

Healthcare Delivery in the Information Age

Michael Christopher Gibbons
Rajeev Bali
Nilmini Wickramasinghe *Editors*

Perspectives of Knowledge Management in Urban Health

 Springer

Healthcare Delivery in the Information Age

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Perspectives of Knowledge Management in Urban Health



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*This series is dedicated to Leo Cussen:
learned scholar, colleague extraordinaire
and good friend.*

Foreword

The twenty-first century is being shaped by the same powerful forces, namely the financial crises, food shortages, climate change and health security. Public health has been battered by multiple global crises from multiple fronts. Historically clinical, genetic, biologic and to a lesser degree psychological factors have been considered the major determinants of ill health and disease. In recent times, it is increasingly recognized that sociobehavioral and environmental factors are also important health outcome and health care determinants. In this century, the driving forces of health are demographic ageing, rapid urbanization, and the globalization of unhealthy lifestyles. Perhaps this reality is most easily understood in the context of Urban Health.

In 1990, fewer than four in ten of the world's population lived in cities. Today, more than half live in cities, and by 2050, seven out of every ten persons will live in urban areas. This phenomenon needs to be understood and factored in as an actionable determinant that impacts on public health and public policy. Urban Health problems exist in a complex interaction of socioeconomic behavioral, environmental, and biologic factors that are related to race, ethnicity and geography. In addition, these determinants coexist in coactive and at times synergistic dynamic systems, which at the population level, often lead to intractable health inequalities and healthcare disparities. Given this reality, an integrated and comprehensive understanding of health and disease in the urban environment requires the collection, analysis and interpretation of diverse types of data that necessitates transdisciplinary analytic approaches. The challenge of Urban Health is further heightened by the fact that we live in an age where continuous monitoring, due to data availability, of almost anything is possible. Thus vast amounts of data about any number of things can be collected within very short periods of time. However, validation of data, pragmatic analytical interpretation, and realistic actions are in general lacking. Health scientists and health care practitioners are ill equipped to collect the necessary information, much less analyze, integratively interpret and then act upon vast amounts of data sources in a timely fashion. Thus many knowledge gaps exist in the field of Urban Health. Some of these gaps exist because science has not yet standardized the data needed for adequate urban health knowledge. We may indeed have vast amounts of data, yet little of this information is in the form of useable

knowledge upon which policy makers, clinical and public health practitioners can act to prevent disease or protect health.

Knowledge management comprises a range of practices typically used by large and complex organizations to facilitate the identification, creation, representation or adoption of critical insights and experiences. These insights and experiences are collectively referred to as knowledge and may either be the insights of individuals or the experiences of the organizations themselves. The magnitude and complexity of comprehensively understanding urban health problems or crafting effective solutions in the urban environment strongly suggests the need for systematic tools and methodologies to facilitate advances in the science and practice of Urban Health. The urban environment is an exceedingly complex system in which illness and disease defy simple linear causes existing at one level only. Therefore appropriate solutions will demand the integration of knowledge derived from several and perhaps even many diverse parts of the “system” “organization” or “environment” use.

Given that the majority of the world’s population now lives in cities, this book will be of interest to clinicians, public health practitioners and academic scientists as well as other urban health stakeholders in industrialized nations and in the developing world. This book is academically-grounded whilst remaining practically relevant. The chapters put together in this book provide the basis for garnering sound public health evidence and taking actions based on such knowledge. Applying urban health knowledge management into practice will ensure efficiency and fairness of health care services, health delivery, and health outcomes for our people.

Dr. Jacob Kumaresan

Preface

For the better part of the twentieth century, and now into the twenty-first century, the United States has been recognized as having one of the world's best healthcare systems in terms of its use of leading edge techniques, technologies and application of the latest medical findings to healthcare delivery (Starr, 1982; Kongstvedt, 1994). Looking at the miraculous cures, incredible surgical feats, control of infectious disease, and other aspects of American medicine, it is difficult to dispute the claim. But there is another story when one looks at the health of the nation's urban poor. The healthcare system in the United States seems to hardly touch many of the most vulnerable individuals and communities. Additionally, when medical care is delivered, it is often inadequate to meet the complex health, social, economic, educational, and environmental needs of inner-city urban residents.

The paradox of the modern American medical system is that, although it has an unparalleled capacity to treat and repair (particularly with regard to trauma and infectious disease), it is often ill-prepared to prevent illness, especially within the complex context of the urban environment. Although this contradiction has implications for the entire American population, its impact is greatest for those with the fewest resources, including, and oftentimes most especially, the urban poor. For inner-city residents who often live close to large academic health centres, the paradox is all the more acute. Even though the "best care in the world" may literally be right next door, poor urban residents experience some of the worst health conditions, live in some of the least-healthy environments, and have some of the worst health indices of any population group in the nation - in some instances comparable to those found in developing nations.

It is important to stress that such problems are not restricted to the USA – the issues are replicated in countries throughout the world (the *International Conference on Urban Health* held in Baltimore (31 Oct–2 Nov 2007)) testifies to this. Quality care of patients requires the evaluation of considerable amounts of data at the right time and right place and in the correct context. These clinical, administrative and operational sources of data are typically kept in separate and disparate operational repositories. With the advent of the electronic health record, these data warehouses will provide data and information at the point of care and provide for a continuous learning environment in which lessons learned can provide updates to clinical, administrative and financial processes. What becomes crucial in such a context is

the identification of relevant data, pertinent information and germane knowledge to support rapid and superior healthcare decision making (Wickramasinghe et al., 2009). Given the advancement of the information tools and techniques of today's knowledge economy, it is imperative that these tools and techniques be appropriately utilized to enable and facilitate the identification and evaluation of these knowledge assets. To do this effectively and efficiently it is imperative that healthcare incorporates the principles of Knowledge Management (KM).

This book then, serves to explore and explain the nature of essential KM principles in a manner applicable to the problems of urban health. Accessibility and usability in this manner would be of use to both students and professionals wishing to learn more about the key aspects of urban health knowledge as they pertain to effecting superior healthcare delivery. The book provides readers with an understanding of approaches to knowledge and knowledge management by examining the purpose and nature of its key components. The rationale of the text is the first demystify the KM field by explaining in an accessible manner the key concepts of KM tools, strategies and techniques, and then clearly identify the benefits of incorporating KM into contemporary urban health issues. The text will demonstrate how, with practice and understanding, its key precepts can be appropriately applied to the domain of urban healthcare.

Many KM texts suffer from pitching theoretical issues at too technical or high a level, or from presenting a theoretical prescriptive treatment of knowledge or KM modelling "problems". It is hard to find a text that approaches the topic from the more versatile "twin" perspectives of both academia and practitioner. The market needs a book which is sensitive to such issues and which can provide readers with approaches to managing and developing KM that is underpinned by theory and research, which is integrative in nature and which addresses softer approaches in manifesting and recognising knowledge. Moreover, given that urban healthcare professionals are incredibly busy people, what is essential for them is to have a book that provides the essence of KM for superior urban health delivery. This will enable them to grasp the key points quickly and more importantly be able to implement effective KM strategies and techniques into urban health operations. Examples of such strategies and techniques include:

- (a) Diagnosing complex diseases and then deciding upon an appropriate treatment strategy: the urban health professional must sort through multi-spectral data and various information sources. By incorporating the various tools of KM, eg. sorting and searching tools as well as decision-making tools, it is possible to search large databases and electronic repositories to access the relevant information and pertinent data required to make a more informed and thus better decision after careful evaluation of critical knowledge
- (b) A computerised medical record represents a document that provides the user: typically an urban health professional, with specific and important information pertaining to a patient from which (s)he can then make further healthcare treatment recommendations. By incorporating various KM tools and techniques (including drill down, connectivity to a healthcare portal as well as searching),

it is possible to transform a relatively static computerised medical record into an intelligent knowledge repository from which the urban health provider can make better decisions pertaining to treatment issues.

- (c) Developing appropriate utilisation usage criteria which impact on reimbursement for urban health funds and urban health professionals, it is necessary to process large amounts of disparate data and analyse trends. In order to develop accurate utilisation levels, it is of paramount importance that the tools and techniques offered by KM are applied.

The format for the book is as follows:

Part I: KM and Urban Health

The first part of this book attempts to introduce and underscore the major challenges that one is confronted with in an urban health context and how the tools, technologies, tactics and techniques of KM might facilitate successful and superior healthcare delivery in such a challenging environment.

Chapter 1: Knowledge Management for the Urban Health Context by Gibbons, Bali and Wickramasinghe serves to introduce the key challenges faced in urban healthcare and how and why the tools, techniques, tactics and technologies of knowledge management might facilitate superior healthcare delivery for urban healthcare.

Chapter 2: Healthcare Knowledge Management: Incorporating the Tools, Technologies, Strategies and Processes of KM to Effect Superior Healthcare Delivery by Wickramasinghe provides a comprehensive coverage of all the major areas within KM and how they can be harnessed to facilitate superior healthcare delivery. The chapter provides case vignettes to highlight key issues.

Chapter 3: Knowledge Management in the Urban Health Context: Moving Towards Tacit-to-Tacit Knowledge Transfer by Bali, Baskaran and Naguib focuses attention most especially to overcoming knowledge gaps in urban healthcare settings with tacit-to-tacit knowledge transfer.

Part II: Incorporating KM Principles into Urban Health Contexts

This second part serves to provide the reader with a miscellany of chapters that discuss numerous instances in which incorporating KM principles into an urban health context has indeed enabled superior healthcare delivery. Of particular note, is that these chapters cover instances in different countries be it Australia or US, countries in Europe, Asia and Africa as well as a variety of different urban populations ranging from children to the elderly. In so doing, we try to emphasise both the

breadth of urban health contexts and the universal benefits of KM principles when applied in any of these contexts.

Chapter 4: A Childhood/Adolescent Knowledge Management System for Urban Area Health Programs in the District of Columbia by Popovich and Zhang. This chapter focuses on the benefits of incorporating a knowledge framework to support urban health care objectives in the District of Columbia with a particular focus on children and adolescent populations.

Chapter 5: Urban Health in Developing Countries by Agarwal, Srivastava and Kumar. The need and benefit of appropriate KM systems to ameliorate the numerous challenges and problems in urban health settings in developing countries is the central theme of this chapter.

Chapter 6: A Pervasive Wireless Knowledge Management Solution to Address Urban Health Inequalities with Indigenous Australians by Wickramasinghe, Troshani and Goldberg. By incorporating a knowledge based solution the authors outline, in this chapter, how urban health inequalities and disparities can be addressed and resolved.

Chapter 7: The Development of a Framework to Evaluate the Management of HIV/AIDS Programmes in Rural and Urban South Africa by Sassman, Lehaney, Bali, Naguib and Marshall. This chapter discusses the development of a framework grounded in the principles of KM to address the HIV/AIDS crisis in South Africa.

Chapter 8: The Potential of Serious Games for Combating Health Inequalities by Gibbons, Bali, Marshall, Naguib and Wickramasinghe. The use of games to facilitate education and understanding of healthcare issues for various groups from the very young to the very old in an urban context is the focus of this chapter. While KM is not explicitly stated throughout the chapter, without the tools, techniques, tactics and technologies of KM it would not be possible to design and develop appropriate games nor would it be possible to effect the necessary knowledge transfer. Hence KM is an integral key success factor in this context.

Part III: Measures and Metrics for KM and Urban Health

This final part of the book attempts to develop and discuss possible measures and metrics. Improvement is only possible if we can objectively examine the current situation, extract appropriate lessons and apply these to the future state. By attempting to develop possible measures and metrics we are attempting to ensure that continuous improvement is also supported and fostered. Continuous improvement and learning are central themes in KM and we believe that if these themes are transferred into applications of KM principles in Urban Health settings we will indeed realise superior healthcare delivery in these instances.

Chapter 9: A Scalable and Viable Strategy for Managing Organizing: Typology for Intervening into Complex Healthcare Environments for Enhancing Continual Development by Saito. This chapter presents an approach for classifying, modelling and managing complex urban healthcare environments.

Chapter 10: Amplifying Resonance in Organizational Learning Process: Knowledge Sharing for Overcoming Cognitive Barriers and for Assuring Positive Action by Saito. This chapter serves to model critical learning process in urban healthcare environments and by doing so noting how to overcome numerous cognitive barriers.

Chapter 11: Developing New Urban Health Metrics to Reduce the Know-Do Gap in Public Health by Castillo-Salgado and Gibbons. This chapter delineates how KM is integral in the development of new and superior metrics to facilitate superior public health delivery.

Chapter 12: Recommendations on Evaluation and Development of Useful Metrics for Urban Health by Castillo-Salgado and Gibbons. The development of useful metrics for evaluating and enhancing urban communities is the central focus in this chapter.

Chapter 13: Making Sense of Urban Health Knowledge by Bali, Baskaran, Gibbons and Wickramasinghe. The final chapter of this book provides a summary of the role for the principles of KM in Urban Health contexts and how we should move forward when we try to incorporate these KM principles to whatever Urban Health context may confront us.

After extensive discussions and focus groups with public and urban health professionals, students (past and present), conference and workshop delegates, business managers and leading academics, it is apparent that there is a need for an accessible yet functional text in this area, one that incorporates valuable insights from all stakeholders. We have endeavoured to meet this need with our book Urban Health Knowledge Management and hope that our readers will find the following pages useful and beneficial as they attempt to address the challenges in Urban Health Contexts.

Baltimore, MD
Coventry, UK
Melbourne, Australia

Michael Christopher Gibbons
Rajeev Bali
Nilmini Wickramasinghe

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For our families

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Dr Vikram Baskaran is a post doctoral fellow based at Ryerson University, Canada having completed his PhD with the Biomedical Computing and Engineering Technologies (BIOCORE) Applied Research Group at Coventry University, UK.

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Dr. Castillo-Salgado has served in several technical positions at the Pan American Health Organization/World Health Organization. He has been the Area Manager for the Health Analysis and Information Systems Area, Chief of the Special Program for Health Analysis and Information Systems, Program Coordinator for the Health Situation Analysis Program, and Regional Advisor in Epidemiology for the Communicable Diseases Program; he has been consultant for many inter-governmental organizations in the area of health information systems, measuring health inequalities, geographic information systems, epidemiological risk assessment and health impact assessment.

Currently he is an Adjunct Associate Professor of the Department of Epidemiology of the Bloomberg School of Public Health, Johns Hopkins University and Courtesy Professor of the College of Public Health, University of South Florida. He served as Professor and Research Coordinator in Primary Health and Community Medicine at the National University of Mexico and Visiting Associate Professor in most of the schools of public health in Latin America and Spain.

Dr. Castillo-Salgado is author of several scientific publications and articles of epidemiology and public health. In 2008, he developed the Health and Education section of the National Geographic Family Reference Atlas, Third Edition, 2008. He also produced the first and second editions of this World Atlas. He has been the scientific editor and coordinator of the Pan American Health Organization 2 flagship's publication: "Health in the Americas" during the cycles of 1998, and 2002. He is the main author of "Geographic Information Systems in Epidemiology", 2001 (with English, Spanish and Portuguese editions), "Measuring Inequalities in Brazil", 2002, and "Mortality Profiles of the Sister Communities on the United States-Mexico Border", (1992–1994 and 2000 Editions). Also, he was the Editor and author of the Special Issue on Measuring

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Since 2002 is member of the Publication Board of the American Public Health Association (APHA). In 2007 was elected as Member of the APHA's Governing Council, representing the International Health Section. He is member of multiple professional associations in epidemiology and public health.

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Communicable Diseases Program, HPT, in recognition of the excellence of the professional work of its staff in 1992. Washington, D.C.; National Dissertation Grant Award in Health Services Research, 1986. National Center for Health Services Research and Health Care Technology Assessment. Department of Health and Human Services. Rockville, Maryland; J.D. with Honorable Mention. Universidad A. De Guadalajara, Guadalajara, Jal, México, 1972.

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Sanjeev Kumar is Ph. D. in Social Medicine and Community Health and working as the Acting Team Leader-Research, Knowledge Management and Advocacy Unit in Urban Health Resource Centre (UHRC), India. He has a rich experience of program planning and monitoring and evaluation of health and social development projects of Government of India and several International Agencies. He is pres-

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Dr. Zhang is active in advancing the research of syndromic surveillance and bio-surveillance and is frequently an invited speaker for international conferences and seminars and has published over 40 papers in the areas of Bio-intelligence and Disease Surveillance; Decision-making Support Techniques under Uncertainty; Complex System Modeling and Simulation; Application of Artificial Intelligence; GIS and Remote Sensing Application with Dynamic System Modeling; and Modeling of Environmental and Hydrological Processes.

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Part I
KM and Urban Health

Chapter 1

Knowledge Management for the Urban Health Context

M. Chris Gibbons, Rajeev K. Bali, and Nilmini Wickramasinghe

Abstract This chapter explains why contemporary and innovative knowledge-based concepts can be of benefit to the urban health environment. The notion of “knowledge gaps” is often cited as a major impediment to effective management in the urban health context (examples of which are included throughout this book). The tools, technologies and strategies of Knowledge Management are particularly applicable to urban health. Coupled with the concept of “sense making”, such advances can assist in efforts to close or mitigate the impact of the urban knowledge gaps.

1.1 Introduction

Whilst there is a plethora of research which describes “knowledge gaps” (or “knowledge islands”) in urban health, there is a paucity of work which presents Knowledge Management (KM) as the primary method to close these gaps. This chapter will introduce some essential theory and concepts in KM and moves on to describe KM’s efficacy for urban health. We illustrate how the knowledge concept of “sense-making” can be used as an interlocking mechanism to draw together KM and urban health. We begin by discussing the concept of urban health.

1.2 Key Concepts in Urban Health

For the better part of the twentieth century, and now into the twenty first century, the United States has been recognized as having one of the world’s leading healthcare systems in terms of its use of leading edge techniques, technologies and application

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of latest medical findings to healthcare delivery (Starr 1982; Kongstvedt 2003). Looking at the miraculous cures, incredible surgical feats, control of infectious disease, and other aspects of American medicine, it is difficult to dispute the claim. But there is another story when one looks at the health of the nation's urban poor. The health care system in the United States seems to hardly touch many of the most vulnerable individuals and communities. Additionally, when medical care is delivered, it is often inadequate to meet the complex health, social, economic, educational, and environmental needs of inner-city urban residents.

The paradox of the modern American medical system is that, although it has an unparalleled capacity to treat and repair (particularly with regard to trauma and infectious disease), it is often ill-prepared to prevent illness, especially within the complex context of the urban environment. Although this contradiction has implications for the entire American population, its impact is greatest for those with the fewest resources, including the urban poor. For inner-city residents who often live close to large academic health centers, the paradox is all the more acute. Even though the "best care in the world" may literally be right next door, poor urban residents experience some of the worst health conditions, live in some of the least-healthy environments, and have some of the worst health indices of any population group in the nation - in some instances comparable to those found in developing nations.

It is important to stress that such problems are not restricted to the USA as the issues are replicated in countries throughout the world. Quality care of patients requires the evaluation of considerable amounts of data at the right time and right place and in the correct context. These clinical, administrative and operational sources of data are typically kept in separate and disparate operational repositories. With the advent of the electronic health record, these data warehouses will provide data and information at the point of care and provide for a continuous learning environment in which lessons learned can provide updates to clinical, administrative and financial processes. What becomes critical in such a context is the identification of relevant data, pertinent information and germane knowledge to support rapid and superior healthcare decision making (Wickramasinghe et al. 2009). Given the advancement of the information tools and techniques of today's knowledge economy, it is imperative that these tools and techniques be appropriately utilized to enable and facilitate the identification and evaluation these knowledge assets. To do this effectively and efficiently it is imperative that healthcare incorporates the principles of Knowledge Management (KM).

Several features of the urban environment distinguish it in character or degree from other settings. These differences constitute the foundation for a consideration of those elements of teaching about urban health that are distinct from teaching about health in general. These include complexity, diversity, economies of scale, contextual factors and unique organizational and political requirements. Also it is clear that several features of life and living exist on a rural-urban continuum. These differences may be qualitative, quantitative or both. Attempting to understand the *interrelationships* between factors and the mechanisms by which these factors impact each other and health may enhance our understanding of health in the urban environment. The major factors impacting the health of urban populations are outlined below.

1.2.1 Economics

The association between higher levels of economic resources and more optimal health is widely documented while economic aspects of local areas have been among the most frequently analyzed contextual factors with regard to mortality and other outcomes. Significant associations have been shown between health status and community economic characteristics including income and inequality in income distribution, wealth, and poverty and the geographic concentration of poverty (Hillemeier et al. 2003). Generally the associations are linear and positive in the case of income and wealth while inverse in the case of income inequality and poverty.

1.2.2 Stress and Health

Stress has short term and long term effects on the body. Given the right balance of factors the effect is positive. It is beginning to be realized that social and psychological circumstances may damage health over the long term (Marmot and Wilkinson 2006; Wilkinson 1996). Chronic anxiety, insecurity, social isolation appear to undermine health (Marmot and Wilkinson 2006). The ability of psychological factors like stress to affect health is biologically plausible (Berkman and Kawachi 2000). The excessive or prolonged activation of biologic stress responses within the body, may enhance the risk of depression, diabetes, high blood pressure, heart attack and increase disease susceptibility (Marmot and Wilkinson 2006). The poor and minorities are at increased risk for many of these health problems. The clustering and accumulation of psychological disadvantage, perhaps beginning as early as childhood is being investigated as a potential contributor to these disparities (Marmot and Wilkinson 2006; Marmot 1986; Marmot et al. 1997).

1.2.3 Early Life Experiences and the Life Course

Social experiences can exert a significant effect on health from in utero development of the fetus through infancy and childhood. At discrete points early in embryological development of the fetus unique periods of time exist, in which an insult, could exert detrimental effects which evidence themselves at some point later in the process of growth and development (Marmot and Wilkinson 2006). As such the origins of adult health and health inequity may begin in early childhood and perhaps even prior to birth. It has been estimated that over 200 million children worldwide are not reaching their development potential (WHO Commission 2007). A child's early environment has a vital impact on the way the brain develops. The more stimulating the environment, the more connections are formed in the brain and the better the child thrives in all aspects of life: physical development, emotional and social development, and the ability to express himself or herself and acquire knowledge. While physical

health and nutrition are important, a young child needs to spend its time in caring, responsive environments that protect from inappropriate disapproval and punishment. Children need opportunities to explore their world, to play, and to learn how to speak and listen to others (WHO Commission 2007). Discreet poor adult health consequences that have been associated with poor growth and development in early life include high blood pressure, cardiovascular disease, diabetes (Cheung et al. 2000; Smith et al. 2001; Miura et al. 2001) and breast cancer (De Stavola et al. 2004).

