline in cardiovascular disease mortality that began in the 1960s has leveled off and that mortality rates may even be beginning to rise. For the first time in decades, the age-adjusted death rate from cardiovascular disease in the United States increased slightly from 1992 to 1993 (68). With the aging of the baby boomers into the coronary heart disease prone years, the burden on the healthcare system will increase.

While population means for cholesterol and blood pressure are decreasing, population-wide trends for cigarette smoking, cigar smoking, obesity, and inactivity are increasing (69–71). In addition, there are alarming trends in the health status of U.S. teenagers, among whom there are also troubling increases in the prevalence of cigarette smoking and obesity and decreases in physical activity (69). These trends will have to be balanced against the new medical discoveries on the horizon: better drugs, minimally invasive surgery and laser treatment, gene therapy, and temporary heart-assist devices. Will these new therapies be able to negate the impact of the increasing prevalence of cardiac risk factors, and, if so, when and at what economic price? Will cardiac rehabilitation fit into this future world of cardiovascular care?

Economic Challenges

Aging Society

The nation's population is getting older. By the year 2025 there are expected to be 25 million people aged 75 and older; a 63% increase from 1997 (72). Healthcare is more costly for older people. With or without Medicare reform, total healthcare expenditures are expected to reach 18% of the nation's gross domestic product or $2119 billion by the year 2005 (73). This increase represents a 14% gain from 1996 levels, with the majority of expenditures for hospital and physician services.

Increased Uninsured

In addition to the expanding Medicare population, access to Medicaid is becoming more restrictive and a growing number of employers are choosing to limit healthcare coverage benefits. As a result, the number of uninsured people will slowly rise. Access to healthcare coverage, particularly for those in poor health, will become more difficult. The uninsured are four times more likely not to get needed medical care and three times more likely to have problems paying for medical attention.

Chronic Diseases

Ninety million Americans have a chronic disease, with more than one-third of these having more than one chronic condition (71). Medical management will be integral to the success of healthcare providers in the future. Medical management is the process whereby the financing of care and the measurement of clinical outcomes is linked to the delivery of services in a high-quality, cost-effective manner, resulting in satisfaction from consumer and provider alike (74). The hallmarks of effective medical management include:

1. Coordination of care across the continuum of delivery settings.
2. Case management that includes protocols for managing the medical needs of a patient during a specific illness.
3. Disease management of chronic diseases.
4. Demand management designed to help support patients in their role as active healthcare participants.

Rehabilitation Opportunities

Coronary artery disease is a chronic disease. The reduction of CAD risks has been proven possible by virtue of lifestyle modification and/or pharmacological interventions (75,76). Practice guidelines define the main strategies for CAD primary prevention and secondary prevention, including the value of utilizing cardiac rehabilitation services (22,77). New risk factors are being identified which have the potential to provide even better primary and secondary prevention measures (78). CAD and its complications are multifactorial and require complex medical strategies and various lifestyle approaches for maximal benefit (79).

New and Expanding Patient Populations

As described above, the number of patients for whom cardiac rehabilitation services have been traditionally prescribed will continue to increase. Additionally, payer interest is emerging to support the inclusion of new patient populations in cardiac rehabilitation. For example, payers are struggling with the uncontrollable costs of congestive heart failure. The components of cardiac rehabilitation, either alone or in combination with infusion therapy, are being harnessed to produce cost savings through reduction in readmissions and use of the emergency room, improved functional capacity, increased compliance with medical therapy, and enhanced well being (80).

New and Evolving Delivery Strategies

Unlike previous generations, baby boomers can be expected to live longer, healthier, happier lives. To accomplish this, they will be proactive about their health. They are choosing to take control over their aging and are choosing more health-conscious lifestyles. As a result, they will cause a massive ''graying'' of all healthcare venues, including cardiac rehabilitation facilities. However, their expectations will be different from those of past participants. Rehabilitation providers and programs will have to adapt.

Consumer Participation. Consumers are increasingly more interested in getting help instead of having things done for them. They are more educated and therefore more able and willing to make decisions on their own (81). As a result, they will expect to be full partners in their care. It will become increasingly important that rehabilitation programs teach independence and mastery of effective skills that promote long-term behavior change (82) (see Chap. 38). Patient-led, clinician-supported, self-care education models and Internet chat groups will be future vehicles of support and information (83,84) (see Chap. 37).

Consumer Expectation. In this hectic society, the American consumer values convenience and access. The busy consumer wants to be productive and they want the rest of the economy to make it easier to be productive (81). Consumers over the age of 50 are more attracted to having experiences than acquiring things. A key psychological need of theirs is to be comfortable, while safety, security, convenience and access are top considerations (85).