1.2.4 Education and Literacy

One key factor that may mitigate adverse child development is education. Education and the associated high social standing in adult life may protect against health-damaging early life exposures. It is possible that inadequate education plays a key role in generating health inequities because it has a profound influence on income, employment status and living conditions (WHO Commission 2007). The importance of education is not limited to primary education nor to low income countries. A key measure of social stratification is education. The influence of education on health is seen not only as a difference between those with some and those with none but it is a gradient that runs to the highest level (WHO Commission 2007). Many health literacy studies rely on the number of school years completed as the sole measure of literacy (Baker 1999). However, many factors including language proficiency and age are associated with health literacy. Measuring the number of years of school, measures education completed. Health literacy on the other hand reflects what was learned during those years and an individual's ability to comprehend new material (Baker 1999). Individuals with low literacy skills have poorer health, higher rates of hospitalizations, and incur higher healthcare costs than those patients with adequate literacy. Finally, in the US low literacy is more frequent among persons of lower Socioeconomic status, the poorly educated, the elderly, racial and ethnic minorities, immigrants, and the disabled (Smedley et al. 2003).

1.2.5 Social Support

There has been longstanding scientific interest in the organization of social life, and the implications of interpersonal and group interactions for emotional and physical health status. As far back as the 1970s research on social support suggested a health-enhancing role for social relationships in buffering the ill effects of stress while subsequent studies confirmed an inverse relationship between social relationships and mortality risk (Hillemeier et al. 2003). More recently, aspects of social interactions and relationships have been increasingly conceptualized as forms of social capital which Putnam defines as features of social organization, such as trust,

norms, and networks that can improve the efficiency of society by facilitating coordinated actions.” Social capital has been operationalized in several ways including per capita membership in groups and associations has been used to assess civic engagement or political participation. Greater levels of mistrust have been related to lower levels of social capital. Perceived helpfulness/reciprocity has also been used as a gauge of social capital, and even crime levels have been seen as indicators of collective well-being that is influenced by the degree of cohesiveness in social relations or social capital (Hillemeier et al. 2003).

1.2.6 Food Availability

A good diet and adequate food supply are central for promoting health and well-being. A shortage of food and lack of variety increase the risk of poor health. On the other hand excessive intake of certain foods contributes to cardiovascular diseases, diabetes, cancer, degenerative eye diseases, obesity and dental caries (Marmot and Wilkinson 2006). The important public health issue is the availability and cost of healthy, nutritious food. Access to good, affordable food makes more difference to what people eat than health education (Marmot and Wilkinson 2006). Several studies have documented that the types of food and grocery store establishments differ in white versus minority communities. In general the white communities have the larger national chain grocery stores while the minority communities tend to have the small corner store food stores with much more limited selection of foods, particularly fresh fruits and vegetables (Morland et al. 2002; Moore and Diez Roux 2006). In addition it has been shown that the costs of food differs by as much as thirty percent between these types of food stores. The higher costs tend to be found in the minority grocery stores where the patrons have lower financial resources at baseline (Morland et al. 2002; Moore and Diez Roux 2006; Diez Roux 2001). In the case of liquor establishments, store location and number of stores in a given community were shown to be associated with amount of alcohol ingested per capita in the local community and associated with dietary nutrient intake by local community residents (LaVeist and Wallace 2000).

1.2.7 Community and Neighborhood

The physical environmental characteristics exert important effects on communities and the health of its population (Amick et al. 1995). The most important factors include air, water pollution, geographic location (urban vs. rural), noise level, housing, transportation patterns and issues. The quality of a community’s air and water resources are among the most visible aspects of the physical environment (Amick et al. 1995). For example, in the US environmental, behavioral, and occupational

exposures to well known pulmonary carcinogens, including tobacco, asbestos, radon, polycyclic aromatic hydrocarbons (PAHs), and heterocyclic amines are well documented (Alberg and Samet 2003; Franceschi and Bidoli 1999; Pitot 2002). Individuals living in housing units located close to a factory spewing carcinogenic emissions from its smoke stack might be expected to experience higher carcinogenic exposure levels over time compared to ambient air exposures in individuals who live in rural areas. In fact, location of urban residence has been associated with increased personal exposure and an increased lifetime risk of cancer (Morello-Frosch et al. 2002; Kinney et al. 2002). In addition, carcinogenic exposures from other sources like automobile exhaust fumes may be significantly higher in urban communities than exposures to these same carcinogens in rural environments.

1.2.8 Work Environment

A major challenge to health is the working environment: working conditions, the nature of employment contracts, and the availability of work itself (WHO Commission 2007). In high income countries, much action has been taken on physical and chemical hazards in the workplace. Now, however, the labor market is mainly segmented and precarious employment has become more prevalent. These labor market changes pose major health risks from the psychosocial and economic hazards associated with less job control, insecurity, lack of work time flexibility and access to paid family leave, and unemployment (WHO Commission 2007). In low income countries these risks are in addition to major persisting physical and chemical hazards. In many countries, the majority of workers are excluded from labor protection. Other workers are deprived of effective protection because of weaknesses in labor law enforcement. The price of “cheap” consumer goods for people in high income countries should not be poor health in low income countries (WHO Commission 2007).

1.2.9 Healthcare

Given the high burden of illness particularly among the socially disadvantaged, it is urgent to make health systems more responsive to population needs. International, national and local systems of disease control and health services provision are both a determinant of health inequities and a powerful mechanism for empowerment (WHO Commission 2007). In both the USA and UK growing proportions of the population are living with chronic diseases. Approximately 60% of UK citizens and 50% of US citizens report having at least one chronic disease (NHS 2004; IOM 2001). These numbers are expected to rise further in the near future. Fragmented healthcare delivery systems and significant proportions of individuals with multiple comorbid conditions contribute directly to poor quality care, unnecessary medical

errors and poor patient outcomes (NHS 2004; IOM 2001). In addition, the healthcare systems of both countries have historically been oriented toward acute episodic inpatient treatment, and as such, have only limited ability in their current configurations, to respond adequately to these growing concerns. Indeed, the World Health Organization has suggested that healthcare systems worldwide are struggling to meet the needs of populations suffering from chronic diseases (NHS 2004). Healthcare quality and health inequalities are related to each other, efforts to eliminate inequalities and those to improve the quality of contemporary medical care represent two inseparable components of high quality healthcare systems (Fiscella et al. 2000). Elective chronic care, unlike acute treatment care, is a much more collaborative process between patients and providers. It involves a much larger reliance on provider directed self care and community based health risk management, disease management, care coordination, and care facilitation. Increasingly in the future, much of this community based care will be provided by non-physician healthcare professionals, family members, friends and associates (NHS 2004; IOM 2001). Electively addressing inequalities will require innovative collaborative approaches that address patient factors, provider factors, healthcare system factors and relevant environmental factors (Smedley et al. 2003; Health Inequalities 1997; Acheson 1998). Development of a robust population perspective in addition to the more traditional medical model of individualized medicine is needed. While individual genetic factors exert substantial influence on the risk of developing disease and or disability among individuals, most people with increased risk do not actually become ill until one or more environmental, cultural or socially determined behavioral factors come into play. Healthcare systems of the future must recognize and respond to shifts in the very nature of medical care away from individualized care to that of care that not only predominantly occurs in communities, and also recognize the neighborhood and community contributions to health outcomes that exist beyond individual and genetic factors (Gibbons 2006).

1.2.10 Transportation

Cycling, walking and the use of public transport provide exercise, reduce pedestrian-motor vehicle accidents, increase social contact and reduce air pollution. Because mechanization has reduced the exercise involved in jobs and house work and added to the growing epidemic of obesity, people need to find new ways of building exercise into their lives. Transport policy can play a key role in combating sedentary lifestyles by reducing reliance on cars, increasing walking and cycling, and expanding public transport (Marmot and Wilkinson 2006). Regular exercise protects against heart disease and, by limiting obesity, reduces the onset of diabetes. It promotes a sense of well-being and protects older people from depression. In contrast to cars, which insulate people from each other, cycling, walking and public transport stimulate social interaction on the streets. Road traffic often divides communities. With fewer pedestrians, streets cease to be social spaces

and isolated pedestrians may fear personal violence (Marmot and Wilkinson 2006). Reduced road traffic decreases harmful pollution from exhaust. Walking and cycling make minimal use of non-renewable fuels and do not lead to global warming. They do not create disease from air pollution, make little noise and are preferable for the ecologically compact cities of the future (Marmot and Wilkinson 2006).

1.2.11 Political/Governance

Since the beginning of time, in every culture across the globe, those who provide protection from ill health or treatment of ill health, stand to gain the gratitude and good will of those who are sick and their families (Starr 1982). The prospect of these tangible and intangible returns on investments in health, often create powerful motives for governments to intervene and at times control the processes. Political leaders since Bismark seeking to strengthen the state or advance their own agendas have used issues of health and care as a means of turning benevolence into power (Starr 1982). Indeed from the Roman sewers and public water systems, to the eradication of smallpox, the health of populations depends upon the power of the state. At times it is necessary for government authorities to seize property, close businesses, destroy animals, treat and even confine involuntary individuals. In the absence of these powers the health of populations could be compromised. On the other hand, the lack of exerting these powers or the inequitable execution and enforcement of these responsibilities can leave individuals and populations vulnerable. Robust oversight, management and accountability measures are critically important to ensure that every individual has the maximum opportunity to achieve and maintain good health. Alternatively, aspects of community political participation have been found to be associated with population health status. In England and Wales areas with better material circumstances and more optimal health, voters were more likely to support leadership that favors reducing public assistance programs. In the United States, individuals living in states with the highest voting inequality were shown to have increased odds of fair or poor self-rated health relative to those in other states, which may be related to disproportionate political participation by the more economically well-off which skews subsequent policymaking toward their interests (Hillemeier et al. 2003). More broadly, political participation it is considered to be a reflection of social capital within a community. Social capital, measured in several different ways, has been associated with positive health outcomes (Hillemeier et al. 2003).

1.2.12 The Environment

The environmental dimension includes physical and chemical components that have known associations with adverse health outcomes: air pollutants, water pollutants,

and environmental hazards including hazardous waste, heavy metals, climatic extremes, and excessive noise. These exposures are known to vary by area and to be disproportionately concentrated among disadvantaged populations (Hillemeier et al. 2003). In addition, this contextual dimension encompasses structural features of communities such as physical design of streets, sidewalks, and safety structures that are associated with level of injury risk. Aspects of land usage are also considered, such as public spaces and parks that may facilitate greater physical activity levels, as are services related to environmental quality like waste disposal and recycling programs (Hillemeier et al. 2003).

1.2.13 Housing

Physical characteristics of housing have been linked to adverse outcomes. For example, the presence of dampness and mold lead to increased risk of respiratory and other illnesses. Dilapidated and abandoned housing in the local area increases the risk of accidental injury among residents, is associated with increased emotional stress, and may provide situational opportunities for high-risk behaviors (Cohen et al. 2000). Population density and overcrowding have also been associated with increased chances of contracting infections and sustaining injury (Hillemeier et al. 2003). Homelessness, has known associations with differentially poorer health. In addition racial segregation has been associated with adverse health outcomes. Similarly, concentration of poverty has been found to be associated with elevated mortality risk. Zoning policy can also affect the degree to which residential areas are exposed to industrial pollution and other health threats such as increased traffic (Hillemeier et al. 2003).

1.2.14 Public Health Services

Adequate functioning of the core public health services of assessment, policy development, and assurance at the local level are critical to urban health. There are a variety of programs aimed at prevention, early detection, and optimal management of a range of health problems which may be provided by local public health agencies or departments (Hillemeier et al. 2003).

1.2.15 Behavior

There has been increasing recognition that aspects of social, physical, and cultural context can affect health status in a community by facilitating or inhibiting behaviors that impact well-being. In the US tobacco use, physical activity, diet/obesity,

alcohol and illicit drug use, and violence are among the nation's major determinants of premature morbidity and mortality. These behaviors though are socially patterned and significantly impacted by several environmental factors. In the case of tobacco use, current community smoking rates, the presence of cessation and preventive education programs, workplace smoking restrictions, the cost and accessibility of cigarettes, and targeted advertising all impact smoking behaviors of individuals. In terms of physical activity, physical education requirements in schools, participation in local sports and recreational activities, as well as availability of exercise facilities in the workplace and in the area more generally all influence activity levels of individuals. In addition television viewing patterns and video game sales and use will also influence activity levels.

Regarding diet and obesity, the quality, availability, and cost of a range of different foods impacts intake as does the community availability of generally less-nutritious "fast food". Similarly aspects of nutrition in schools, such as the prevalence of subcontracting to vendors of non nutritious items and the presence of nutrition education programs may affect the dietary intakes of children. In the area of alcohol and illicit drug use, the number of liquor stores in the community, the local marketing laws as well as the nature of public advertising have all be shown to affect intake. Also drug and alcohol treatment service availability and the presence of syringe laws and exchange programs impacts behavior. Finally, violence in the community will impact the behaviors of residents and is related to the availability of guns in the community and the level of exposure to violence occurring in the neighborhood.

As can be readily seen from the above outline, the major factors impacting health outcomes among persons living in urban populations are extremely diverse. It is a challenge for any health practitioner or researcher to quantitatively consider the impact of all factors in an attempt to understand health status or in designing the most effective intervention strategies. Thus, conventional wisdom would suggest taking a more narrow and focused approach. While conceptually and practically such an approach has merit, because it necessarily leads us to consider one or more factors in isolation of potentially important contextual variables, the inevitable results are attenuated understandings of disease pathogenesis and interventional strategies with limited efficacy. KM offers promise for enabling scientists and practitioners to consider diverse forms of knowledge in a replicable and scientifically defensible manner. In so doing, we will likely improve our understanding of health and disease as it exists, not in test tubes, but in communities and society. In turn we may also uncover novel opportunities for treatment, therapeutics and public health interventions.

Newcomers to KM, especially urban healthcare specialists, are often overwhelmed when trying to understand the intricacies of KM in the urban healthcare setting. These challenges provided the necessary impetus for investigating various KM concepts and clear elucidation of the principle components for easier understanding. The core for KM is knowledge and its management of its various avatars. It is fundamentally important to understand and define knowledge from the KM perspective.

1.3 Information and Knowledge

A misconception exists in differentiating knowledge from information that has attracted a continued debate on the legitimacy of the KM paradigm itself (Wilson 2002). Information and knowledge can be differentiated within a healthcare perspective. If we take the analogy of data as a set of raw, unprocessed numbers (75, 77, 57, 70, 72); contextual details, when added to this set of data, (such as (1) this dataset represents heart beats per minute and (2) pertaining to male aged 62 years), can add lucidity to the dataset provided, becoming information (Miller 2002; Bali et al. 2009). When a heart specialist assimilates this information, a unique process (which is an inherent characteristic of the human brain) of identifying connections, similarities and patterns in the information provided using his/her earlier insight on the subject initiates new knowledge about the patient and may result in the conclusion of symptoms of Arrhythmia (Koskinen 2003). These steps constitute the initial phase of the knowledge cycle. Such knowledge cycles will contribute further knowledge creation and result in adding clarity and assist in achieving wisdom. As a routine process of sharing this acquired knowledge, an individual has to resolve this issue through traditional knowledge sharing techniques such as writing notes, manuals, reports and books coupled with lectures, meetings and the like. The knowledge residing in the human brain is termed Tacit (or implicit) knowledge and the other externalised forms of it are termed Explicit (or expressed) knowledge (Wickramasinghe and von Lubitz 2007).

There is a grey area in differentiating the explicit knowledge from information. Under some circumstances, these can become interchangeable but the human context alone differentiates the information from explicit knowledge (Augier et al. 2001). In expressing his/her tacit knowledge, the heart specialist resorts to the creation of notes based on the patient's information. This form of knowledge, when viewed by any individual from the heart specialist's perspective, is termed explicit knowledge. When the same notes are referred to by a neurosurgeon for cerebro-vascular accident diagnosis, the explicit knowledge created through these same notes becomes information (since the current interpretation of the notes has lost its creation context). Therefore the expressed knowledge viewed in the knowledge creator's context is explicit knowledge, but not otherwise (Rodrigo 2001). This completes the knowledge cycle which can be dichotomised into distinct sets of activities, one related to knowledge creation and the other to knowledge sharing. Such knowledge cycles overlap and feed on each other in propagating knowledge through the time continuum.

1.4 KM in Healthcare

The healthcare domain not only provides challenging opportunities for managing knowledge but also is one of the areas where it is often most poorly understood and deployed (Eardley and Czerwinski 2007). This predicament is slowly being

addressed as more and more KM-focussed projects are initiated and professionals with better understanding of KM are being involved (Sharkie 2003). Any healthcare domain (whether primary care or secondary care in nature) relies on a lot of data and information flows (Baskaran et al. *in press*). Similarly, modern day healthcare environments should also provide knowledge sharing through conducive and well established channels (Breen 1997). Knowledge gaps or “islands” can be circumvented through removing bureaucracy and formal channels. This would pave the way to leverage knowledge that has been created within the healthcare domain, thus expediting well informed and correct clinical decisions (Breen 1997).

The will to share knowledge has to originate from the human mind irrespective of what technological tools are available; the inclination to do so still has to be spontaneous and forthcoming. This aspect may be mapped to social, cultural and moral ethics of the human beings involved in knowledge sharing (Walsham 2001; Chourides et al. 2003). In healthcare, there is no one “silver bullet” solution that can successfully address the KM issues; rather, the whole organisational environment has to be aligned to encourage knowledge creation and knowledge sharing (Ellingsen 2003). Nonaka’s knowledge creation company concept and the SECI model (Nonaka and Takeuchi 1995; Nonaka et al. 2001) cannot be expected to justify the complex nature of modern day KM. Existing healthcare concepts such as Evidence Based Medicine (EBM), Community Health Information Networks (CHIN), and Integrated Patient Pathways (IPP) address only small aspects of KM in healthcare. A radical new approach, focussed on maximum knowledge sharing at a tacit-to-tacit level (Baskaran et al. 2004; Wickramasinghe 2006) would be an ideal beginning for the current KM challenges in healthcare.

All projects in urban health should be part of a KM initiative and all challenges should be approached through a KM perspective. This would provide a holistic approach and a successful strategy to enable innovation and success at all levels (Baskaran et al. 2004). In spite of an exhaustive research interest shown in KM, is yet to evolve a universal approach towards the KM paradigm, at least it has been established that KM is desirable and cannot be disregarded and are clear about the tacit and explicit nature of knowledge (Paul and Kimble 2002; Nonaka and Takeuchi 1995; Pemberton 1998; Kwon 2004). Currently, healthcare management views KM as a holistic concept and not as another routine management process (Wickramasinghe 2006; Baskaran et al. 2009). Healthcare has been the focus of KM initiatives, healthcare embodies the most knowledge intensive activities and its interaction with public directly, makes it more critical and a prime candidate for KM based improvements (Baskaran et al. 2006). Physicians and medical experts agree that every patient scenario is a unique experience and it ranges from less critical to life threatening (Ellingsen 2003). Hence the knowledge gaps can be crucial in making the right decisions during a healthcare intervention (Open 2000).

Current healthcare organisations are experiencing a huge shortage of healthcare experts in every field of medicine, and this requires new strategies to cope up with the increased pressures from the government and the public (Suliman 2002). KM can make a huge impact in creating effective training processes.

This could be extended to create a realistic environment for knowledge transfers such as training, workshops, communities of practices and all knowledge sharing activities. Coupled to this, the healthcare informatics revolution has handed down new challenges such as information deluge and information overload. This resulted in a slow shift from a pull strategy to push strategy; hence KM is viewed as the saviour to deliver from the perils envisaged by healthcare organisations (Burns 2003; Gray 2002).

The earlier comprehensive review of urban health would readily suggest that improvement of the context is long overdue and a pressing goal for contemporary society. The multifarious components of the problem require a multidisciplinary solution and, in this regard, KM is ideally placed to assist. When introduced correctly, KM and its components can enhance clinical practice and foster quality care of (potentially vulnerable) patients. Medical care for the urban health is an ideal candidate for knowledge-based applications as medicine itself is a knowledge-based profession, as finding, sharing and developing clinicians' knowledge is necessary for effective primary care practice (Orzano et al. 2007).

KM is a still relatively new phenomenon and a somewhat nebulous topic that needs to be explored. However, organisations in all industries, both large and small, are racing to integrate this new management tool into their infrastructure. KM caters to the critical issues of organisational adaptation, survival, and competence in the face of increasingly discontinuous environmental change (Rubenstein and Geisler 2003). Essentially, it embodies organisational processes that seek synergistic combination of data and information processing capacity of information technologies, and the creative and innovative capacity of human beings. Knowledge is a critical resource in any organisation and is also crucial in the provision of healthcare. Specifically, organisational knowledge (not just in healthcare scenarios) exists at the confluence of people, process and technology.

1.4.1 Knowledge for Urban Health Contexts

Recent advances in the computer sciences and information technology fields have spawned several methodological advances in the biological and molecular sciences (e.g., DNA chip technology and microarray analysis), enabled quantum leaps in molecular and submolecular medicine, and catalyzed the emergence of whole new fields of study such as proteomics, phenomics, nutrigenomics, and pharmacogenetics. Perhaps, in like manner, with the emergence of eHealth, the behavioral and population sciences may be on the verge of a similar information technology-based scientific revolution. New eHealth solutions may soon permit the real-time integrative utilization of vast amounts of behavioral-, biological-, and community-level information in ways not previously possible. Behavioral algorithms and decision support tools for scientists could facilitate the analysis and interpretation of population level data to enable the development of "community (population) arrays" or community-wide risk profiles, which in turn could form the foundation of a new "populomics" (Gibbons 2005).

This confluence of three seemingly disparate concepts (population science, medicine and informatics) has parallels with the growing field of KM. It has been argued that such improvements and improvements in disciplines as supposedly diverse as organizational behavior, ICT, teamwork, artificial intelligence, leadership, training, motivation and strategy have been equally applicable and relevant in the clinical and healthcare sectors as they have been in others. Clinicians and managers have used many of these disciplines (in combination) many times before; they may have, inadvertently and partially, carried out knowledge management *avant la lettre* (Bali et al. 2005a).

Understanding and disentangling the myriad determinants of disease, particularly within the context of urban health or health disparities (inequalities in health), requires a transdisciplinary approach. Transdisciplinary approaches draw on concepts from multiple scientific disciplines to develop integrated perspectives from which to conduct scientific investigation and provide needed care. Attempts to organize and understand complex bio-socio-behavioral systems have led some researchers to *Chaos Theory* and *Complexity Theory* as constructs to facilitate the understanding about health and its relationship to diverse processes and outcomes (Garfinkel et al. 1992; Weiss et al. 1994; Olsen and Schaffer 1990; Tidd et al. 1993). In reality though, it is likely that these approaches are beyond the practical usefulness of many clinicians and scientists. Recently, elaboration of the Sociobiologic Integrative Model (SBIM) has been advanced as a theoretic construct to facilitate the integration of knowledge from many different fields (Gibbons et al. 2007). Utilizing the SBIM along with the principles of KM may offer health disparities researchers and clinicians providing care in the urban environment significant promise towards the quest to improve Urban Health and eliminate health disparities/inequalities.

1.5 Concluding Remarks

KM is a still relatively new phenomenon and a somewhat nebulous topic that needs to be explored. However, organisations in all industries, both large and small, are racing to integrate this new management tool into their infrastructure. Essentially, it embodies organisational processes that seek synergistic combination of data and information processing capacity of information technologies, and the creative and innovative capacity of human beings. For any healthcare organization to succeed, it needs to excel in a number of key processes (i.e., patient diagnosis, care treatment, etc.) that are necessary for it to achieve its mission. If the processes are repetitive, automation is possible via the use of IT (Bali et al. 2005). Medical knowledge stems from scores of multiple sources. The design principles for the management of knowledge sharing and its global impact are a complex mix of issues characterized by varying cultural, legal, regulatory, and sociological determinants (Laxminarayan 2005).

Because such knowledge has been created by humans, as a result of interpreting information (e.g., critically appraising journal articles and making sense of health sites on the internet), there is a level of subjectivity which can create

uncertainty; there is an inherent risk of misinterpretation when the user does not possess skills for making sound judgements about the extent to which this knowledge applies to his or her problem situation (Bali et al. 2005). The major value of KM is to generally aid in the elucidation of new medical knowledge not just in the quest to improve the quality of medical care, but also specifically in the generation of new clinical interventions as well as the reduction and ultimate elimination of inequalities in health and health disparities.

KM then can be seen to afford many advantages to enabling cost effective, high quality urban healthcare to ensue as we discuss in this chapter; but of even greater appeal is that these techniques are relevant to both the clinical practice and administrative management concerns of urban healthcare, thereby making them a most powerful and apropos remedy to the numerous maladies and challenges currently facing healthcare. Therefore, we believe that KM is a critical necessity for any forward thinking urban healthcare organization.

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Chapter 2

Healthcare Knowledge Management: Incorporating the Tools Technologies Strategies and Process of KM to Effect Superior Healthcare Delivery

Nilmini Wickramasinghe

Abstract As medical science advances and the applications of information and communications technologies (ICTs) to healthcare operations diffuse more and more data and information begin to permeate healthcare databases and repositories. However, given the voluminous nature of these disparate data assets, it is no longer possible for healthcare providers to process these data without the aid of sophisticated tools and technologies. The goal of knowledge management is to provide the decision maker with appropriate tools, technologies, strategies and processes to turn data and information into valuable knowledge assets. The following discusses the benefits of incorporating these tools and techniques to the healthcare arena in order to make healthcare delivery more effective and efficient, and thereby maximise the full potential of all healthcare knowledge assets. To ensure a successful knowledge management initiative in a healthcare setting the chapter proffers the knowledge management infrastructure (KMI) framework and intelligence continuum (IC) model. The benefits these techniques lie not only the ability of making explicit the elements of these knowledge assets, and in so doing enable their full potential to be realized, but also to provides a systematic and robust approach to structuring the conceptualization of knowledge assets across a range of healthcare environments as the case study data presented demonstrates.

Keywords Knowledge management • Data mining • Business intelligence • Knowledge management infrastructure • Knowledge assets • Intelligence continuum • Healthcare • Healthcare delivery

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2.1 Introduction

Knowledge management is an emerging management technique that is aimed at solving the current business challenges to increase efficiency and efficacy of core business processes while simultaneously incorporating continuous innovation. The premise for the need for knowledge management is based on a paradigm shift in the business environment where knowledge is central to organizational performance (Drucker 1993, 1999).

Knowledge management offers organizations many tools, techniques and strategies to apply to their existing business processes. Healthcare is an information rich industry that offers a unique opportunity to analyze extremely large and complex data sets. The collection of data permeates all areas of the healthcare industry and when coupled with the new trends in evidence-based medicine and electronic medical record systems, it is imperative that the healthcare industry embraces the tools, technologies, strategies and processes of knowledge management if it is to fully realize the benefits from all these data assets.

The successful application knowledge management hinges on the development of a sound knowledge management infrastructure and the systematic and continuous application of specific steps supported by various technologies. This serves to underscore the dynamic nature of knowledge management where the existing extant knowledge base is always being updated. The knowledge management infrastructure (KMI) framework not only helps organizations to structure their knowledge assets but also make explicit the numerous implicit knowledge assets currently evident in healthcare (Wickramasinghe and Davidson 2004), while the intelligence continuum (IC) provides the key tools and technologies to facilitate superior healthcare delivery (Wickramasinghe and Schaffer 2006). Taken together, the KMI and IC can enable healthcare to realize its value proposition of delivering effective and efficient value added healthcare services.

2.2 Knowledge Management

“Land, labor, and capital now pale in comparison to knowledge as the critical asset to be managed in today’s knowledge economy.” Peter F. Drucker (1999, p. 47)

The nations that lead the world into the next century will be those who can shift from being industrial economies, based upon the production of manufactured goods, to those that possess the capacity to produce and utilize knowledge successfully. The focus of the many nations’ economy has shifted first to information-intensive industries such as financial services and logistics, and now toward innovation-driven industries, such as computer software and biotechnology, where competitive advantage lies mostly in the innovative use of human resources. This represents a move from an era of standardization to an era of innovation where knowledge, its creation and management hold the key to success (Bukowitz and Williams 1997; Drucker 1993, 1999).

Knowledge management is a key approach to help solve current business problems such as competitiveness and the need to innovate that are faced by organizations today. The premise for knowledge management is based on a paradigm shift in the business environment where knowledge is central to organizational performance (Swan et al. 1999; Newell et al. 2002). In essence, knowledge management not only involves the production of information but also the capture of data at the source, the transmission and analysis of this data as well as the communication of information based on or derived from the data to those who can act on it (Davenport and Prusak 1998). Thus, data and information represent critical raw assets in the generation of knowledge while successful knowledge management initiatives require a tripartite view; namely the incorporation of people, processes and technologies (Wickramasinghe 2003).

Broadly speaking, knowledge management involves four key steps of creating/generating knowledge, representing/storing knowledge, accessing/using/re-using knowledge, and disseminating/transferring knowledge (Davenport and Prusak 1998; Markus 2001; Alavi and Leidner 2001; Wickramasinghe 2004a, b, c). Knowledge creation, generally accepted as the first step for any knowledge management endeavor, requires an understanding of the knowledge construct as well as its people and technology dimensions. Given that knowledge creation is the first step in any knowledge management initiative, it naturally has a significant impact on the other consequent KM steps, thus making the identification of and facilitating of knowledge creation a key focal point for any organization wanting to fully leverage its knowledge potential.

Knowledge, however is not a simple construct. Specifically, knowledge can exist as an object, in essentially two forms; explicit or factual knowledge and tacit or “know how” (Polanyi 1958, 1966). It is well established that while both types of knowledge are important, tacit knowledge is more difficult to identify and thus manage (Nonaka 1994; Nonaka and Nishiguchi 2001). Of equal importance, though perhaps less well defined, knowledge also has a subjective component and can be viewed as an ongoing phenomenon, being shaped by social practices of communities (Boland and Tenkasi 1995). The objective elements of knowledge can be thought of as primarily having an impact on process while the subjective elements typically impact innovation (Wickramasinghe 2003). Enabling and enhancing both effective and efficient processes as well as the functions of supporting and fostering innovation are key concerns of knowledge management.

Organizational knowledge is not static; rather it changes and evolves during the lifetime of an organization. What is more, it is possible to transform one form of knowledge into another; i.e., transform tacit knowledge into explicit and vice versa (Wickramasinghe 2004a, b, c). This process of transforming one form of knowledge into another is known as the knowledge spiral (Nonaka 1994). Naturally, this does not imply one form of knowledge is necessarily transformed 100% into another form of knowledge. According to Nonaka (1994): (1) Socialization or tacit to tacit knowledge transformation usually occurs through apprenticeship type relations where the teacher or master passes on the skill to the apprentice. (2) Combination or explicit to explicit knowledge transformation usually occurs via formal learning

of facts. (3) Externalization or tacit to explicit knowledge transformation usually occurs when there is an articulation of nuances; for example, if an expert surgeon is questioned as to why he performs a particular surgical procedure in a certain manner, by his articulation of the steps the tacit knowledge becomes explicit. (4) Internalization or explicit to tacit knowledge transformation usually occurs when explicit knowledge is internalized and can then be used to broaden, reframe and extend one's tacit knowledge. Integral to these transformations of knowledge through the knowledge spiral is that new knowledge is being continuously created (ibid) and this can potentially bring many benefits to organizations. What becomes important then for any organization in today's knowledge economy is to maximize the full potential of all its knowledge assets and successfully make all germane knowledge explicit so it can be used effectively and efficiently by all people within the organization as required (Wickramasinghe 2004a, b, c).

Healthcare is an industry currently facing major challenges at a global level (Wickramasinghe and Silvers 2003; Wickramasinghe and Schaffer 2006). This industry has yet to embrace knowledges management. Yet, KM appears to provide several viable possibilities to address the current crisis faced by global healthcare in the areas of access, quality and value (Wickramasinghe and Schaffer 2006). In healthcare, one of the most critical knowledge transformations to effect is that of tacit to explicit; i.e., externalization so that the healthcare organization can best leverage its knowledge potential to realize the healthcare value proposition (Wickramasinghe et al. 2005). Integral to such a process is the establishment of a robust knowledge management infrastructure and the adoption of key tools and techniques. This is achieved by the application of the KMI and IC models.

2.3 Establishing a Knowledge Management Infrastructure

The most valuable resources available to any organization are human skills, expertise, and relationships. Knowledge Management (KM) is about capitalizing on these precious assets (Duffy 2001). Most companies do not capitalize on the wealth of expertise in the form of knowledge scattered across their levels (Duffy 2000, 2001). Information centers, market intelligence, and learning are converging to form knowledge management functions. Knowledge management offers organizations many strategies, techniques and tools to apply to their existing business processes so that they are able to grow and effectively utilize their knowledge assets. The KM infrastructure not only forms the foundation for enabling and fostering knowledge management, continuous learning and sustaining an organizational memory (Drucker 1999) but also provides the foundations for actualizing the four key steps of knowledge management; namely, creating/generating knowledge, representing/storing knowledge, accessing/using/re-using knowledge, and disseminating/transferring knowledge (discussed in Sect. 2.2). An organization's entire "know-how", including new knowledge, can only be created for optimization if an effective KM infrastructure is established. Specifically, the KM infrastructure

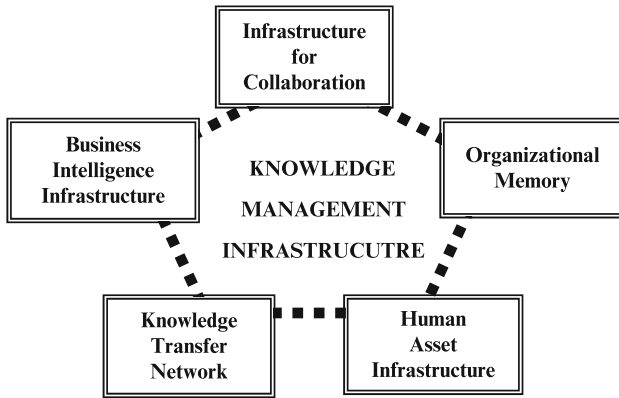


Fig. 2.1 Key elements that constitute the knowledge management infrastructure. (adapted from Wickramasinghe and Sharma 2004)

consists of social and technical tools and techniques, including hardware and software that should be established so that knowledge can be created from any new events or activities on a continual basis. In addition, the KM infrastructure will have a repository of knowledge, systems to distribute the knowledge to the members of the organization and a facilitator system for the creation of new knowledge. Thus, a knowledge-based infrastructure will foster the creation of knowledge, and provide an integrated system to share and diffuse the knowledge within the organization (Srikantaiah 2000) as well as support for continual creation and generation of new knowledge (Wickramasinghe 2003). The knowledge management infrastructure (KMI) depicted in Fig. 2.1 contains the five essential elements of organizational memory, human asset infrastructure, knowledge transfer network, business intelligence infrastructure and infrastructure for collaboration that together must be present for any KM initiative to succeed.

2.3.1 Element of the Knowledge Management Infrastructure

From Fig. 2.1 above it is possible to identify the five key elements that together make up the KM infrastructure. It can be seen that these elements support the socio-technical perspective of KM in that they consist of people process and technological aspects (Wickramasinghe 2004a, b, c). Let us examine each of them in more detail.

2.3.1.1 Infrastructure for Collaboration

The key to competitive advantage and improving customer satisfaction lies in the ability of organizations to form learning alliances; these being strategic partnerships

based on a business environment that encourages mutual (and reflective) learning between partners (Holt et al. 2000). Organizations can utilize their strategy framework to identify partners, and collaborators for enhancing their value chain.

2.3.1.2 Organizational Memory

Organizational memory is concerned with the storing and subsequent accessing and replenishing of an organization's "know-how" which is recorded in documents or in its people (Maier and Lehner 2000). However, a key component of knowledge management not addressed in the construct of organizational memory is the subjective aspect (Wickramasinghe 2003). Knowledge as a subjective component primarily refers to an ongoing phenomenon of exchange where knowledge is being shaped by social practices of communities (Boland and Tenkasi 1995), in the tradition of a Hegelian/Kantian perspective where the importance of divergence of meaning is essential to support the "sense-making" processes of knowledge creation (Wickramasinghe and Mills 2001).

Organizational memory keeps a record of knowledge resources and locations. Recorded information, whether in human-readable or electronic form or in the memories of staff, is an important embodiment of an organization's knowledge and intellectual capital. Thus, strong organizational memory systems ensure the access of information or knowledge throughout the company to everyone at any time (Croasdell 2001).

2.3.1.3 Human Asset Infrastructure

This deals with the participation and willingness of people. Today, organizations have to attract and motivate the best people; reward, recognize, train, educate, and improve them (Ellinger et al. 1999) so that the highly skilled and more independent workers can exploit technologies to create knowledge in learning organizations (Thorne and Smith 2000). The human asset infrastructure then, helps to identify and utilize the special skills of people who can create greater business value if they and their inherent skills and experiences are managed to make explicit use of their knowledge.

2.3.1.4 Knowledge Transfer Network

This element is concerned with the dissemination of knowledge and information. Unless there is a strong communication infrastructure in place, people are not able to communicate effectively and thus are unable to effectively transfer knowledge. An appropriate communications infrastructure includes, but is not limited to, the internet and intranets for creating the knowledge transfer network as well as discussion rooms, bulletin boards for meetings and for displaying information.

2.3.1.5 Business Intelligence Infrastructure

In an intelligent enterprise various information systems are integrated with knowledge-gathering and analyzing tools for data analysis, and dynamic end-user querying of a variety of enterprise data sources (Hammond 2001). Business intelligence infrastructures have customers, suppliers and other partners embedded into single integrated system. Customers will view their own purchasing habits, and suppliers will see the demand pattern which may help them to offer volume discounts etc. This information can help all customers, suppliers and enterprises to analyze data and provide them with the competitive advantage. The intelligence of a company is not only available to internal users but can even be leveraged by selling it to others such as consumers who may be interested in this type of informational intelligence.

2.3.2 The Intelligence Continuum

The Intelligence Continuum consists of a collection of key tools, techniques and processes of the knowledge economy; i.e., including data mining, business intelligence/ analytics and knowledge management which are applied to a generic system of people, process and technology in a systematic and ordered fashion (Wickramasinghe and Fadlalla 2004; Wickramasinghe and Schaffer 2006; Wickramasinghe and Silvers 2003; Wickramasinghe and Lichtenstein 2005; Wickramasinghe et al. 2005). Taken together they represent a very powerful system for refining the data raw material stored in data marts and/or data warehouses and thereby maximizing the value and utility of these data assets for any organization (Geisler 1999, 2000, 2001, 2002; Geisler and Wickramasinghe 2006, Kostoff and Geisler 1999). As depicted in Fig. 2.2 the intelligence continuum is applied to the output of the generic healthcare information system. Once applied, the results become part of the data set that are reintroduced into the system and combined with the other inputs of people, processes, and technology to develop an improvement continuum. Thus, the intelligence continuum includes the generation of data, the analysis of these data to provide a “diagnosis” and the reintroduction into the cycle as a “prescriptive” solution. In this way, the next iteration, or “future state” always represents the enhancement of the extant knowledge base of the previous iteration. For the IC to be truly effective however, the KMI must already be in place so that all data, information and knowledge assets are explicit and the technologies of the IC can be applied to them in a systematic and methodical fashion.

2.4 Case Study

This case study focuses on a well renowned Spine Unit in the Mid-west of the US. It is possible to define this environment as a cure environment since the primary goal of this Spine Unit is to return patients to normal life activities. The following serves to furnish the key elements from this environment as they pertain to knowledge

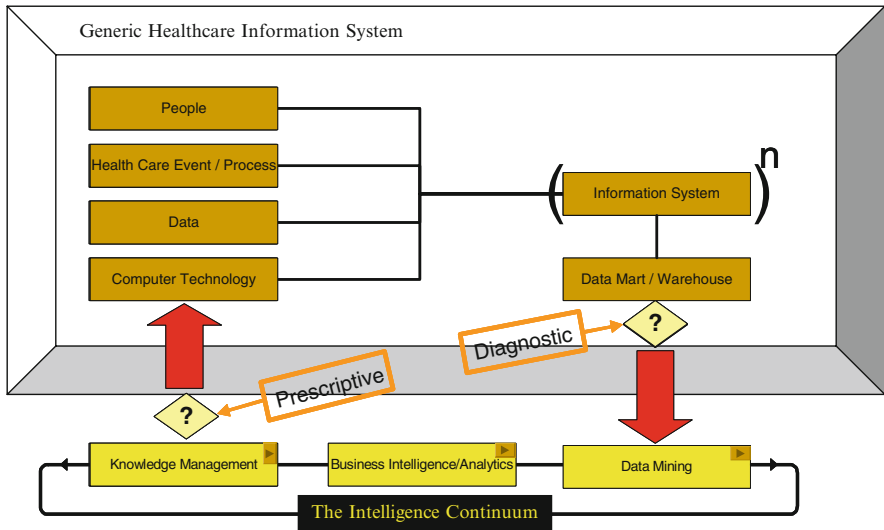


Fig. 2.2 Application of the intelligence continuum on the generic healthcare system

management, its benefits and applications in this setting. Exploratory case study research was adopted to enable the generation of rich data in a non restrictive manner. Information was gathered from several sources including semi-structured interviews, the collecting of germane documents and memos, numerous site visits and the direct observation of various procedures; thus enabling the triangulation among different data sources (Eisenhardt 1989). Rigorous coding and extensive thematic analysis was conducted to analyze the qualitative data gathered (Kavale 1996; Boyatzis 1998). Each of the points listed was confirmed by multiple interviews, written documentation and passive observation; thus ensuring the highest level of reliability possible for qualitative research (Boyatzis 1998).

2.4.1 Background for Case

In the U.S., the healthcare industry is in a state of flux (Applegate et al. 1986; Chandra et al. 1995; Malhotra 2000; Wolper 1995). ‘The rate of the rise in healthcare costs has been variable. The shocking increases experienced in the early 1990s, has slowed in the mid-and late 1990s, but there is no guarantee that they will continue to do so’ (Kongstvedt 1997, pp xvii). In other market places buyers are sensitive to the price of the product and undertake cost-benefit analysis. ‘In the medical market place, however, the buyers and users of medical services and technologies have been relatively insensitive to the cost of these services’ ... ‘The traditional financing and reimbursement policies of the healthcare industry are felt to be largely responsible for this price insensitivity, inhibiting the forces of competitive supply and demand economics’ (Applegate et al. 1986, pp. 80). As a result, there is

increased pressure on providers of medical care to develop ways to control and manage costs as well as increase productivity without compromising quality. In an attempt to stem the escalating costs of healthcare, managed care has emerged. It is aimed at creating value through competition in order to combat ‘...an extremely wasteful and inefficient system that has been bathed in cost-increasing incentives for over 50 years’ (Enthoven 1993, p. 40). The intended result is to provide adequate quality healthcare and yet minimize, or at least reduce, costs.

Managed Care Organizations (MCOs) contract with individuals, employers and other purchasers to provide comprehensive healthcare services to people who enroll in their health plans. The essential difference between MCOs and more traditional types of medical care is connected with the distribution of financial risk among the purchaser of healthcare, the provider of the care and the insurer (Knight 1998). ‘MCOs typically reduce this financial risk for the purchaser of healthcare insurance by guaranteeing a comprehensive range of services at a fixed price to them. To do this of course, the MCO must keep the use of healthcare resources within a budget; thus making critical a focus on managing medical care’ (Wickramasinghe and Silvers 2003). This then represents a radical change to the traditional healthcare environment where quality irrespective of cost was the goal. The new goal is cost effective quality care and thus also demands a more competitive healthcare environment.