To meet these expectations, case management models such as MULTIFIT have to be incorporated into cardiac rehabilitation program design (86) (see Chap. 34). Length of time contact is maintained with the patient will have to be systematically weighed, balancing outcomes and cost (87). Dissemination of programs in rural areas using innovative technology and via other healthcare partners such as home health agencies and retirement communities have to be explored (see Chap. 35).

CONCLUSION

Cardiac rehabilitation, as defined and discussed in this text, will play a vital role in the managed care environment of the future if the cost effectiveness of services provided can be clearly demonstrated. Beginning now, the results of rehabilitative efforts—patient and program outcomes—must be measured, documented, and communicated to all involved parties. To purchasers, payers, patients, and physicians alike, decisions about using and supporting cardiac rehabilitation services will have a common bottom line: value.

In basic accounting terms: Assets − Liabilities = Net Worth
In healthcare economic applications: Quality/Costs = Value

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Challenges and Opportunities for Additional Research

Nanette K. Wenger
Emory University School of Medicine, Grady Memorial Hospital, and Emory Heart and Vascular Center, Atlanta, Georgia

L. Kent Smith
Arizona Heart Institute, Phoenix, Arizona

Erika Sivarajan Froelicher
Schools of Nursing and Medicine, University of California, San Francisco, California

Patricia McCall Comoss
Nursing Enrichment Consultants, Inc., Harrisburg, Pennsylvania

Major scientific advances pertaining to cardiac rehabilitation and exercise training have occurred in the latter part of the twentieth century. However, as we approach the next millennium, several key issues regarding cardiovascular rehabilitation continue to provide both opportunity and challenge for additional and expanded research. A number of these aspects were detailed in the Agency for Health Care Policy and Research (AHCPR) Clinical Practice Guideline, *Cardiac Rehabilitation*, published in October of 1995. The majority of these issues remain unresolved. High-priority areas for appropriate research are as follows.

1. Assessment of the clinical and economic outcomes of cardiac rehabilitation in patients following acute myocardial infarction treated with contemporary acute management strategies. Since acute interventions, including coronary thrombolysis and primary transcatheter revascularization procedures, have reduced mortality and risk status, the

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potential for additional reduction in mortality from effective cardiac rehabilitation services is correspondingly less likely to be documented. Both more effective medical therapies and later revascularization procedures also have favorably affected late survival. Therefore, quality of life outcomes of cardiac rehabilitation services, as well as effects on risk reduction, functional status, return to work, and economic outcomes have to be assessed with meaningful and appropriate research.

2. Various innovative models for the delivery of cardiac rehabilitation services have been documented to be effective and safe in randomized clinical trials involving predominantly low-to-moderate risk cardiac patients. Additional research is required to assess the impact of delivering cardiac rehabilitation services in various healthcare structures and settings (e.g., in an HMO setting vs. home-based cardiac rehabilitation or in rural compared to urban areas). New models of cardiac rehabilitation practice should be designed that deliver individualized services in a variety of settings and compared and contrasted in various groups of patients for safety, clinical effectiveness, operational efficiency, and cost benefit.
3. The safety of cardiac rehabilitation, and in particular of exercise training, delivered in nontraditional settings, in higher-risk patients (e.g., patients who are elderly, those with left ventricular dysfunction, patients with residual myocardial ischemia and/or arrhythmias, or patients with comorbid conditions) utilizing technological advances in transtelephonic and other approaches to patient monitoring and communication must be evaluated. The requisite extent and duration of surveillance and/or ECG monitoring of exercise training in these populations must be ascertained.
4. The value of home-based educational and exercise videos and the value of documentation of exercise performance and cardiac risk factor modification strategies utilizing cyberspace have to be explored. The role of computer technology for rehabilitation charting and recordkeeping, patient education, and outcome tracking should be ascertained.
5. With the major increase in the proportion of elderly patients, and particularly of elderly women as well as patients of racial and ethnic minorities seen for clinical care, the characteristics of needs for and outcomes of multifactorial cardiac rehabilitation have to be examined and documented in these specialized populations. This is best accomplished through group-specific sampling, using a stratified study sample to allow subgroup specific estimates for each research question.