2.4.2 Spine Care

Nearly everyone experiences back or neck pain at some time during their life. Pain or disability can be caused by injuries sustained at home or work, while involved in sports or recreation, during accidents or falls or from medical conditions, such as arthritis, osteoarthritis or osteoporosis. The Spine Unit is part of a large multispecialty group practice and academic medical center located in the Midwest of the US. This Center is actually made up of surgeons and medical staff from the department of Neurology and Neurosurgery and the department of Orthopedics. A co-operation of the surgeons of these two departments has led to the Spin Unit where more than 9,000 patients with spinal problems are treated annually. The multidisciplinary team in this setting consists of experienced spine surgeons, well trained psychologists, physical therapists, OR personnel and laboratory pathology experts. The multidisciplinary team works with well-established proven protocols. Naturally with back and neck complaints the process cannot be the same for every patient, rather is dependent on the specific complaint the patient has.

2.4.3 Technologies

In order for the Spine Unit to achieve its goal of providing high quality treatment to patients suffering from various back and neck complaints many key factors must

be addressed concerning both the clinical and practice management issues. Technologies of various types play a key role in enabling effective and efficient high quality treatments at the Center. The clinical technologies include the laboratory and radiology facilities to enable best possible detection of the specific complaint, as well as the technologies to support the treating of this complaint especially if surgery is the course of action; for example the use of image-guided spinal navigation to facilitate the accuracy, precision and safety of spinal instrumentation and reduction in operative time or laparoscopic or endoscopic procedures to minimize invasive spinal surgery. On the practice management side, the technologies include the HMIS (Hospital Management Information System) in place. Table 2.1 describes the systems that comprise the HMIS.

Table 2.1 Systems comprising HMIS

System	Description
HIS (Hospital Information Systems)	Provide integrative medical and clinical information support services using a variety of computer services that are linked with high speed networks
ES (Expert Systems)	Provide expert consultation to end-user for solving specialized and complex problems
CMS (Case Management Systems)	Evolved recently as a result of a growing trend of integrating health service delivery both vertically (coordinating clinical care across providers i.e., between surgeons and physical therapy) and horizontally (linking institution providing the same types of treatments) Another feature of these systems is that they enable case mix applications and thus provide the capability and flexibility of integrating financial and clinical data. The benefits of this cannot be understated
HDBMS (Health Database Management Systems)	Have been used extensively in some hospital settings. HDBMS refer to a Repository of logically organized facts and figures which query facilities. A typical example of such a HDBMS is the automated patient record system. These systems also enable data mining and other data analysis techniques to be used with the help of OLAP (on-line analytic processes) features so that it will be able to analyze cumulative treatments and thus update, revise or adjust practice protocols as required. This will of course ensure the Spine Unit maintains its high standard of offering best possible services to its patients
GDSS (Group Decision Support Systems)	Involve the use of interactive, computer based systems that facilitate the search for solutions to semi-structure and unstructured problems shared by groups. Once again these systems will benefit the quality of the patient treatment by supporting decision making processes regarding patient treatments made within the Spine Unit

2.4.4 Structure

The spine is a very complex part of the human anatomy. Bones and nerves play a central role in the well functioning back and neck. Given the inherent complexity with the spine, it is understandable that for high class spine care a multidisciplinary team made up of neurology, neurosurgery and orthopedics is central to the care of spine patients. In addition to these disciplines, it is also important to incorporate other disciplines such as physical therapy, pain management and psychiatry. Thus, what we can see is that in spine care the use of multidisciplinary teams is critical to the cure process.

2.4.5 Knowledge Management in the Spine Unit

Modern medicine generates huge amounts of heterogeneous data on a daily basis. For example, medical data may contain SPECT images, signals like EKG, clinical information like temperature, cholesterol levels, etc., as well as the physician's interpretation. Add to all of this the daily mountains of data accumulated from a healthcare organization's administrative systems. Those who deal with such data understand that there is a widening gap between data collection and data comprehension and analysis. These data represent raw assets that need to be converted into knowledge via information. Technologies play a significant role in facilitating the transformation of raw data assets into knowledge, this is done in many ways including application of data mining tools to just providing a structure and context for apparently disparate data elements so that they can be viewed as a whole within a specific context typically a case scenario, this in turn then supports critical decision making (Wickramasinghe et al. 2003). Integral to any sound knowledge management strategy within a healthcare organization is the transformation of these data and information assets into germane knowledge (Sharma et al. 2004). However, in order to do this both effectively and systematically it is necessary to have an organizing structured approach.

The HMIS in place at the Spine Unit help physicians as well as administrators to address this problem by enabling these raw data assets to be transformed into information and knowledge. At the clinical level, for example, the HMIS help in early detection of diseases from historical databases of symptoms and diagnosis – thus providing an early warning system that leads to a much more effective quality treatment. At the hospital administration level, for example, the HMIS help in tracking certain kinds of anomalies, which may reveal areas of improvement and may help the realignment of certain kinds of resources (e.g., equipment, personnel...). The major reason for the specific HMIS in place is to support delivery of quality healthcare in a cost-effective manner. These systems are considered to be very sophisticated systems in the current healthcare market. The systems uses NCQA (National Committee for Quality Assurance) standards and data gathered

by the Spine Unit; i.e., findings from key medical journals such as The New England Journal of Medicine or Journal of American Medicine, as well as data generated and analyzed from Center's own data base of patient history. These standards are continually updated and revised as new findings become available.

The systems therefore, not only enable the physicians to perform their work more effectively and efficiently as well as render high quality services to their patients, but also provide them with care parameters. This helps to enforce practice guidelines; in addition, it provides peer data on providers which enables benchmarking for specific treatments in terms of costs, length of stay and other key variables to be calculated. The systems also enable the center to understand the occurrence of outliers; i.e., physicians' practice patterns can be studied to understand why they are outliers and then, if necessary, to change inappropriate behavior and thereby support effective and efficient delivery of healthcare. Physicians play an active role with defining the criteria and characteristics of the functions of the systems. This is an example of a knowledge creating/renewal aspects enabled and supported by the system. In addition, the systems facilitate the sharing of knowledge, enabling discourse and discussion between physicians and other members of the multidisciplinary team. Thus, in an ad hoc fashion, the HMIS are supporting the four key knowledge transformations of combination, internalization, externalization and socialization. However, without a structured systematic approach; i.e., given the ad hoc nature of these knowledge transformations, it is reasonable to expect that the Spine Unit is not fully maximizing the potential of these knowledge assets. We assert that the full potential of these knowledge assets can be realized through the establishment of a knowledge management infrastructure.

2.5 Discussion

From the data presented on the Spine Unit in Sect. 2.3, it is possible to observe that the Spine Unit has a significant investment in technology both at the clinical and practice management levels. On the clinical side there are various technologies that facilitate speedy detection and then enable the subsequent cure to be effective and efficient; hereby, ensuring a high standard of quality treatment is experienced by the patient. On the practice management side the HMIS are crucial. When the Spine Unit is analyzed through the lens of knowledge management, the relevant technologies become those on the practice management level; namely the technologies that make up the HMIS. These various technology systems (which make up the generic healthcare information system of the spine unit and are described in Table 2.1) form the collection of key data and information and then through various interactions of members of the multidisciplinary team with these technologies, protocols and treatment patterns are changed or developed; i.e. through the interactions of both people and technologies these raw data and informational assets are transformed into knowledge assets. Table 2.2 identifies each relevant case element in terms of the KMI framework presented earlier.

Table 2.2 Relevant case elements in terms of the knowledge management infrastructure model

Element of the KM infrastructure	Case study element
Infrastructure for collaboration	<p>Primarily via the HIS – the system provides the forum for the exchanging of patient data and medical information between members of the multidisciplinary team</p> <p>Also the GDSS – this provides the opportunity to share and discuss treatment options amongst members of the multidisciplinary team in an efficient and effective fashion</p> <p>For example when looking at a patient who had spinal fusion – neuro-surgeons and orthopedic surgeons have the infrastructure to easily exchange key information and data in an organized and systematic fashion regarding the best procedure to follow and how to proceed on such a procedure. Such interactions support the knowledge transformations, in particular externalization</p>
Organizational memory	HDBMS – the database stores large volumes of data pertaining to treatments, key protocols and statistics regarding cure options as well as lessons learnt pertaining to various cure strategies
Human asset infrastructure	Multidisciplinary spine care team – the combination of highly trained specialists from neurology, neurosurgery and orthopedics as well as psychologists, physical therapists OR personnel and lab/radiology experts are all vital to ensuring a proper cure outcome
Knowledge transfer network	<p>Primarily via the GDSS – the creation of new knowledge as well as the possibilities to discuss and debate appropriate cure strategies to various cases is enabled and facilitated</p> <p>Also via HIS – the ability to access complete medical records and their by develop a clear understanding of the patients true history is supported via the HIS, in addition it is possible to access the latest medical findings via this system</p> <p>Once again key knowledge transformations are supported in a systematic and structured fashion including combination and externalization</p>
Business intelligence infrastructure	CMS – the case mix data and information stored on this system as well as the ability of the system to link both vertically and horizontally enables integration across the Spine Unit resulting in supporting the business infrastructure

What can be seen then, is a very heavy investment in the business intelligence infrastructure; i.e. HMIS which are facilitating the knowledge transfer, maintaining the organizational memory and enabling the collaboration of the multidisciplinary team in a very effective and efficient fashion. The Spine Unit has highly trained specialists who are encouraged to always keep at the cutting edge of new techniques

for achieving better results and higher quality outcomes, with a strong emphasis on continuous improvement, they impart and exchange the knowledge and skills gained via interacting with the GDSS and the HIS components of the HMIS.

From Table 2.2, one can see that in this cure setting the knowledge management infrastructure is established and sustained through the technologies in place. By explicitly identifying the components of the knowledge management infrastructure in the Spine Unit case study, it is possible to make explicit the knowledge assets currently in place and thereby, facilitate better management of these knowledge assets as well as maintain and update the knowledge management infrastructure itself as it becomes possible to identify key knowledge transformations in a systematic fashion. Technologies are continuously changing and when new technologies are added to the Spine Unit it will then be possible to also evaluate their role in sustaining and supporting the existing knowledge management infrastructure. Furthermore, by making explicit the elements within the knowledge management infrastructure as they occur in the case study, it is possible to get a feel for the relative complexity of various tasks and processes that are evidenced in the Spine Unit and thus be able to evaluate these to identify if modifications are required or how best to support them. It is therefore, not only possible to identify elements of the knowledge management infrastructure within the Spine Unit, but by doing so one can ensure that the knowledge management processes that occur are supported and enhanced so that the primary goal of cure for the patient is indeed realized. In addition the knowledge management infrastructure facilitates the knowledge transformations of the knowledge spiral which in turn serve to increase the extant knowledge base of the organization and thus enabling the spine unit to maximize the full potential of its knowledge assets. Moreover, once such a KMI is established it is possible then to apply the IC to the data and information stored and generated throughout the healthcare setting so superior healthcare decisions can be made as the following example from the orthopedic operating room highlights (Wickramasinghe and Schaffer 2006).

The orthopedic operating room represents an ideal environment for the application of a continuous improvement cycle that is dependent on the Intelligence Continuum. For those patients with advanced degeneration of their hips and knees, arthroplasty of the knee and hip represent an opportunity to regain their function. Before the operation ever begins in the operating room, there are a large number of interdependent individual processes that must be completed. Each process requires data input and produces a data output such as patient history, diagnostic test and consultations. From the surgeon's and hospital's perspective, they are on a continuous cycle. The interaction between these data elements is not always maximized in terms of operating room scheduling and completion of the procedure. Moreover, as the population ages and patient's functional expectations continue to increase with their advanced knowledge of medical issues; reconstructive orthopedic surgeons are being presented with an increasing patient population requiring hip and knee arthroplasty. Simultaneously, the implants are becoming more sophisticated and thus more expensive. In turn, the surgeons are experiencing little change in system capacity, but are being told to improve efficiency and output, improve procedure time and eliminate redundancy. However, the system legacy is for insufficient room

designs that have not been updated with the introduction of new equipment, poor integration of the equipment, inefficient scheduling and time consuming procedure preparation. Although there are many barriers to Re-Engineering the Operating Room such as the complex choreography of the perioperative processes, a dearth of data and the difficulty of aligning incentives, it is indeed possible to effect significant improvements through the application of the intelligence continuum.

The entire process of getting a patient to the operating room for a surgical procedure can be represented by three distinct phases: preoperative, intraoperative and postoperative. In turn, each of these phases can be further subdivided into the individual yet interdependent processes that represent each step on the surgical trajectory. As each of the individual processes are often dependant on a previous event, the capture of event and process data in a data warehouse is necessary. The diagnostic evaluation of this data, and the re-engineering of each of the deficient processes will then lead to increased efficiency. For example, many patients are allergic to the penicillin family of antibiotics that are often administered preoperative in order to minimize the risk of infection. For those patients who are allergic, a substitute drug requires a 45 minute monitored administration time as opposed to the much shorter administration time of the default agent. Since the antibiotic is only effective when administered prior to starting the procedure, this often means that a delay is experienced. When identified in the preoperative phase, these patients should be prepared earlier on the day of surgery and the medication administered in sufficient time such that the schedule is not delayed. This prescriptive reengineering has directly resulted from mining of the data in the information system in conjunction with an examination of the business processes and their flows. By scrutinizing the delivery of care and each individual process, increased efficiency and improved quality should be realized while maximizing value. For knee and hip arthroplasty, there are over 432 discrete processes that can be evaluated and reengineered as necessary through the application of the Intelligence Continuum (Schaffer et al. 2004).

2.6 Conclusion

Healthcare globally is facing many challenges including escalating costs and more pressures to deliver high quality, effective and efficient care. By nurturing knowledge management and making their knowledge assets explicit, healthcare organizations will be more suitably equipped to meet these challenges; since knowledge holds the key to developing better practice management techniques, while data and information are so necessary in disease management and evidence-based medicine. The case study data presented depicted the complexity of the service delivery process, driven by the complexity of the issues being dealt with by the teams, which in turn requires that many disciplines create and share knowledge to enable the delivery of a high quality of care. Thus the need for shared knowledge is a fundamental requirement. The KMI was presented and used to structure these disparate knowledge

assets as explicit and integrated within a larger system, the generic healthcare information system, that allowed analysis of the extent of the knowledge management infrastructure for the Spine Unit. Further, such a framework in particular supports in a systematic and structured fashion all four key knowledge transformations identified by Nonaka (1994), in particular that of externalization (tacit to explicit). To this generic healthcare information system the application of the IC ensures that maximisation of appropriate and germane knowledge assets occurs and a superior future state will be realised.

On analyzing the case data with the KMI framework and IC model the benefits to healthcare of embracing KM become clearly apparent. Given the challenges faced by healthcare organizations today, the importance of knowledge management, understanding the means available to support knowledge management and explicitly developing and designing an appropriate healthcare information system using the KMI framework and then applying to this the IC model is indeed of strategic significance especially as it serves to facilitate the realization of the value proposition for healthcare. In closing then, this chapter calls for similar applications of KM principles, most especially the KMI framework and IC model into the urban health setting. It is envisaged that such initiatives will also realise success and superior healthcare delivery.

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Chapter 3

Knowledge Management in the Urban Health Context: Moving Towards Tacit-to-Tacit Knowledge Transfer

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Abstract Knowledge Management (KM) has made a significant impact on the global healthcare sector. However, it is important to address the link between knowledge, information and engineering. This paper discusses how concepts from the established KM field can be applied to the area of urban health. Explicit and tacit modes of knowledge transfer are presented and discussed. We conclude by advocating “tacit-to-tacit” knowledge transfer as the most useful method to overcoming knowledge gaps in the urban health setting.

Keywords Knowledge transfer • Tacit • Creation • Stimuli • Gaps

3.1 Introduction

Like many abstract entities, the concept of knowledge also differs according to the context in which it is interpreted – it may be as an object that might be identified, created, captured, stored and accessed or as a process that has a strong human-centric orientation in culture, trust, beliefs and values (Miller et al. 2002; Nonaka et al. 1995). Healthcare institutions have now realized the true potential of knowledge and are trying, in various ways, to move forward in the new “knowledge era”. Whether knowledge is interpreted as an object or as a process (McElroy et al. 2003), the business world has also accepted that knowledge is the way forward (Paul et al. 2002), especially in organizations where the prime deliverable is

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service-oriented (such as healthcare). Knowledge richness makes healthcare the most receptive domain for KM-based improvements. Due to the fact that a large volume of healthcare knowledge is being lost because of its tacit-bias, even the smallest effort for managing this tacit knowledge can result in huge resource savings (Burns et al. 2003).

3.2 Knowledge Management

The term “knowledge” is often misunderstood and misinterpreted as it exhibits both physical and mental characteristics (Miller et al. 2002; Breen et al. 1997). All organizational domains, including healthcare, have embraced the concept of managing knowledge as the primary way of effective management for the future (Paul et al. 2002). Domains predominantly focused in the aspect of service provision are more directly influenced and affected by “right or wrong” choices made towards implementing Knowledge Management (KM). Service-based domains (such as healthcare) are more influenced by these choices as such domains are “knowledge rich”. They are therefore prone to become breeding grounds for the creation of knowledge gaps (often referred to as “islands” or “silos”). Eventually, this can lead to knowledge deprivation at the required point of delivery, ultimately losing the competitive edge (Rodrigo et al. 2001; Smith et al. 2000).

The fact that modern day organizations are facing a deluge of data and information whilst simultaneously lacking knowledge is very well documented (Liebowitz and Beckman 1998; Sieloff et al. 1999). Technological innovations relating to workflow and such technologies as groupware systems have brought about a radical transformation in the way organizations can interact both internally and externally. These new ways of collaboration have resulted in organizations being inundated with information to an unprecedented degree resulting in data and information overload (Sieloff et al. 1999; Cothrel et al. 1999; Drucker 1998). It has been said that knowledge is an inherent characteristic of the human brain (Baskaran et al. 2006). IT has opened a new vista for replicating this ability to a degree through techniques as Artificial Intelligence (AI). Despite such technological breakthroughs, the ability of machines to imitate human cognition is very limited. One of the promising areas for AI is in prediction (Baskaran et al. 2006) but even this is when there are a number of factors that are involved and a suitable training data set is available (Protti 2005).

Technologies such as data integration, document and content management (support applications enabling users to have personalized access to the organizational knowledgebase) continue to grow at an exponential rate (Bali et al. 2005). This has implications for decision makers across all sectors including healthcare, as they have to deal with large amounts of data (Bali 2005). One of the major challenges that face healthcare managers is how to make effective decisions based on the data at hand. It is acknowledged that the selection of a particular direction is both constrained and influenced by the availability of data,

the ability to transform data into information and then to make recognition of it by deriving knowledge from information. Practitioners then have to decide on how best to effectively transfer this knowledge on an organization-wide basis. KM tools and techniques are defined by their social and community role in the organization by way of:

- The facilitation of knowledge sharing and socialization of knowledge (production of organizational knowledge).
- The conversion of information into knowledge through easy access, opportunities of internalization and learning (supported by the right work environment and culture).
- The conversion of tacit knowledge into ‘explicit knowledge’ or information, for purposes of efficient and systematic storage, retrieval, wider sharing and application.

For the healthcare setting, knowledge deprivation can result in a loss of resources, making the care process inefficient (Burns et al. 2003). Confusion still exists in differentiating knowledge from information (Paul et al. 2002). In most cases, data is the point of origin for new knowledge creation within a typical knowledge cycle. Data can be viewed as a representation of unprocessed numbers, text and so forth. When given *context*, this same data is transformed into information. This same information, when assimilated by the cognitive environment recognizes similarities, connections or patterns in the information, paves the way to knowledge creation.

3.3 Tacit and Explicit Knowledge

Knowledge can be broadly classified as *tacit* when it is within the cognitive environment (e.g. a human brain) or *explicit* (Koskinen et al. 2003; Suliman et al. 2002), when the tacit knowledge is expressed for sharing (accompanied by the context of the created knowledge) through various tools (Baskaran et al. 2004). Until now, managing knowledge has been specifically focused on the explicit type since that is often the only method available for sharing knowledge (Timo et al. 2001). The irony of KM is that more importance is often given to technology-based aspects, rather than the more human-centric aspects (Timo et al. 2001). The healthcare domain not only provides challenging opportunities for managing knowledge but also is one of the domains where it is often most poorly understood and deployed.

This predicament is slowly being addressed as more and more KM focused projects are initiated and professionals with better understanding of KM are being involved (Open Clinical 2000). Any healthcare domain, whether primary care or secondary care in nature, relies on a lot of data and information flows. Similarly, modern day healthcare environments should also provide knowledge sharing through conducive and well established channels (Augier et al. 2001). Knowledge gaps can be circumvented through removing bureaucracy and formal channels.

This would pave the way to leveraging knowledge which has been created within the healthcare domain, thus increasing the overall efficiency in making well informed and correct clinical decisions (Ellingsen et al. 2003). The will to share knowledge has to originate from the human mind no matter what technological tools are available; the inclination to do so still has to be spontaneous and forthcoming. This aspect may be mapped to socio, cultural and moral ethics of the human beings involved in knowledge sharing (Baskaran et al. 2004). In healthcare, there is no one “silver bullet” solution that can successfully address the KM issues; rather, the whole organizational environment has to be aligned to encourage knowledge creation and knowledge sharing (Burns et al. 2003). Nonaka’s knowledge creation company concept and the SECI model (Nonaka et al. 1995; Kikawada et al. 2001) cannot be expected to justify the complex nature of modern day KM.

A radical new approach, focused on maximum knowledge sharing at a tacit-to-tacit level (Baskaran et al. 2004) would be an ideal beginning for the current KM challenges in healthcare. All projects in healthcare should be part of a KM initiative and all challenges should be approached through a KM perspective. This would provide a holistic approach and a successful strategy to enable innovation and success at all levels (Baskaran et al. 2004).

3.4 Information and Knowledge

A misconception exists in differentiating knowledge from information that has attracted a continued debate on the legitimacy of the KM paradigm itself (Wilson et al. 2002). The schematic depicted in Fig. 3.1 aims to differentiate between information and knowledge within a healthcare perspective. The figure’s analogy of data can be interpreted as a set of raw, unprocessed numbers. Contextual details when added to this set of data – such as (1) this dataset represents heart beats per minute and (2) pertaining to males aged 62 years – can add lucidity to the dataset provided, hence becomes information (Miller et al. 2002). When a heart specialist assimilates this information, a unique process (which is an inherent characteristic of the human brain) of identifying connections, similarities and patterns in the information provided using his earlier insight on the subject initiate new knowledge about the patient and may result in the conclusion of symptoms of Arrhythmia (Koskinen et al. 2003). Such knowledge cycles will contribute further knowledge creation and result in adding clarity and assist in achieving wisdom.

As a routine process of sharing this acquired knowledge, an individual has to resolve this issue through traditional knowledge sharing techniques such as writing notes, manuals, reports and books coupled with lectures, meetings and the like. The knowledge residing in the human brain is termed Tacit (or implicit) knowledge and the other externalized forms of it are termed Explicit (or expressed) knowledge. There is a grey area in differentiating the explicit knowledge to information. Under some circumstances, these can become interchangeable but the human context alone differentiates the information from explicit knowledge (Augier et al. 2001).

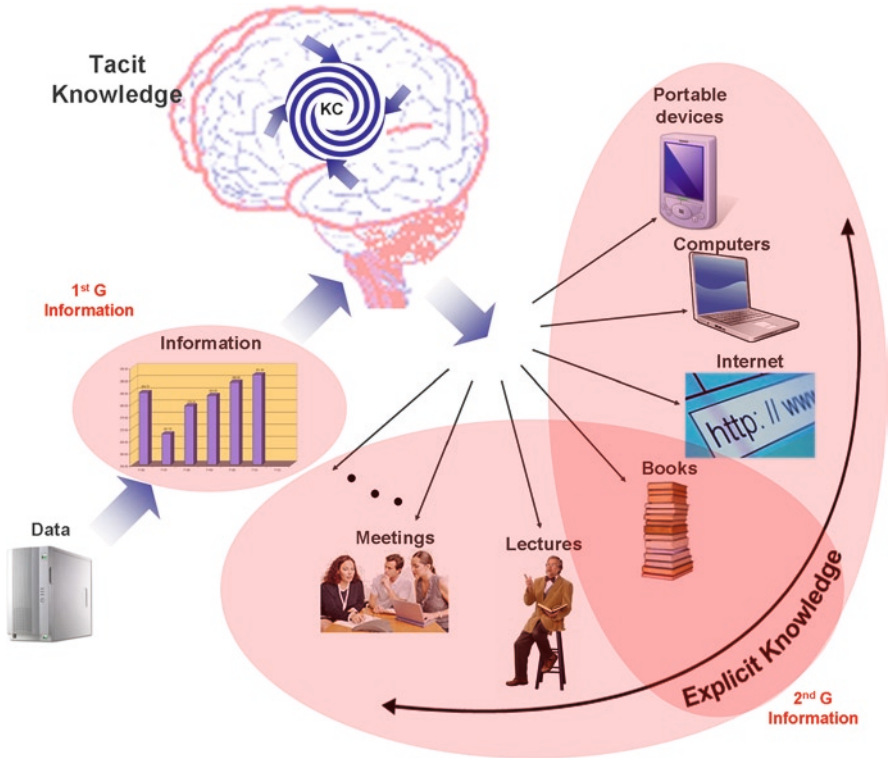


Fig. 3.1 Tacit and explicit knowledge

In expressing his tacit knowledge, the heart specialist resorts to the creation of notes based on the patient's information. This form of knowledge, when viewed by any individual from the heart specialist's perspective, is termed explicit knowledge. When the same notes are referred to, by a neurosurgeon for cerebrovascular accident diagnosis, the explicit knowledge created through these same notes become information (since the current interpretation of the notes has lost its creation context). Therefore the expressed knowledge viewed in the knowledge creator's context is explicit knowledge, but not otherwise (Rodrigo et al. 2001).

In spite of growing research interests shown in KM, we are yet to establish a universal approach towards the KM paradigm. It has been ascertained that KM is desirable and cannot be disregarded (Paul et al. 2002). Healthcare managers need to view KM as a holistic concept and not as another routine management process. KM has penetrated into all manner of industrial sectors but the healthcare sector has enjoyed particular focus as it embodies the most knowledge intensive activities and interacts directly with the public, thereby making it more critical and a prime candidate for KM based improvements. Physicians and medical experts agree that every patient scenario offers a unique experience which ranges from non-critical to life threatening (Ellingsen et al. 2003), hence knowledge gaps can be crucial in

making the right decisions during a healthcare intervention (Open Clinical 2000). Contemporary healthcare organizations are experiencing a huge shortage of experts in every field of medicine; new strategies are required to cope with the increased pressures from governments and the public (Suliman et al. 2002). Coupled with this, the healthcare informatics revolution has presented new challenges such as how to deal with information deluge and information overload. This has resulted in a slow shift from a pull strategy to a push strategy; KM is therefore viewed as the savior to deliver from the perils envisaged within healthcare organizations (Burns et al. 2003).

3.5 Knowledge Creation Stimuli

Knowledge Creation (KC) has been a core issue of the KM paradigm. KC in a cognitive sense is yet to be clearly understood. Experts do agree that knowledge is created by various stimuli (Kikawada et al. 2001). Managing KC literally means managing the knowledge-creating stimuli (depicted in Fig. 3.2). From the schematic: explicit knowledge stimuli range from physician's notes to well defined evidence-based healthcare standards which, when viewed from the KC context, offer the best stimuli for new KC (Burns et al. 2003; Koskinen et al. 2003). Interaction stimuli are often related to the iterative cycles of interactive communication between individuals and can culminate in a strong KC stimulus. This should not be viewed as a form of explicit knowledge as the iterating interaction is to facilitate individuals to align their perceptions in assisting tacit-to-tacit knowledge transfer (Miller et al. 2002). An information stimulus is a major source of KC. This represents all the information without the KC context and depends greatly on the individual to comprehend the information in order to create new knowledge. These three types can be unified as external (Timo et al. 2001). Personal or self-insight stimuli is the final step for KC. Regarded as an internal stimulus, it is unique when compared to the rest and potentially becomes the final stimulus



Fig. 3.2 Knowledge creation stimuli

which can trigger new KC. It is an inherent characteristic of an individual's capability, which relies mainly on the individual's earlier acquired knowledge (Tissen et al. 2000).

KC in the context of stimuli, explains the importance given to the Knowledge Engineering (KE) aspects in earlier KM projects. KE is related to the physical aspects of KM in the following ways:

- Creating facilities/infrastructure for capturing not only information but also to encapsulate it with its creators' context e.g. healthcare knowledge bases, healthcare training, neural networks, fuzzy logic, Artificial Intelligence for prediction, pattern recognition and image processing on CT scans, X-rays etc. relate to explicit knowledge stimuli (Rodrigo et al. 2001).
- Providing communication for close interaction between individuals through e-mails, telephones, mobile devices, discussion fora and chat rooms etc., assists in the betterment of interaction stimuli (Smith et al. 2000).
- Information access to a wealth of medical journals and publications, medical data, books, health informatics portals, healthcare data mining and data warehouses and so forth forms part of the information stimuli (Rodrigo et al. 2001). All these KE aspects often motivate KC; hence the legacy support of KE in KM projects (Dwivedi et al. 2002).

KC, or rather stimuli to KC, has been the focus of the early part of KM in healthcare. This has unnecessarily deprived the focus on the human-centric aspects of KM (Timo et al. 2001). KM in healthcare hinges not only on an individual's knowledge but also on organizational knowledge. Organizational knowledge resides within a virtual network of healthcare specialists who can be viewed as sharing knowledge as an implicit function of their routine activities. The organizational context crystallizes an individual's knowledge into organization knowledge (Sharkie et al. 2003).

The "Achilles heel" of any network (for example, a computer network) is its communication path. This also holds true for any communication path in a knowledge-networked healthcare organization. Knowledge sharing relies on the communication path available in this organization. This in turn is largely dependent on the hierarchic nature of organizational management, structure and style of functioning of the organization. Knowledge gaps can be avoided if there is less bureaucracy and formality in the path of knowledge sharing. Proper knowledge leveraging would eliminate knowledge islands created by large knowledge gaps (Breen et al. 1997). The next equally important factor is the inclination to communicate and share knowledge which can be affected by the culture (Ellingsen et al. 2003). A knowledge-evolved healthcare culture would encourage individuals to readily share experiences and knowledge (Burns et al. 2003). Current KM frameworks find it difficult to offer ready-made solutions to these problems (Paul et al. 2002). This calls for a radical new approach where tacit knowledge sharing would be the centre of KM initiatives in healthcare and not only concerned with knowledge conversion (as earlier perceived by Nonaka's knowledge creation company and the Socialization Externalization Combination Internalization (SECI) model of KM (Nonaka et al. 1995)).

3.6 Urban Health

Urban Health is a multidisciplinary and multisectoral approach to promoting public health and individual health in the urban setting. The field of urban health is concerned with the determinants of health and diseases in urban areas and with the urban context itself as the exposure of interest (Galea and Vlahov 2005). The complexity of urban health makes it suitable for focused research and examination. The multidisciplinary nature of urban health encompasses public, private and non-governmental sectors including public health, urban planning, social work, education, engineering, architecture, law, media, food and agriculture, community development, environmental protection, transportation, economics amongst several others. The term Populomics has emerged from the synthesis of the Population sciences, Medicine and Informatics (Abrams et al. 2006; Gibbons 2008). Populomics is defined as an emerging discipline focused on population level, transdisciplinary, integrative disease/risk characterization, interdiction and mitigation that rely heavily on innovations in computer and information technologies. Populomics seeks to characterize the interplay of socio behavioral pathways and biophysiologic and molecular mechanisms which work across levels of existence, to impact health particularly, at the population level.

In essence, KM embodies organizational processes that seek synergistic combination of data and information processing capacity of information technologies, and the creative and innovative capacity of human beings. Populomics, a confluence of three seemingly disparate concepts (population science, medicine and informatics) has parallels with the growing field of KM, itself a blend of people, process and technology (Wickramasinghe et al. 2009). KM principles and methodologies provide researchers and practitioners (concerned with health impacts associated with the urban environment) valuable analytic tools and a systematic approach to the integration of different types of data to enable novel knowledge-based insights and spur scientific advances in urban health.

3.7 Conclusion

We would like to conclude that current KM initiatives concentrate heavily on knowledge transfer in tacit-to-explicit modes which do not yield the expected outcomes. A tacit-to-tacit mode of knowledge transfer would achieve a more effective transfer of knowledge. For the urban health setting, judicious and integrative use of novel concepts (such as populomics) will help enable KM-based constructs. We would suggest that future KM implementations in the urban health setting should orient all future efforts on sharing tacit-to-tacit knowledge in order to avoid knowledge gaps and leverage all of the available, multidisciplinary, resources.

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Part II
Incorporating KM Principles into Urban
Health Contexts

Chapter 4

A Childhood/Adolescent Knowledge Management System for Urban Area Health Programs in the District of Columbia

Michael L. Popovich and Xiaohui Zhang

Abstract This chapter introduces an information system with data-derived knowledge management in support of health management of urban children. The development of the standardized medical data collection form which enforces the preventive care content and the summarized medical records in electronic format are the foundation for community health management decisions. The analysis of the lab screening results and risk assessment by the primary care physicians, the assessment of child mental and physical development, and chronic disease diagnosis provide the patient-centric evidence of the health conditions of urban community children with geographical variations. The knowledge acquisition, construction, organization, and business processes are systematically illustrated with examples. The introduced system demonstrates that principles of knowledge-driven health management decision making can be achieved through the improved use of data from disparate systems.

Keywords Knowledge management • Urban health • Urban children • Data management system • Public health • Child health • Population health • Electronic medical record • Health information exchange • Comparative effectiveness research • Medicaid

4.1 Introduction

The World Health Organization principles for a core foundation to a healthy population focus on minimizing the inequalities of health care in communities. They focus on promoting healthy living, disease prevention, and access to health services.

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As access to health services increases an expected outcome is improved wellness, which improves the health and economic welfare of the community.

In order to work toward an increased “healthy” population in any urban community, public health professionals, health care providers, and policy makers must have access to sets of data that can be cognitively and analytically structured to create information. This information can then be used to provide a knowledge base to support community health decisions. Health data sets collected through expanding information technology initiatives such as the increased use of electronic medical records (EMR) and health information exchange (HIE) projects provide new resources for this urban health knowledge base.

Health data within EMRs is patient specific as are HIE projects that extend patient point of care service data to multiple sets of providers. The ability to capture these health service data sets within an urban area support the establishment of a population-based data system on which to build a knowledge management framework. Incorporation of analytical tools designed to support and monitor the impact of urban health care decisions becomes a key objective. These tools include pattern-identification, disease modeling, and statistical and spatial analysis. They can be used to provide information to detect health associations within urban demographic populations, assess risks, establish health care trends, and support epidemiologic disease modeling (Wickramasinghe et al. *in press*). This knowledge-based environment supports comparative effectiveness research (Federal Coordinating 2009) (CER) which allows the establishment of best practices within diverse urban communities and sub-populations. CER provides knowledge to support health policies and programs directed at increasing access to care, improving service delivery, and setting new targeted standards of practice.

This chapter presents a case study of an existing data management system designed to collect point of care services for children in the District of Columbia urban area. The information system, in operation since 2006, captures data from pediatric well-child visits and leverages the data in a knowledge framework to support urban health care objectives, policy, and health delivery. It demonstrates that when a knowledge-based framework is established to collect, analyze, and monitor health data, urban area health strategic objectives for multi-disciplined health professionals are supported.

4.2 Background

Prior to 2000 in the District of Columbia, there was little or no key health data to support the community coordination of care for children. There was little data to effectively evaluate the impact of health promotions, policies, or delivery of health care to this population. Health outcomes were assessed through anecdotal experience, surveys, or through analysis of billing claims data. Health care specialists relied on standard public health reporting workflows that resulted in under reporting and data that was not timely, accurate, or representative of the urban area.

Information was not available to adequately support and monitor outcomes of urban area health care policy decisions.

The District of Columbia has over 75% of its population of 110,000 children under the age of 21 enrolled in the government Medicaid program. These children receive their health care from providers who are reimbursed for services. Without sufficient data to determine the effectiveness of the Medicaid program, the District was engaged in a legal action, *Salazar vs. the District of Columbia* (United States District 2001). This court case originated to challenge the District’s ability to ensure all Medicaid eligible children had access to care through the Early Periodic Screening, Diagnosis, and Treatment (EPSDT) program.

One of the principal court orders mandated the monitoring and reporting of patient access to providers for the eligible population to ensure they received the full benefit of services available. Two key outcomes resulted from this court order: (1) the creation of a Standard Medical Record Form (SMRF) which was used for collecting age appropriate point of care well-child visit data, and (2) the development of an information system that generates service coverage statistics and pay-for-performance provider data. The District established an initial target goal to ensure that 80% of the eligible children were age appropriately enrolled in the program and were receiving services with an ever increasing coverage rate over the course of a number of years.

A series of seven, age appropriate SMRFs (Beers et al. 2007) were established for documenting the well-child encounter visit, see Fig. 4.1. The data to be recorded complied with federal regulations 42 U.S.C 1396d(r), standards of care outlined in the

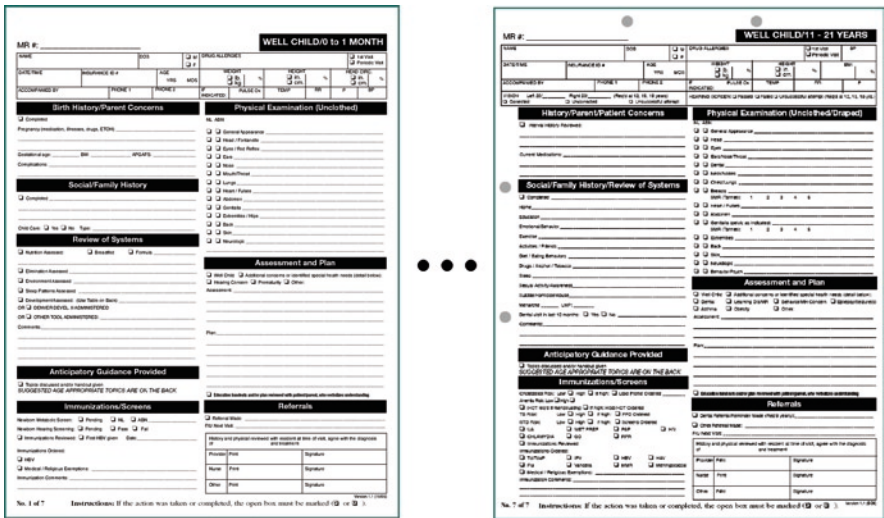


Fig. 4.1 Two of DC’s standardized medical record forms, (1) Children 0–1 months of age (left), and (2) Children 11–21 years of age (right)

Centers of Medicaid and Medicare Services (CMS) Medicaid Manual, and the DC Health Check program periodicity schedule. This schedule is based on the American Academy of Pediatrics recommendations for preventative pediatric health care.

The SMRFs were used by physicians to build a paper medical record that followed each child through their age appropriate visits. An information system was developed to capture data electronically, with a patient centered system design. A point of care data system, in and of itself, does not ensure an effective information environment to support more informed health decisions. Therefore, a knowledge management approach was taken to create the framework to expand service delivery data to population data and a resulting urban area information environment.

4.3 The Child Health Information System Workflow

Figure 4.2 illustrates the work flow of the health information system that was created.

The system recognizes electronically if a child and the child's provider were Medicaid enrolled at the time of service and thus, the provider was eligible for reimbursement. Currently, the application relies on collecting copies of the forms, accomplishing data entry, and scanning the forms as an attached electronic record to the patient record. In the near future as providers move toward EMRs the data entry component of the work flow will gradually be enhanced with electronic capture of records.

Individual patient data collected through this system is illustrated in Table 4.1.

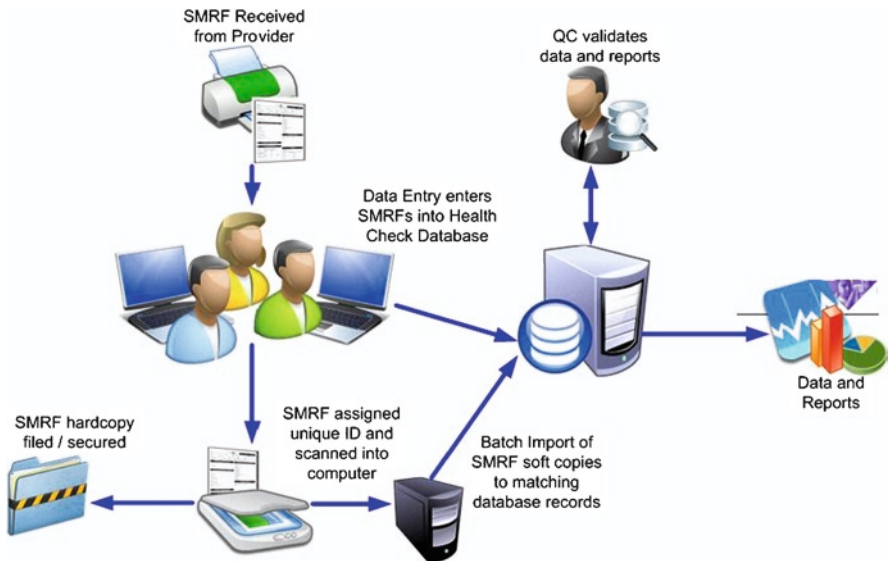


Fig. 4.2 Work flow of age-appropriate well-child checks in DC

Table 4.1 Data collected during the well-child visits

Basic parameters	Family history	Physical examination
Date of birth	Education	Eyes, ears, nose, throat
Gender	Exercise	Chest, lungs
Height and weight	Drugs, alcohol, tobacco	Neck, nodes
Vision	Diet	Heart, pulse
Hearing	Sleep	Abdomen, back, skin
	Dental	Breasts, genitalia
Risks and screens	Assessment	Referrals
Cholesterol	Well child	Dental
Anemia	Dental	Specialists
TB	Learning disability	
STD	Mental health concern	
Immunizations	Seizures	
Blood lead level	Asthma	
	Obesity	

4.4 The DC EPSDT Knowledge Management System

To cast this system in a knowledge management framework (Liebowitz 2001), Fig. 4.3 is presented which consists of the five levels:

The five levels are standard to the knowledge management approach, with layers 1, 2 and 5 specifically tailored to the District pediatric system.

1. Data Sources – Currently this pediatric data system relies on data collected through standard medical record forms for EPSDT visits as illustrated in Table 4.1. Eligibility data is electronically exported from the District’s Medicaid claims system for both providers and patients. Immunization records are available in a District registry, and the design supports electronic capture from EMRs.
2. Knowledge Acquisition – Patient information is generated from the visit data as a child ages to 21 and receives services. Physical exams, risk screening, family histories, development assessment, and preventive care measures such as immunizations are established and tracked for each individual patient.
3. Knowledge Construction – As data is gathered and patient information retained, the third level of the knowledge management framework applies rules and processes to the data allowing knowledge to be constructed from the results.

For example, District regulations for lead toxicity establish that screening through blood lead tests should occur for children age 12 months and 24 months. The pediatric care protocol requires providers to request a blood test for lead at the age appropriate patient visits.

When the result of the blood test is reported, the knowledge management system applies rules to assess the patient risk to lead poisoning. Specifically, if the test result is equal to or greater than 10 µg/dl, a patient is flagged as a “high lead risk,” thus knowledge is gained as a result.