6. Documentation is needed of factors that impact negatively on patient adherence to cardiac rehabilitation to allow the development of strategies to enhance adherence and optimize beneficial clinical and economic outcomes. The applications of behavior change theory should be expanded and the best strategies defined to optimize risk reduction efforts in cardiac rehabilitation, and especially to enhance motivation and compliance.
7. Well-designed research trials should focus on the role of strength training and the attainment and maintenance of mobility, flexibility, and optimal cardiorespiratory status in higher risk populations including elderly patients, unfit patients, high-risk populations, and the growing number of overweight individuals. Both safety and efficacy require examination.
8. Studies of patients with left ventricular dysfunction with and without clinical manifestation of heart failure should be a major focus of research in the twenty-first century. This population group currently totals about 5,000,000 patients and will expand even further in the first 30 years of the next millennium. The early promising studies of the benefits of exercise training and cardiac rehabilitation have to be further extended. The optimal mode(s) and duration of exercise training and requirements for exercise surveillance are not known.
9. Research focusing on psychosocial variables and quality of life, utilizing more sensitive instruments to measure outcomes, should be addressed in the next decade, with appropriate attention to issues of gender, age, ethnic, and sociocultural diversity. Attention should be directed to the impact of depression, inadequate social support, and poverty in predicting psychosocial risk in a cardiac rehabilitation setting, as a basis for designing and implementing risk reduction strategies.
10. Guidelines should be developed and validated—criteria, protocols, algorithms—to aid in clinical decision making for optimal cardiac rehabilitation placement (i.e., how to get the right patient to the right program at the right time).
11. Studies are needed to identify patient and family preferences for services to more closely match the fit between healthcare provider offerings and patient preferences and satisfaction with services.
12. Effective strategies should be developed and validated for long-term follow-up of cardiac rehabilitation graduates. For example, the following should be examined: what works operationally, what methods are best—visits, telephone, mail—and how long patients should be followed, among others.

13. Additional quality measures should be established, especially national benchmarks for major cardiac rehabilitation outcomes, against which both program performance and patient results can be compared.
14. Cost-effectiveness studies of both individual service elements (e.g., stress management) and different practice models as a whole should be continued and expanded. Opportunities should be identified for working with third party payors to explore cost-related issues of common interest.

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About the Editors

NANETTE K. WENGER is Professor of Medicine in the Division of Cardiology at the Emory University School of Medicine, and a Consultant to the Emory Heart and Vascular Center, Atlanta, Georgia. She is Chief of Cardiology at Grady Memorial Hospital, Atlanta, Georgia. Dr. Wenger is the author or coauthor of more than 950 scientific papers, review articles, and book chapters, and serves as senior editor for the *American Journal of Geriatric Cardiology.* She is a Master of the American College of Physicians, and a Fellow of the American College of Cardiology and the American Heart Association Council on Clinical Cardiology. Dr. Wenger received the B.A. degree (1951) from Hunter College, New York City, and the M.D. degree (1954) from Harvard Medical School, Boston, Massachusetts.

L. KENT SMITH is Director of Ambulatory Drug Research at the Arizona Heart Institute, Phoenix, Arizona. Dr. Smith is the principal investigator in more than 130 clinical trials, the author or coauthor of over 80 scientific papers and articles, and consultant to the United States government for the modernization of health care in Hungary. He is a member of the American Heart Association, the International Society of Cardiology, and the American Association of Cardiovascular and Pulmonary Rehabilitation. Dr. Smith received the B.A. degree (1964) from the University of Kansas, Lawrence, the M.D. degree (1968) from Creighton University Medical School, Omaha, Nebraska, and the M.P.H. degree (1981) from Boston University Medical School, Massachusetts.

ERIKA SIVARAJAN FROELICHER is Professor, Department of Physiological Nursing, School of Nursing, and Adjunct Professor, Department of Epidemiology and Biostatistics, School of Medicine, University of California San Francisco, San Francisco, California. The author or coauthor of more than 30 journal articles, Dr. Froelicher is a Fellow of the American Association of Cardiopulmonary Rehabilitation; the American Heart Association, Council on Cardiovascular

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Nursing; and the American Academy of Nursing; and a member of the American Nurses' Association and the American Association of Critical Care Nurses. She received the B.S. (1973) and M.A. (1975) degrees from the University of Washington, Seattle, and the M.P.H. (1985) and Ph.D. (1989) degrees from the University of California, Los Angeles.

PATRICIA MCCALL COMOSS is a Nurse Consultant for Cardiac Rehabilitation, Nursing Enrichment Consultants Inc., Harrisburg, Pennsylvania. She is the author or coauthor of numerous journal articles and book chapters, and serves as the case studies editor for the *Journal of Cardiopulmonary Rehabilitation.* Ms. Comoss is a Fellow and past president of the American Association of Cardiovascular and Pulmonary Rehabilitation, and a member of the American Heart Association, the American Nurses' Association, and the American College of Sports Medicine. She received her R.N. degree (1968) from the St. Joseph's Hospital School of Nursing, Reading, Pennsylvania, and the B.S. degree (1982) in health care administration from Pennsylvania State University, Harrisburg.