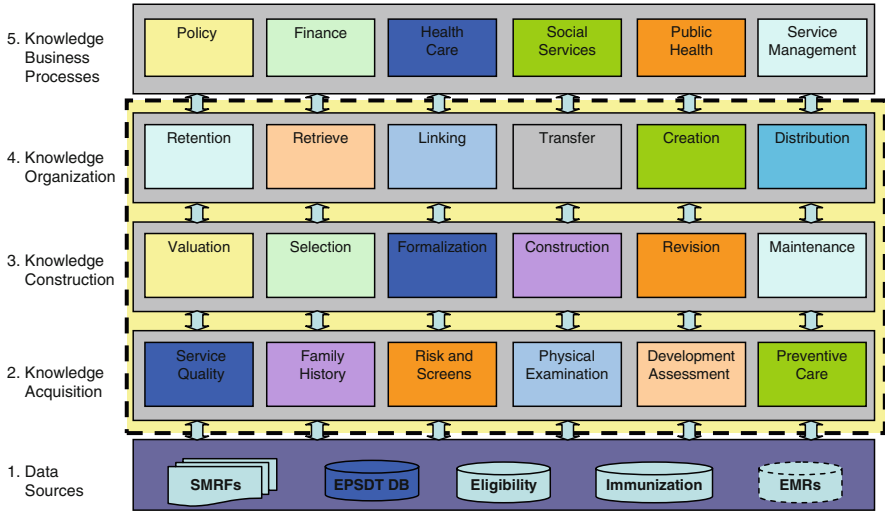


Fig. 4.3 The framework of EPSDT knowledge management system

4. **Knowledge Organization** – As the data application is web-based, it provides an effective method for knowledge transfer, creation, and distribution to support the needs of management, health care, and public health stakeholders. Knowledge organization includes the tools for information retention and retrieval from simple data queries to complex searches across various patient demographics. In addition, this organizational component includes the ability to link data, such as spatial links. This allows population health knowledge to be created by linking individual patient care to common sub-populations.

For example, take the geographical representation of children lead tests from one District sub-population as illustrated in Fig. 4.4. By spatially representing this data, knowledge of potential clusters of high lead risk children are established through a geographical “heat map.”¹ By linking additional data, such as the age of housing in the District, it is possible to identify high risk areas to target mitigation efforts. A high risk knowledge resource is created and can be replicated to support health policy, implementation, and assessment of the outcome.

In this example, as the mitigation programs are implemented over time, the knowledge gained by continually monitoring and displaying graphically the population risks to lead supports the effectiveness of the health decisions being made today.

5. **Knowledge Business Process** – The end users of the pediatric knowledge management system are represented in this layer. Public health practice, service delivery, policy, and management support benefit from the data collected as it rolls up

¹Produced using the ESRI’s ArcGIS Server system tools

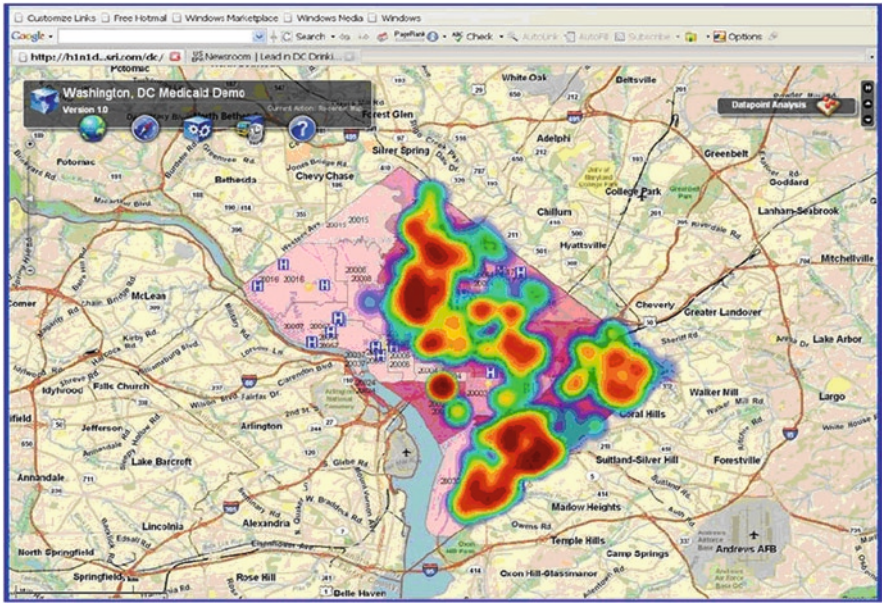


Fig. 4.4 Example of spatial cluster analysis of linked data

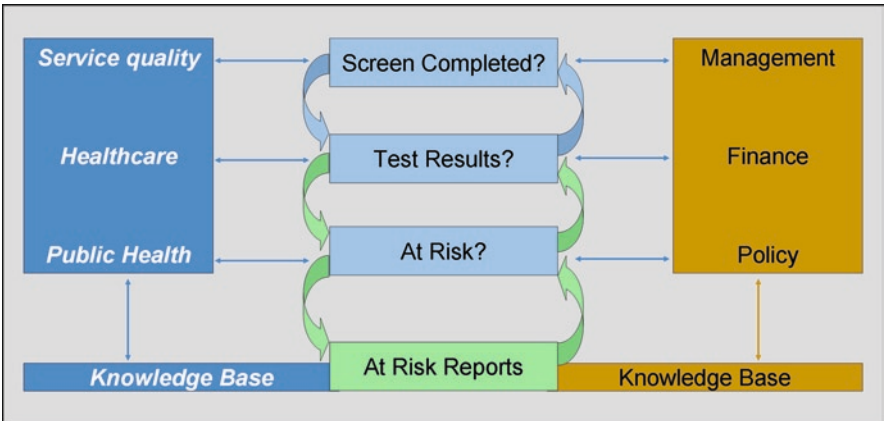


Fig. 4.5 Illustration of lead screening process and case knowledge-based approach

through the system. Figure 4.5 illustrates how the knowledge management system supports the end user community, specifically for the lead example. As patients are appropriately screened during their well-child visits, data captured, and rules applied, information is gathered based on patient centric and case-driven processes. This information provides the knowledge to the user community to support their specific needs.

4.5 Summary

The principles of knowledge management drive decisions through improved use of information derived from increasing data captured by disparate systems. Health information technology initiatives continue to create opportunities to support expanded stakeholders through the use of this information.

The District of Columbia EPSDT program, as it evolves from paper forms and data entry to a solution with electronic data capture and integrated tools for mining of data, will increase the decision support and evaluation capabilities for users. Future extensions of the system that integrate visualization tools and orchestrated displays to allow the sharing of data through an urban area health dashboard (Scientific Technologies 2009) will take advantage of this knowledge framework, as illustrated in Fig. 4.6.

Although it was the U.S. court system that became the driver initiating the creation of a standardized reporting and data collection system for a specific sub-population of the urban area, it is the architecture and design of the system that allows for true population health knowledge to be created from point of care services. The vision of the District to not only address the immediate needs but create a system to support evolving health reform through a knowledge-based framework will serve the urban community for years to come. Its value will be further demonstrated as utilization supports the World Health Organization principles for a healthy population day-in and day-out provision of data, information, and knowledge to measure and monitor:

- (a) Access to care.
- (b) Ensuring age appropriate risk screening.



Fig. 4.6 Facilitation of knowledge transfer through EPSDT specific information displays

- (c) Monitoring disease prevention care, i.e., immunizations.
- (d) Ensuring care and appropriate referrals for high risk children.
- (e) Assessing “wellness” of urban area population.
- (f) Monitoring “outcomes” to ensure best practices and management of resources.

Knowledge management is a science. It is the science of organizing the knowledge that exists when people, processes, and technology come together. Applying knowledge management to improve health outcomes in a population is an art. It is the art of orchestrating the data and information from these same people, processes, and technology.

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Chapter 5

Urban Health in Developing Countries

Siddharth Agarwal, Aradhana Srivastava, and Sanjeev Kumar

Abstract The world is becoming more urbanized. This trend is now particularly pronounced in the developing world, where the urban population is expected to double in the next 30 years. The impact of urbanization on the health of citizens in developing countries has received increasing attention recently. Urban residents in developing countries, especially the poor, are exposed to the health hazards of low access to healthcare, food insecurity and under-nutrition, polluted living environment, poor water quality, violence and accident injuries. Poor people in urban centers also suffer from health problems associated with poor access to social services and safety nets. In such a scenario, ensuring access to basic yet life-saving healthcare among the urban poor is a key development priority. Efforts towards this end can be vastly improved through shared learning of experiences in enhancing access of the urban poor to basic services, healthcare and social security. A robust knowledge management system for urban health in developing countries is essential for achieving this. This chapter outlines the urbanization scenario in developing countries, associated urban health challenges, relevant program experiences and priority areas of research, besides highlighting the significance of knowledge management and avenues for knowledge sharing within this perspective.

Keywords Urbanization • Urban • Developing countries • Urban health • Urban poor • Slums • Disparities • Healthcare access • Knowledge management

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5.1 Demographic Overview of Urban Health in Developing Countries

5.1.1 Urban Growth

The era in which developing countries were depicted mainly as rural is now bygone. The world has entered the urban millennium in 2008, and if Milton's Satan were to fly over developing countries today, the panoramic view of their present-day demographic landscape would reveal a myriad of cities and towns.

Urbanization trends across the world are persistently on the rise and by 2008, for the first time, more than half of the world's population, numbering about 3.3 billion, will be living in towns and cities rather than rural settings. By the year 2030, global urban population will grow to 4.9 billion, whereas the world's rural population is expected to actually decline by about 28 million in the same time period (United Nations Population Fund 2007).

World population has grown exponentially in the 20th century from around 1.6 billion in 1900 – to around 6.1 billion in 2006, with each additional billion people being added more rapidly than the last. The vast majority of this growth has occurred in the developing world.

Developing countries will increasingly form the focus of world urbanization over the coming decades. According to United Nations projections, by 2030 more people in the developing world will live in urban than in rural areas; by 2050, two-thirds of its population is likely to be urban. Cities are currently home to more than half of the world's population and over the next 30 years most of the two-billion-plus person increase in global population is expected to occur in urban areas in the developing world (Fig. 5.1).

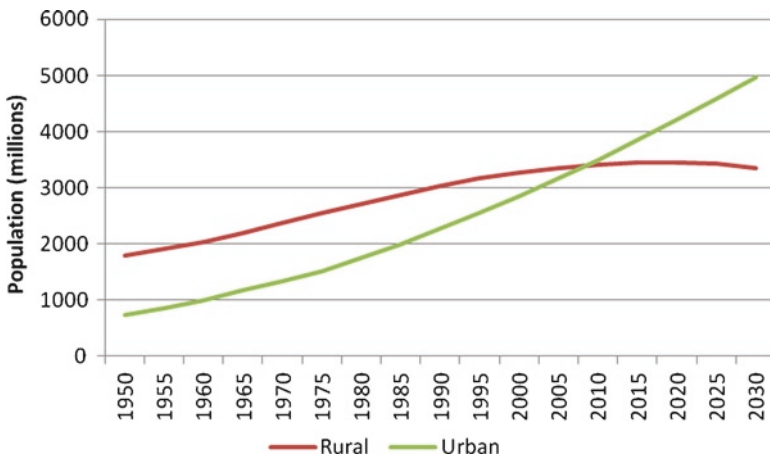


Fig. 5.1 Urban and rural populations of the world, 1950–2030. Source: World Urbanization Prospects: The 2003 Revision (United Nations Department of Economic and Social Affairs/Population Division)

It is in developing countries, where more than 90 percent of the future urban population growth is likely to take place (United Nations Population Fund 2007). In Asia and Africa, the urban population may double (Asia 1.36–2.64 billion and Africa 294–742 million) by 2030 in contrast to the slower growth in high-income countries from 870 million to 1.01 billion. Essentially, developing countries will have 80% of the world's urban population (United Nations Population Fund 2007).

An important fact central to the present day demographic transition that often gets hidden in the glitter of mega cities is that most of the urban population growth is taking place in smaller cities of less than 500,000 population, a trend reinstated by the recently released State of World Population 2007 Report.

The inescapable reality of urbanization in the developing world is that it is also accompanied with the urbanization of poverty. Numbers of the urban poor are expected to rise sharply as the cities of developing nations expand.

5.1.2 Growth of Slums¹

Today the best estimate is that over one billion people worldwide – or one in every three urban dwellers on the planet – now live in slums, places where every day is an intense struggle for survival. Of these about 960 million (or about 95%) are in developing countries (UN-HABITAT 2003b). Rapid and unstoppable urbanization is projected to result in 462 million slum dwellers being added by 2020 to this number. Of these 455 million (or 98%) will be in developing countries. Over half of the world's slum dwellers will be living in Asian cities by 2020. More than 72 percent of population in the cities of Sub-Saharan Africa lives in slums; the proportion in Asian cities is 56 percent.

Though not all slum dwellers are poor, slums represent significant concentrations of urban poverty. Illegal, informal, unrecognized and marginally located, slums are typical urban backwaters. The physical and psychological well being of slum populations is severely compromised on account of the poor living environment, inhibiting their ability to be active, productive and prosperous members of society.

5.2 Sharp Health Disparities and Growing Needs in Urban Areas

Although urbanization assists poverty reduction overall, the poverty that remains becomes concentrated in urban areas and exhibits higher levels of inequality (World Bank 2007a). Behind the glittering façade of urban prosperity lies the grim reality

¹UN-HABITAT defines a slum household as a group of individuals living under the same roof lacking one or more of the following conditions: access to improved water; access to improved sanitation facilities; sufficient living area (not more than three people sharing the same room); structural quality and durability of dwellings; and security of tenure (UN-HABITAT 2008).

of urban poverty, presenting two faces like two sides of a coin. While the United Nations Millennium Declaration, which specifies a target of achieving by 2020 “significant improvement in the lives of at least 100 million slum dwellers” under the broader goal of ensuring environmental sustainability has brought accentuated focus on the issue, the urban poor more so in developing countries continue to face severe health challenges that inhibit their ability to be active, productive and prosperous members of society.

5.2.1 *Disparity in Health and Nutritional Status*

Nowhere are the disadvantages of the urban poor compared with other city dwellers more marked than in health (Montgomery 2005). There is a wide gap between the poor and non-poor in terms of health and nutritional status as per available data. DHS surveys show trends of intra-urban inequity in health indicators in countries across the developing world (Figs. 5.2–5.5).

The urban poor also suffer from food insecurity and poor nutritional status on account of insufficient finance for purchase of adequate food. In the cash-based urban economy, they solely depend on the market for meeting their food needs. However, insecurity of income and livelihood implies that this cash availability is not uniform, leading to irregular food consumption. Urban poor children in fact have higher nutritional deficiencies than rural children in some countries (WHO 2002).

High prevalence of undernutrition among young children is the result of a combination of several factors including faulty infant feeding practices, poor quality of food, lack of hygiene, food and water contamination leading to frequent infections,

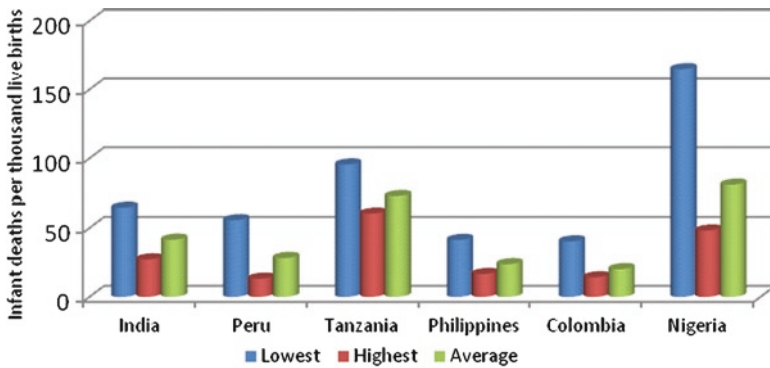


Fig. 5.2 Urban IMRs by Wealth Quintiles-DHS data from selected developing countries

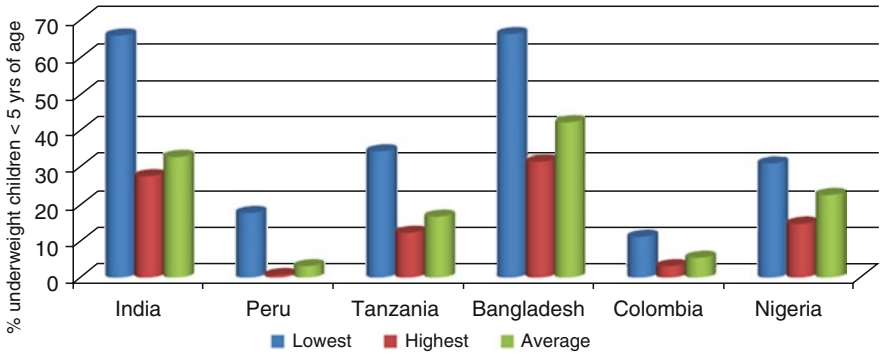


Fig. 5.3 Urban Underweight children by Wealth Quintiles-DHS data from selected developing countries

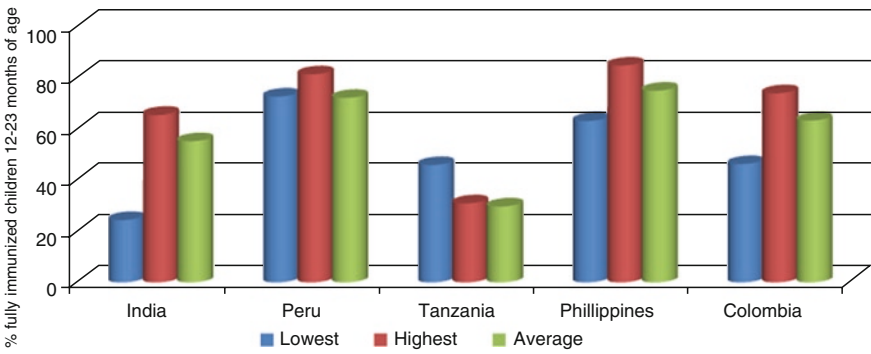


Fig. 5.4 Urban full child immunization coverage-DHS data from selected developing countries

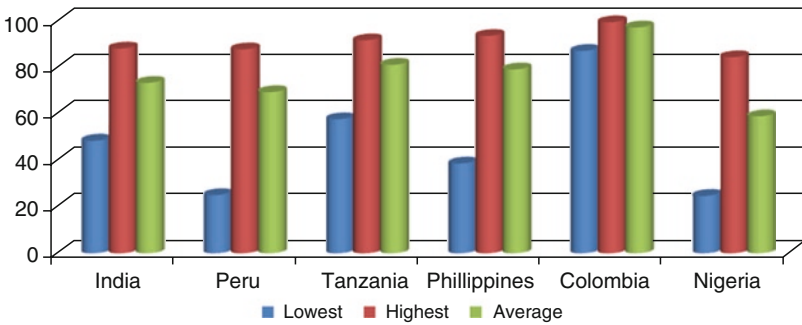


Fig. 5.5 Urban delivery attendance by medically trained person-DHS data from selected developing countries

lack of proper child care practices and absence of a responsible adult care giver due to employment pressures. Moreover poor access to treatment services and drugs prolongs the debilitating effect of illnesses and enhances malnutrition among children (Kjellstrom and Mercado 2008).

5.2.2 Access to Health Services

Inadequate and unequally distributed primary healthcare facilities affect healthcare of communities, as was seen in a study conducted in Bangladesh (Jamil et al. 1999), where children living in communities with outreach clinics farther than 2 miles were 30 percent less likely to be immunized than children living in communities with outreach clinics within 2 miles.

Though private health facilities have a wider presence in urban areas, they are often not accessible to the poor because of the high cost. The poor are therefore forced to fall back on the unqualified private providers who provide poor quality services.

A study in Delhi, India (Das and Hammer 2007) found that the more competent providers were concentrated in richer neighborhoods. Utilization of public hospitals by the poor was also low. The poor received worse medical care due to the lower competence of private providers they visited. Public providers, though higher in competence, made less efforts to reach them.

Poor linkages between slum communities and health providers results in limited knowledge and awareness among slum residents regarding the location and services provided by health facilities, such as outreach camps or visits of health workers. This results in poor demand and utilization of health services.

5.2.3 Poor Water Supply and Sanitation

Lack of safe water supply and sanitation facilities are among the key defining characteristics of urban poor living environments like slums. City level data of 43 African cities shows that 83% of the population lack toilets that are connected to sewers; for the large cities of Asia it is 55% (UN-HABITAT 2003a).

Studies of individual cities confirm DHS data that poor urban households must defecate outside or resort to unsanitary “wrap and throw” methods. More than 420 million urban residents do not have access to even the simplest latrine. In less developed countries, only 8% of urban low-income dwellers have a house sewer connection, while 62% of urban high-income dwellers do have a connection (World Resources 1996–1997). The tens of millions of urban dwellers, who have no toilet in their homes, rely on pay-as-you-use toilets or use open spaces or plastic bags (Satterthwaite 2001).

In many cities in developing countries, the scarcity of public water supplies forces many low-income urban residents to purchase water from private vendors,

who can charge much more than the cost of municipal water supply (World Bank 2007c). Consequently, people in slums often must pay much more for lower quality water than other urban residents (Satterthwaite 1997). It is not uncommon for low-income households to spend 10–20% of their cash income on water (Cairncross 1990). Many studies have also reported intermittent water supplies or long outages. A study carried out in Mombasa (the second largest city in Kenya) showed that very few neighborhoods had an average of only 3 h of water a day and some have seen no water in their pipes for several years (Rakodi et al. 2000).

Unsafe water and lack of sanitation, which also compromise maintenance of basic hygiene, are the causes for majority of water-borne and feco-oral infections, especially diarrheal diseases. Each year 2.2 million deaths, or 4% of all deaths, can be directly attributed to inadequate supplies of clean water and sanitation (UN-HABITAT 2003c). Women and children suffer from additional vulnerability to this challenge. They often have to haul the water required for domestic use from distant sources. Women and girls are also not able to attend their sanitary needs timely or during daylight hours on account of the absence of sanitation facilities at or near homes (personal observations of first author).

5.2.4 Other Health Related Risks Faced by Urban Poor

5.2.4.1 Occupational Health Hazards

The urban poor are often compelled to take up hazardous or labour-intensive occupations to earn a living. In an ILO survey in Bangkok, Thailand, 87 percent of the city's slum dwellers were found to work in the informal sector (ILO 2006). Poor working environments as well as practically non-existent occupational health services create a grave risk to health and life (Chattopadhyay 2005). The health threat posed by these workplaces is accentuated through the use of toxic products, the risk of injury, noise and the disregard to occupational safety measures (Kjellstrom and Mercado 2008). In the shoe-making industry in India, it was found that children were exposed to poor illumination, noise and poor ventilation, leather dust and hazardous chemicals like benzene, used in solvents and glues. Resultant disorders included respiratory problems, lung diseases and skin infections (Tiwari 2005).

5.2.4.2 Exposure to Crime and Violence

Violence in urban areas is a growing reality in developing countries, especially among urban poor on account of inequality, exclusion and lack of identity. Cities such as Rio de Janeiro, São Paulo, Mexico City, Lima and Caracas account for more than half the total of their national homicides (Moser 2004). Violence takes

different forms such as local violent crime, gang violence and abuse taking place within the home. Women and children are most vulnerable to such conditions. Urban poor women in some countries were found to be likely to experience violence as compared to other women (Montgomery 2005). Analysis of DHS data of several countries by Kishor and Johnson (2004) also reflects that women are beaten up by their spouse or partner. The percentages of women who faced such violence was quite high the study reflects that in Cambodia 18%, Colombia 44%, Dominican Republic 22%, Egypt 34%, Haiti 29%, India 19%, Nicaragua 30%, Peru 42%, and Zambia 48% women experience violence by their partner or spouse, (Kishor and Johnson: 2004 in Montgomery 2009). Strong links have also been found between alcohol/drug abuse and violence, especially on women (WHO 2006).

Though women in almost all sections experience violence by their partner or spouse, it is higher among poor slum dwelling population. Alcohol abuse exacerbates the frequency and severity of violence faced by women from their spouse or partner. This violence to the women has serious implications on their mental health conditions. A study among women in urban areas of Bangladesh reflects that of the women who were abused by their partner, 21 percent thought of suicide as against only seven percent among those who were not abused (Montgomery 2008).

5.2.4.3 Substance Abuse and Tobacco Consumption

The difficult life of the urban poor, stresses of poverty, hard labour and poor living conditions contribute to poor mental health and enhance substance abuse and tobacco consumption among them. Such behavior is more prevalent among young persons, particularly males. Studies show that daily tobacco smoking is most prevalent in lowest-income households in developing countries. In some Latin American countries like Colombia and Guatemala, easy access and affordability of drugs make their use rampant, in addition to widespread alcohol abuse (McIlwaine and Moser 2004). Substance abuse and high tobacco consumption takes a toll on the economic health of the household, besides affecting the physical health of the abusers. Research evidence from India and Sri Lanka showed that households consuming alcohol spent 24–30% of their income on it (World Bank 2007b).

5.2.4.4 Traffic Related Injuries and Deaths

Road traffic related injuries and deaths rank among the top ten causes of death, yet are not accorded appropriate importance, especially in developing countries. WHO estimates put the number of deaths in road traffic accidents at 1.2 million and injuries at 50 million globally (WHO/World Bank 2004). Around 85% of all global road deaths occur in low and middle-income countries, largely among pedestrians, passengers, cyclists, users of motorized two-wheelers, and occupants of buses and minibuses (WHO/World Bank 2004). Urban poor are more prone to road traffic

accidents, since a higher proportion of them would belong to high risk groups of pedestrians, cyclists, or bus passengers or pavement dwellers. Studies across the developing world report a higher risk and incidence of traffic related morbidity and mortality among urban poor (Hijar et al. 2003; Bartlett 2002).

5.2.5 Urgent Need to Augment Urban Health Services in Developing Countries

Above discussed disparities and health related challenges faced by the urban poor point to the urgency of the need to address these issues, especially since the urban poor form a large and rapidly growing section of the population in developing countries. In terms of urban health, major needs are as follows.

5.2.5.1 Health Infrastructure

First and foremost there is a need to augment the urban health infrastructure to meet the requirements of ever-growing urban poor populations. Expanding public health-care services may not be sufficient, and therefore governments must be open to utilizing innovative approaches in public-private partnerships. With private for-profit and private non-profit care being a significant presence in most cities, effective partnerships are also likely to require engagement with the private sector (Barbiero 2007).

5.2.5.2 Health Personnel

Problems relating to urban public health personnel include inadequate staff and unsympathetic behavior towards to urban poor, which is a major reason behind low utilization of public health services by the urban poor. While additional staff would be required with expansion of services, a crucial need would be to provide motivational training to health providers at all levels to be more sensitive towards the disadvantaged. Health personnel need to also be trained to coordinate effectively with community-based health workers and other agencies effectively respond to community health needs (Agarwal et al. 2007).

5.2.5.3 Reach of Services

To improve reach of health services to the urban poor there is a need to develop a delivery system that is responsive to community needs and facilitates them to avail services (Agarwal and Sangar 2005). Moreover, since urban poor populations are highly mobile and diverse, urban health services need to be flexible to ensure that

such populations are included. For this there is a need to regularize outreach services in slums, especially the non-notified slums and invisible urban poor clusters or slums, which are also the neediest. Coverage of all urban poor populations through health insurance schemes would help them access quality healthcare. Such schemes may be operated in the public-private-partnership mode. Trained community-based health workers have also proven to be crucial links for facilitating access of urban poor communities to healthcare services (Agarwal et al. 2008).

5.2.5.4 Need to Address Determinants of Health

Besides healthcare, urban health needs encompass other services like housing, water and sanitation, security, traffic planning, social welfare schemes, employment generation and environmental improvement. For this purpose public health and other sectors need to work in tandem with each other to realistically address needs of the urban poor. Municipal governments too, in the increasingly decentralizing scenario, will play an important role in integrated planning and implementation of urban health and welfare interventions.

5.3 Challenges Faced by Increasingly Urbanizing Developing Countries

5.3.1 Unplanned Urban Growth and Unregulated Slum Growth

The nature of urban growth in developing countries is largely unregulated, with cities expanding too fast and much beyond the scope of planned development. A constraint of resources as well as lack of policy and governance support lead to unregulated slum growth in cities. Slums in many modern cities of the developing world are no longer marginalized settlements housing a minority of urban residents – rather they are home to significantly large proportions of the urban population and slum growth is as high as or even higher than urban growth (UN-HABITAT 2008). Mumbai, for example, is one of the world's largest megacities, and also has the highest proportion of slum residents to total urban population among cities in India with 54% of its residents living in slums (United Nations Population Division 2008; Office of the Registrar General and Census Commissioner 2001). In spite of the growing awareness of accelerated urban growth accompanied with a disproportionate growth in the numbers of the urban poor, research and policy attention to them is comparatively insufficient (UN-HABITAT 2003a, b, c). As a consequence slums and the larger community of urban poor often get left out or ignored in city development plans and programmes.

Most slums and urban poor habitations are encroachments on public or private lands. They have no ownership of the place they live on. The illegal nature of occupied land prevents their inclusion in official slum lists (Ramanathan 2004). Civic and health services as well as crucial social welfare and security benefits usually do

not reach such hidden and missing pockets of urban poor that are not a part of official records. Being illegal occupants, the urban poor have to live constantly under the threat of eviction. This insecurity of housing and tenure prevents them from upgrading their housing or living condition or amassing any fixed assets which could improve their quality of life (World Bank 2007a).

5.3.2 Health System in Urban Areas: Inadequate and Ineffective Public Sector Health Services

In most of the developing countries health care system is inadequate to cater to the health needs of the urban population. Though in urban areas physical distance to services is not a concern, and many of the large hospitals appear to be easily accessible, the urban poor are not able to access them since they are too expensive. In some other cases high opportunity cost for poor to access health services and inadequate and inefficient management of health facilities are also act as bottlenecks in ensuring the universal care. In some of the developing countries, such as in India, unlike rural areas which have a dedicated primary health infrastructure, such structure is absent in urban areas.

Moreover the rapidly growing urban population, especially of the urban poor, renders the already scarce urban health infrastructure further inadequate. In India urban primary health care facilities functions sub-optimally and cater to a much higher population compared to the norms. For example functioning of nearly one third health posts and Urban Family Welfare Centres (UFWCs) is below average, with weak referral, inadequate trained staff, short supply of medicines and equipments and vacant positions of medical officers (Shekhar and Ram 2005). Similar is the situation in the countries of South and Latin America where health and social insurance, which is major source of healthcare, remain out of reach of the majority of the urban poor and less than 20% of the urban poor have access to some sort of insurance.

The problem of inadequate services is being recognized and efforts of revamping the health services have been taken up but they have been limited to only a few large cities. In India efforts for strengthening the health services were taken up through Population Project (IPP-VIII) but they remain limited to only Bangalore, Delhi, Hyderabad and Kolkata (Institute for Research in Medical Statistics 2003).

The challenges of health services, in particular are more serious in smaller cities and towns and with more rapid growth and low resources these challenges are going to be further deepen (Panel on Urban Population Dynamics 2003).

5.3.3 Community Level Challenges

The characteristics of urban poor communities' pose multiple challenges in terms of health related behavior as well as demand of and access to health services. Such communities comprise of vulnerable groups who may be difficult to reach, such

as migrants, pavement dwellers or homeless people. Widespread illiteracy and ignorance among them implies limited knowledge and practice of appropriate health behaviors and lack of awareness regarding services and entitlements. Poor incomes and compulsion to work for survival also prevents them from timely healthcare access.

Vulnerable groups such as migrants and homeless difficult to reach: Migrants constitute a key vulnerable group even amongst the urban poor. They are often temporary settlers and may move between worksites within the urban area. Their living conditions are also worse off than more settled groups. Such groups suffer on account of their poor living conditions and their mobile nature which prevents them from accessing basic health services and welfare schemes. Studies have found poorer health status among migrants as compared to older settlers in urban poor settings (Chatterjee 2006; Unnithan-Kumar et al. 2008).

Lack of community awareness and culturally influenced behaviors: Urban poor communities are characterized by low education levels with limited knowledge of appropriate nutrition, health and hygiene behaviors (Agarwal and Taneja 2005). Practices based on cultural beliefs which could be harmful to health are also sometimes widely prevalent among them. Lack of awareness leads to non-recognition or delayed recognition of symptoms of ailments, often leading to complications and even fatality on account of delayed treatment.

Poor incomes and livelihood insecurity leads to poor demand for healthcare: The urban poor are largely employed in the urban informal sector as casual labor, dependent on daily wages for sustenance (UNDP 2009). Low wages also do not leave much scope for saving for a rainy day. The pressure of earning livelihoods often leads the urban poor to postpone treatment for long periods, leading to a low demand and utilization for healthcare among urban poor communities. Another reason for low demand is poor linkage between urban poor communities and health providers, and low awareness among them regarding the location and services provided by health facilities, out-reach visits of health workers and other services such as health and immunization camps. This results in poor demand and utilization of health services (Agarwal et al. 2007). The situation is exacerbated among recent or temporary migrants.

5.3.4 Environmental Factors Including Climate Change

Poor Living Environment adds to health challenges of slum dwellers in developing countries. Inadequate sanitation, drainage, hygiene and water (a predominant feature of urban slums), results not only in more sickness and death but also in higher health costs, lower school enrollment and retention rates and lower work productivity. Poor living environment in urban slums therefore, calls for greater attention of service providers and coordinated action by all stakeholders.

Studies have demonstrated that slums located adjacent to large open drains have a greater incidence of diarrhea and other water-borne diseases (Chelala 2000).

Slums adjacent to waste disposal sites face several hazards of degraded environment such as polluted water and air (personal observation). Pigs, vultures and other animals affect the levels of hygiene maintainable in a slum and thereby increase the risk of spread of infection amongst children who come in close contact with the outside environment (personal observations of first author during slum visits). In developing countries, it is estimated that more than 90% of sewage is discharged directly into rivers, lakes and coastal waters without treatment of any kind. Waterways, canals, and rivers are often used to dump raw sewage. More than 2 million Bombay residents have no sanitary facilities, and most sewerage collected is discharged untreated or partially treated into creeks or coastal waters. In Metro Manila, about 11% of the population is served by piped sewerage; the majority of sewage is conveyed through open ditches and canals untreated into Manila Bay (UN Habitat 2009). Solid waste services are also rare in poor urban settings since most slums do not benefit from municipal services. As a result, residents live among mountains of garbage and the associated vermin.

The urban poor mostly live in sub-optimal housing ranging from high-rise tenements to shacks to plastic sheet tents on sidewalks, often tending to be unregulated, precarious, overcrowded, and often open to the elements. Poor access to water and sanitation services is also a threat to the living environment and heightens the risk of environmental health problems. A major environmental crisis is looming large as many developing countries as cities discharge ever increasing amounts of waste into the air or into freshwater bodies, threatening water quality and aquatic ecosystems. The combined effect of these problems is borne not only by urban poor, but all humanity.

5.3.4.1 Climate Change

Cities of Asia and Africa are among those that are vulnerable to the increased incidence of extreme events such as heavy rainstorms, cyclones or hurricanes. Coastal cities that are at risk from storms will be doubly at risk as sea-level rise increases hazards from coastal flooding and erosion, particularly at risk being urban populations residing within the low-elevation coastal zone (McGranahan et al. 2007).

Changes in the distribution of rainfall (long periods of no rainfall punctuated by short periods of intense rainfall) would result in overall decreased water availability, the worst affected being the urban poor. Urban areas always present some risk of flooding when heavy rainfall occurs. Buildings, roads, infrastructure and other paved areas prevent rainfall from infiltrating into the soil – and so produce more runoff. Heavy and/or prolonged rainfall produces very large volumes of surface water in any city, which can easily overwhelm drainage systems and affect slum dwellers that have least protection.

Longer window of increased temperatures along with substandard housing with poor sewage and water management provides an increased number of breeding sites for mosquitoes and disease causing organisms, thus resulting in increased incidence of water and vector borne diseases.

5.3.4.2 Malaria and Vector Borne Diseases

Hay et al. (2004) argue, urban population growth in Southeast Asia, as well as sub-Saharan Africa, may be contributing substantially to the global burden of malaria morbidity. Keiser et al. (2004) calculate that in urban sub-Saharan Africa, some 200 million city dwellers face appreciable risks of malaria, and they estimate that 25–100 million clinical episodes of the disease occur annually in this region's cities and towns. Indirect estimates suggest wide variations in prevalence by site, even within small geographic areas, with higher prevalence in the suburbs and city peripheries (especially when these are adjacent to wetlands) than in city centers.

Growth of slums, inadequate sanitation infrastructure and unplanned construction create increased breeding potential for mosquitoes. Urban areas provide fertile grounds for breeding of *Aedes aegypti* and *albopictus* which transmit Dengue and Chikungunya. *Aedes* breeds in man-made water receptacles like drums/barrels, earthen pots/jars, flower-pots, plant saucers, disused tyres, discarded plastic glasses/bottles, desert coolers and uncovered overhead tanks. Increased population movement facilitates spread of virus to newer areas. Inadequate public health infrastructure and ensuing deficiencies in preventive measures in urban areas contributes to resurgence and outbreaks. Leptospirosis (during flooding in slums), plague and typhus are also re-emerging especially in slum areas as a consequence of climate change coupled with poor drainage and water stagnation which characterize slums.

5.3.4.3 Air Pollution, CO₂, Lead in the Air

Congestion in many large cities can also be extremely severe and air pollution is now a serious environmental concern in many cities. In many of the cities poor families rely on traditional fire wood, coal and traditional stoves for cooking and heating needs. According to estimates more than two billion people worldwide are dependent on such unclean fuel (Larson and Rosen 2002), which generates particulate matters and harmful gasses. These particulate and gasses are amongst the greatest environmental health concerns which contribute to learning disability in young children and increase the risk of respiratory diseases. Since urban poor stay at congested places in inadequately ventilated houses, they are more prone to the indoor air pollution. A Study in Bangladesh reflects that young children and women in poor households face greater exposures than those of higher income groups.

In addition to indoor air pollution outdoor air pollution is also a serious health hazard to the urban population. Motorized vehicles, industries, trash burning and hospital and medical waste are key source of outdoor pollution, which in most of the cities in developing countries have reached at an alarming level. WHO estimates that 1.5 billion urban dwellers face levels of outdoor air pollution that are above the maximum recommended limits (WHO 2003), and UNEP reports that one billion urban residents are exposed to health-threatening levels of air pollution (UNEP 1999). This exposure to urban poor population is much higher as they often stays near pollution sources in the factory premises, pavements and railway stations.

5.3.5 Governance and Service Provision

Urban slums and squatter settlements, especially those not listed in official records, generally have poor coverage of civic and health services. They are also deprived of the benefits of public schemes which are crucial for the welfare of the poor. In fact fast-growing cities in developing countries struggle with the challenge of providing adequate affordable housing and the extended water supplies and sanitation facilities needed to serve growing populations. In addition to limited infrastructure, there is lack of clarity of roles, coordination and accountability for providing services to the urban poor by the agencies responsible.

Management of urban infrastructure, including slum up-gradation and healthcare for urban poor, is increasingly a responsibility of local governments. However, local governments in many developing nations often lack the necessary authority, resources or technical expertise to take up such responsibilities. Weak municipal or urban health governance, coupled with municipal mistrust of NGOs and CBOs are a major bottleneck in extending health services to the city's poor (Harpham 2007a, b). In countries such as Philippines, Vietnam and Indonesia, decentralization to local bodies has encouraged local innovations and participation in public health, but has also brought forth significant operational issues (Lieberman et al. 2005). Such problems include shortage of technical staff, poor quality of service delivery and weak and often-corrupt system of procurement of medical supplies (Montgomery 2005).

In a study of decentralization of health system in South Africa, it was found that larger cities had more advantages on transitioning to local health services and raising revenues as compared to smaller ones (di Gropello 2002).

Convergence of health departments with other government agencies providing health services at the city level, or influencing health at the local level, such as the water and sanitation departments and health and nutrition schemes is also essential for effective problem-solving, comprehensive development and enhanced community health impact.

5.4 Practical Lessons and Experiences from Urban Health Programs in Developing Countries

5.4.1 Organizing and Managing Urban Health Services: Increasing Access of the Urban Poor to Public and Private Health Services

Mapping and identification of unserved pockets: It is imperative that programs involved in slum improvement efforts are backed by sound planning so that they have the desired impact. As discussed earlier, a large proportion of slums are illegal and therefore do not form part of official records. These slums therefore remain outside the purview of basic civic services. It is therefore necessary to identify and map all slum

clusters prior to initiating an urban health program. It has also been observed by several programmes (Agarwal and Taneja 2005; Loughhead et al. 2001; Falkingham and Namazie 2001) that all slums are not equally vulnerable to health risks. It is therefore imperative that an assessment of slums is conducted before implementing an urban health program and the most vulnerable slums are targeted. Slum improvement programs must involve local stakeholders including slum communities so that their wisdom, experience and resources are utilized in improving their well-being.

Increasing coverage through outreach services: Limited presence and effectiveness of fixed facility-based care in reaching all the urban poor necessitate a flexible approach to maximize coverage. Outreach services such as visits by health workers, mobile medical units or health camps are an effective way of reaching un-served slum areas and uncovered urban poor populations. Advantages of these services include reduced waiting time for the poor (which is significant in terms of avoidance of loss of wages) and increased accessibility through door-step services. The Indore urban health program in India has witnessed considerable improvement in maternal, child health and immunization coverage among the targeted urban poor populations through outreach services as a key program strategy (Agarwal et al. 2008).

Demand and supply linkage: Weak community demand and poor access of healthcare services can be addressed through building capacities of slum-based community organizations for promoting awareness, demand and linkage of communities with service providers. Slum-based community organizations are empathetic towards and better informed about the various dimensions of deprivation among the urban poor. Hence, their involvement would address health issues in a more effective and sustainable manner, and would be more responsive to the issues faced by the slum community (Agarwal et al. 2008). Community groups, when suitably empowered, can also engage and effectively negotiate with service providers to improve regularity of services in their slums (Barua and Singh 2003; Islam et al. 2006). This approach has successfully been used in enhancing health outcomes among the urban poor in several programs such as in Indore, India (Agarwal et al. 2008).

5.4.2 Creative Financing Options for Urban Health Services

Community health funds; community-based health insurance: Owing to poverty and irregular employment, often during health emergencies the urban poor face resource shortage that either delays or restricts their access to health services or leads to high indebtedness. To address this, collective savings by slum-based groups which are an unconventional form of community risk pooling have been adopted at various health programs in India, such as in Agra, Indore and Pune. Members of slum community based organizations (CBOs), who in most instances are women, collect Rs. 5–20 each month, as decided by the group members. This amount is disbursed to needy families as loan at a modest interest, decided by the group members (Jha et al. 2008).

In another similar approach that has increased access of urban poor to water connections and sanitation services, DAI in Indonesia under Indonesia Environmental Services Program (ESP) has supported low income households through providing them affordable and low risk loans (Hollenbach and Bahar 2009). Community health insurance is another method of risk pooling. In India and other developing countries various examples of community insurance exists, which takes care of the cost for accessing health care, mainly for surgery and hospitalization needs for the urban population at reasonable costs. One such example is of Self Employed Women's Association (SEWA) in India, in which self employed women, who are member of SEWA cooperatives, and their dependents are provided a cashless hospitalization of up to expenses Rs. 2,000 per year. The women pay a premium of Rs. 85 per person per year.

5.4.3 Role of NGOs: Between Providers and Communities

Role of Civil Society Organizations (PVOs, NGOs): The roles of civil society organizations (also referred to in different contexts as Non-Governmental Organizations and Private Voluntary Organizations) are examined specifically in terms of complementing public sector or municipal services in, improving accountability of the health care system addressing determinants of health, advocating, promoting and facilitating people-oriented and equitable systems and policies and facilitating inter-sectoral actions for enhanced impact of health and related program initiatives.

Complement service delivery: When local governments, with their own capabilities and legal status, partner with NGOs (often with facilitation of a support agency) that demonstrate abilities to deliver targeted services with a minimum of bureaucracy, then new possibilities for serving the needs of the urban poor can be opened up. Following is an example of NGOs' contributions in making the program implementation more effective.

Planning of health programs: With their closer association to the poor and greater knowledge about poverty clusters and available facilities of their area NGOs have helped city governments to locate and plot slums (including unlisted and hidden clusters) and facilities on a map. In several cities in India (parts of Delhi, Mumbai; Meerut, Agra and Indore) NGOs have prepared such city maps, which have served as highly effective tool of planning city programs (Siddharth 2004). In Bangladesh (Saidpur and Parbatipur municipalities under the Child Survival Program) and Nairobi (Kibera and other slums), Non-govt agencies have played a crucial role in planning and organizing the health care system for the slum dwelling population (Concern Worldwide 2009; APHRC 2009).

Demand Generation and Linking communities to services: The urban poor despite physical proximity to health facilities, do not have access to most of these facilities.

NGOs have effectively complemented the public sector efforts through enhancing demand, promoting optimal behaviors and facilitating linkages of the urban poor

with available public and private healthcare providers in Indore, India (Agarwal et al. 2007). Similar efforts have been successful through efforts of NGOs in Bangladesh (Concern Worldwide 2009) and Cairo (USAID and ESD 2007). Civil society agencies are able to enhance demand and facilitating improved linkages of the urban poor with health services by building social engineering which include a) deployment and capacity building of slum-based volunteers and b) promoting and strengthening slum-level women's health groups (Siddharth 2004). These approaches have led to increase in utilization of existing public health services.

Expansion of health care to un-served areas: As cities grow, the poverty clusters in the areas without health facilities remain unserved or under-served. In various cities in India (Institute for Research in Medical Statistics 2003; Siddharth 2004), Bangladesh (Concern Worldwide 2009) and Egypt (USAID and ESD 2007) NGOs have helped extend reach of health services to such under-served and most needy urban clusters.

Improve accountability and facilitate inclusive governance: NGOs can help improving accountability in program implementation through facilitating ward or health facility level multi-stakeholder review committees which can help in improving services, addressing problems of the public sector workers. They also make the community aware of their entitlements and empower them to negotiate for services that they rightfully deserve. The multi-sector and multi-level structure of city health systems in developing countries and the role of social capital in protecting or promoting health strengthens the need for truly inter-sectoral, or 'joined up' government activities (Harpham 2007a, b).

Addressing determinants of health: sanitation and related services in slums: NGOs such as Apnalaya and Society for Promotion of Area Resource Centers (SPARC) in alliance with federation of slum based women's groups such as Mahila Milan and the National Slum Dwellers Federation (NSDF) have facilitated the process of construction of toilet blocks in several cities, Mumbai and Pune. Communities manage the process of designing, contracting arrangements and construction of toilets and also formed maintenance committees. Such experiences demonstrate that sustainable environmental sanitation improvement programs are possible with community inclusion, community control over assets and better triangulation of community-government-donor agencies (Siddharth 2004; Patel and Mitlin 2001).

Influencing policy through advocacy and technical support to governments: Most of the developing countries have been traditionally rural and as an effect their policies are also focused on rural needs. Through evidence based advocacy NGOs can sensitize the policy makers rapid towards population transition and growing urban health needs and thereby can help bringing greater policy focused attention towards improving health of urban poor. The NGOs, based on their experiences can help policy makers in formulating pro-urban poor programs and their guidelines. Urban Health Resource Centre, an NGO working in India has been successful in convincing policy makers to include unlisted (unrecognized) slums in the purview of health programs. Mercy Corps in Indonesia (North Jakarta) has worked with municipal and national governments to facilitate strengthening the policies supportive to breast feeding (Mercy Corps Indonesia 2009).

In the Philippines, for example, CSOs provided services to low income urban households, but also lobbied for mayors with pro-poor policies and monitored elected leaders (Rifkin 1990).

Dar es Salaam Urban Health Project, Tanzania

Dar es Salaam, the capital city of Tanzania, is a typical example of the rapid urbanization process in sub-Saharan Africa. Health problems rife among the city's growing poor population include infectious and vector borne diseases like malaria and cholera, besides HIV/AIDS and emerging chronic diseases. The Dar es Salaam Urban Health Project (DUHP) was started in 1990 with joint funding from Government of Tanzania and the Swiss Agency for Development and Cooperation (SDC). The project aimed at strengthening of public health services and improving coverage and access to health services of the population, with special emphasis on women through ante-natal care and safe motherhood interventions and children through post-natal care and Integrated Management of Childhood Illness (IMCI).

Key aspects of the project included identification and targeting of vulnerable groups within the urban population, strengthening of the existing public health infrastructure to improve quality of primary health services, capacity building of personnel and training for better management of facilities and improving sustainability of healthcare financing through introduction of user charges. Community participation was ensured through membership in Health Boards at the Facility level. "Community-based health care (CBHC) and IEC implementers" carried out clinical outreach and health education activities among slum communities. All these helped increase the demand and utilization of primary health care, especially for maternal and child healthcare. Today the DUHP experience substantially influences health sector programs across the country. Active staff and community involvement and ownership of the project has laid the foundation for a more democratic health system with greater prospect of sustainability in the long term.

Vietnam Household Sanitation Revolving Fund

For the last 7 years, the international agency GHD is managing the Three Delta Towns Water Supply and Sanitation Project (3DT), for improved water supply, drainage, wastewater and solid waste management facilities in Bac Lieu, Ha Tien and Sa Dec urban wards and communes and developing the capacity of local institutions and community groups to manage these systems on a sustainable basis.

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At the start of the project, 53% of households in Ha Tien (population 40,000), 33% in Bac Lieu (population 135,000) and 27% in Sa Dec (population 95,000) had no toilets. Common practice was open defecation in rice fields or canals or in some cases pit latrines with fish pond toilets.

Cost-effective designs of sanitation were developed in consultation with the local community. Sanitation Credit Scheme (SCS) was developed in each town to establish a sustainable revolving sanitation credit fund at the town's women's union (TWU) level in each town in order to meet the credit needs of poor households to build septic tank systems. Parameters of the scheme were developed using a participatory approach. TWUs were given seed funds for loaning initially and additional funds for awareness generation and training. TWUs took full management control of the SCSs and ownership of the seed fund in 2005. Loans to householders were fixed at VND 1,500,000 with a repayment term of 15 months. Borrowers make fixed monthly repayments with an interest rate of 1% per month. 50% of the interest amount is returned to the credit fund to add to the loan capital, with the other 50% used to pay for salaries and overheads.

During the past 5 years septic tank coverage has increased significantly in the three towns, with more than 4,500 households, or approximately 22,500 people, having new sanitary toilets at home. Increased awareness has resulted in toilets being constructed even without loan assistance from SCS.

Bangladesh Urban Primary Health Care Project

Bangladesh has high maternal and infant mortality rates: 390 mothers died per every 100,000 live births in 1996–2000, and 54 babies died per every 1,000 live births in 2000, according to ADB's *Key Indicators 2002*. The Urban Primary Health Care Project, supported by a US\$40 million loan from ADB, supports 105 PHCs in the country's most populous cities of Chittagong, Dhaka, Khulna, and Rajshahi. Between them, the PHCs serve about 5.3 million people—most of them poor. It is implemented in partnership with NGOs and City Corporations which help run the PHCs. Other agencies like the Nordic Development Fund and the United Nations Population Fund provide equipments. The PHCs charge only Tk20 per visit and provide medicines at subsidized rates. Every PHC supported by ADB under the project has between three and six satellite clinics, which are basically weekly outreach clinics run by health workers in slums and other poor communities. They provide first aid, health education, counseling and referral to the PHC. The medical professionals at the PHCs and satellite clinics provide both preventive and curative medicine. They also provide counseling and advice on nutrition, family

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planning and domestic violence. The majority of patients at the PHCs are women and children. Women most often come to the centers for deliveries, and antenatal and postnatal care, while children are brought for treatment of infections like diarrhea and ARI.

The project helps fill a gap in the country's health sector, which has traditionally focused on reaching the rural poor rather than the urban poor. Yet in recent years, it is the urban poor who have had the worst health problems. The Urban Primary Health Care Project is helping prevent and cure illnesses, and reduce preventable deaths, especially among women and children.

5.5 Action Points for Taking This Agenda Forward

5.5.1 Global, National Policy Advocacy and Focus on Energetic Policy Implementation

It is critical for development agencies including donors, technical agencies, public health movers and shakers, think tanks, other global development players to unequivocally acknowledge the unprecedented demographic transition that the world is witnessing and the associated public health challenges that are emerging. There are two important and undisputed facts that will guide future public health policy direction: (i) One billion people, or one of every three urban residents, live in slums. By 2030, if trends continue, the number of slum dwellers will double, increasing the proportion of slum dwellers to two of every five urban residents (UN-HABITAT 2006); (ii) that there are sharp health disparities in urban centres with the urban poor suffering far worse health conditions than urban average data represents; urban slums are characterized by very poor access to health care, high incidences of communicable and non-communicable disease and injuries, high levels of under-nutrition especially among women and children and unacceptably high morbidity and mortality rates.

Almost all developing countries have had a long history of being predominantly rural which has led to a rural bias in policy focus for health and other social sector policies. It is important to undertake policy advocacy in close partnership with country level civil society players and involve country and regional governments as allies and partners as per the capacity and situation of governance in the country. A perseverant effort at policy advocacy will steadily build a team of urban health champions in developing countries. The energy and attention generated through the implementation of a lead program should be harnessed to catalyze policy advocacy efforts. Advocacy efforts aim to bridge the gap arising from lack of sharing of knowledge and experiences across agencies and technical areas. Such efforts are also critical for strengthening collaboration among health, urban infrastructure development, housing and social sectors in order to achieve better policies and programs for the urban poor, with the required financial and human resources allocated toward these programs. Such policy

advocacy efforts have shown substantial success in India, a country whose urban areas are growing at 34% decadal growth (Census of India 2001) and which has about 100 million urban poor (Government of India 2000). The Ministry of Health and Family Welfare, Government of India has taken a decision to soon launch a country level policy initiative by the name of National Urban Health Mission.

Country level policy advocacy efforts should be complemented with and linked to a global policy effort for lending requisite focus on urban health considering that the world has already become more than half urban and urbanization (associated with growth in urban poor population) continues at a rapid pace in developing countries.

Local government leaders and urban champions can be advocates for elevating urbanization onto the national agenda. Ministers, members of parliament, political leaders and national policy advisors can be advocates for putting urbanization and investment in human capital on the national as well as global development agenda.

Effective advocacy of the urban health agenda must be solutions-oriented. Simply put, while the scale of the urban health challenge is enormous, it is not hopeless. It should be stressed that there are key things that can be done to ameliorate the situation of failing urban population health systems, using the approaches suggested in this chapter.

5.5.2 Develop Lead Programs in Asia and Africa

To provide a strong dose of catalytic stimulus, donors, national, sub-national and city governments should join hands to develop need responsive programs in select cities. In light of the fact that the proportion of urban poor and the pace of increase of urban and urban poor population is fastest in Asia and Africa, these should be focus destinations for such early learning programs.

These lead programs can provide working examples to stimulate other cities in the same country and also encourage other countries to address urban health challenges systematically. Key elements that these lead programs should include (a) mapping all listed and unlisted/un-accounted poverty clusters to address inequity, and health resources in the city so that the map can serve as an effective planning and review tool; (b) develop and implement a program that has is based on consultations with stakeholders in the city; (c) involve as appropriate private providers, charitable facilities/clinics, NGOs for defined health care services including out-reach services; (d) proactively involve city, region and country authorities so that over the course of the project they are able to equip themselves with tools and capabilities to replicate/adapt lessons in other cities; (e) focus on periodic review of program progress and documentation of lessons learned to inform the program itself as well as other potential champions in other cities/countries; (f) utilize baseline data to describe conditions among urban poor habitations so and utilize the same for strengthening advocacy efforts; (g) lead programs should focus on health empowerment of slum communities through developing system of deployment, training and supervision of slum-based health volunteers and through promotion of

slum-based health groups to strengthen community-provider linkages; (h) technical priorities of maternal, neonatal, child health, nutrition, tuberculosis, water, sanitation and hygiene are critical areas to focus on; (i) the specific social historic urban context is important to form the basis of creation of solutions that suit local conditions.

Specifically, governments must be actively involved in designing health-service outreach and public-health infrastructure with the explicit intention of reaching a greater share of the urban poor.

SDC supported pro-poor health sector projects in N'Djaména (Chad), Douala (Cameroon) and Dar es Salaam (Tanzania) have served as crucial learning sites and lead programs not only for scaling up urban health programs in the respective countries but also for adoption in other African countries (Wyss 2003; SDC 2009; Harpham and Few 2002).

It is crucial to integrate prevention and health promotion programmes into comprehensive urban health programmes that include treatment and mitigation to achieve measurable decrease in the rates of incidence and prevalence of disease. This has been amply demonstrated by the success in Brazil (Berkman et al. 2005).

5.5.3 Make the Invisible Visible

A large proportion of slum dwellers are unrecognized and therefore uncounted. A large part of making the invisible visible and highlighting the need for action will require that data on slums is collected locally, through the process of community mapping. Making the invisible visible will not only help give slum dwellers a voice in the political process, but will also allow governments to better prepare and respond to the complexities, as well as to take advantage of the opportunities, that increasing urbanization will bring. Evidence from the National Sample Survey in India (58th round) in 2002 indicates that 48% of the slums are not part of official lists (National Sample Survey 2003). Counting in Kenya (Nairobi) has also left a large segment of slum population not counted.

Even when data is collected, it is often not adequately representative and the real health conditions of the urban poor are largely hidden by the distortion of urban averages, which give the impression that urban dwellers are better off than their rural counterparts.

5.5.4 Ensure that Underlying Determinants of Health are Included in the Scope of Programs

Even if limited by a specific technical funding stream, it is important for such programs to have a broader 'urban under-served habitation development/improvement approach' while maintaining the focus on "health". There is a need to focus on

environment issues such as water contamination, sanitation, drainage, growing threat of water and vector borne diseases therefore whatever programming model is used would do well to consider other sectors.

In a cash dependent urban economy, food insecurity is common among the urban poor. This remains an underlying determinant of under-nutrition and consequent compromised immunity, increased incidence of disease and poor health. The interactions of health with other sectors/issues (e.g., transportation, water, sanitation, and climate change) need to be better understood and articulated by those responsible for designing, managing and implementing plans targeted towards improving, among other things, urban population health.

5.5.5 Demonstrate the Economic Benefits of a Well-Functioning Urban Health System

With cities being recognized as the drivers of economic growth in most developing countries, one important dimension that is vital to emphasize upon national and city leadership is the far-reaching impacts of an urban health system that ensures good health in an inclusive manner, not leaving out the poor. Urban health is integral to the ability of educational programs to increase individual opportunities and labor productivity. Good urban health systems help to protect savings and permit their use in moving ahead rather than merely mitigating social costs. Together realities such as these go a long way towards the stimulation of sorely needed urban-based economic growth.

It is essential that heads of government, members of parliament, and ministers of finance recognize and address the health dimension of poverty in order to achieve national (and international) development goals. Health is a more equitable indicator of human well-being than economic output. As such, well-performing health systems, which are inclusive by definition as well as practice, are vital for development per se but are particularly crucial to the equitable development and success of rapidly growing cities, especially those in developing countries.

5.5.6 Engage the Urban Poor Communities as Active Agents of Change

It is a mistake to treat the urban poor as passive objects in need of rescue. That approach did not work in the past and is unlikely to work in the future. In several initiatives it has been observed that some of the most effective approaches to reduction of urban health problems had the poor themselves meaningfully involved in the program processes.

It is worthwhile to recognize that like the rich, urban poor also have an inherent desire for good health. They have proved to be potential partners in health and

development programs. Organized community groups have generated awareness, promoted health behavior and mobilized communities to take action towards improving their health status.

The urban poor are active agents of their own development, and their ability to organize themselves is ultimately a key to improving their lives for the long term (Garau et al. 2005). Communities that are not yet organized may need assistance in developing cohesion. Program experience has demonstrated that training communities and community leaders is best done by other communities and community leaders that have faced similar problems and successfully organized or by sensitive and socially committed field workers. This is an adaptation of the model that is successfully employed by which is made up of federations of community organizations in places like Kenya, India and South Africa.

With stimulation, motivation, training and mentoring slum-based community organizations can develop the capacity to effectively negotiate with the health providers in the public and private sector for increasing supply of health services and respond to the increased demand of the slum dwellers. Where slum-based women's groups are associated with such programs, these groups empower women and enhance their self-esteem, confidence, decision making capacity and ability to coordinate with health providers.

The initiatives from the community groups such as Mahila Milan, National Slum Dwellers Federation, Shack/Slum Dwellers International in Cambodia, India, Nepal, the Philippines, Sri Lanka; Africa: Kenya, Namibia, South Africa, Uganda and Zimbabwe can provide valuable lessons which can be adapted (d'Cruz and Mitlin *in press*). Similar experiences of slum based CBOs in Indore and Agra also have valuable lessons that can be utilized in different cities (Agarwal et al. 2007).

5.5.7 Capacity Building at All Levels

While working at the national level is important and financing in most developing countries flows from the that level, it is crucial to acknowledge that problems manifest themselves at the city level and strategies to address them are implemented and managed at the city level. The centrality of city governments to the effort of addressing the vulnerabilities of the urban poor implies a need to develop local capacity to act in terms of technical ability as well as through fiscal resources. Local governments cannot act alone.

In capacity building efforts, it is important to include managerial capacity including financial management so that when resources are allocated, the authorities at sub-national and city levels are able to expeditiously and effectively utilize the same for improving health of the underserved urban population. Members of local governments, researchers, and professionals such as health workers and planners also need training to better understand and respond to the changing and increasingly complex urban population health challenges that will continue to

mount with increasing urbanization and globalization. It is vital to focus on building capacity at the city, State and national levels.

Building capacity at the city level to equip municipal governments, urban planners and health professionals is vital. Local government leaders and local champions, in collaboration with local partners, can play a strong role in advocating/elevating the urban agenda to the national level, particularly as local actors are often the best placed to understand conditions on the ground.

Not-for-profit NGOs foster constructive engagement between the urban poor and public or private sector providers and thereby their contribution key intermediary roles has been noted in several program instances (Montgomery 2008). Slum-CBOs (community-based organizations) play a vital role in improving the lives of the urban poor. The urban poor are also potential advocates themselves. Their direct voice when facilitated at appropriate levels is potent and can contribute valuably to policy advocacy efforts. Hence capacity building efforts aimed at enhancing their ability to take better care of their health and also advocate for the cause of the urban poor (Agarwal et al. 2007).

5.5.8 Foster Learning from Experiences Through Exchange Programs and Dissemination of Lessons

It is important to utilize lead programs to share knowledge in terms of data, reports of slum mapping exercises, program planning consultations and program lessons through appropriate media to reach out to the global public health fraternity.

Another helpful approach is fostering city-to-city learning through exchange programs, study tours, convening of consultations aimed at mutual sharing and learning of program lessons for select cities/countries which have demonstrable examples.

Research groups would do well to bring out intra-urban disparities in usually observed DHS data to highlight the sharp inequalities between the urban poor and the well-off city dwellers will help strengthen the case for the cause.

5.5.9 Financing and Creative Utilization of Resources

Financing issues are typically related to national priorities, which are reflected in national budget allocations. International funding, such as development aid, flows directly to national governments and often does not adequately filter down to the local levels of administration, where it is needed to tackle the multifaceted challenges that accompany (unplanned) rapid urban growth. On an international level, these funds may be set up to flow differently to ensure that they reach the local level through the processes of poverty reduction strategies, regional development bank

planning, as well as the strengthening of international, national, regional and municipal networks (e.g., United Cities and Local Governments, Shack/Slum Dwellers International, etc.). The collective savings of the federations of slum based women's groups of Shack/Slum Dwellers for an Urban Poor Fund in Tanzania, Phnom Penh, Dar-es-Salaam and Mumbai (detailed reports available at sdinet.org/reports).

Creation of incentives to foster cooperation between local governments/health authorities and NGOs and CBOs in capacity building and service delivery (Agarwal et al. 2008) serve the interest of the urban poor. Incentives could take the form of national, local and international funds that would be dispensed to urban centres that demonstrated capacity and effective partnerships.

Among the opportunities identified to address financing issues at the national level were: helping to change the national budgeting processes (including capital budgets); developing national health accounts; and forming MDG-themed groups at national levels. At the local level, some opportunities to address financing issues were identified as the creation of municipal bonds; designing appropriate taxation schemes; strengthening city councils; altering city budget processes (to make them more inclusive, etc.); and using (and strengthening) community accountability processes.

Link major programs and sources of funds to facilitate economies of scale – Links should be forged with major health programs such as those focusing on HIV or HIV-TB co-infection, Child Survival/MCH, TB, Malaria, and Infectious Diseases (including AI) and more recently Climate Change related funding avenues to maximize impact. There are cross-cutting issues, such as communication, laboratory support, referral care, and NGO/private sector engagement that can be maximized in the urban environment.

5.5.9.1 The Real/Most Crucial Action Point

Translate words into action: The suggestion about lead programs can provide the catalytic stimulus for converting words/ideas into real action which reaches health benefits to the urban poor.

Slum Communities as Active Agents for Health Improvement in Indore, India

In Indore a rapidly growing mid-sized city in central India, strengthened social capital in slums part of the Indore Urban Health Program, is evident from the improved health promotion and negotiation capacity (assessed qualitatively through interaction with CBO representatives) of the CBOs. These CBOs now have at least six active members who meet once a month to review and plan health promotion activities for their respective slums/areas, are

(continued)

actively involved in group and individual counseling and Behaviour Change Communication (BCC) activities, and maintain information on MCH in their respective slum communities. They are also able to negotiate directly with local government officials and elected representatives for improved access to water or health services in their Basti. Indeed, seven CBOs are now registered formally with the government as independent organizations. They are also recognized as credible urban health organizations by the district administration and local NGOs and are, therefore, involved in other slum development programmes in Indore. These CBOs now clearly appreciate the value and benefit of collective action to achieve shared community goals. An important achievement of the demand-supply and linkage approach has been the evolution of slum CBOs as a potent institutional mechanism for implementing slum health and development programmes.

CBO members now function as role models, empower slum families to adopt behaviours, avail themselves of services, and negotiate for other slum development programmes. Moreover, focused programme efforts by Basti CBOs and CCTs, to foster community linkages with public and private health providers, have helped expand access to health services (Agarwal et al. 2007).

5.6 Knowledge Management in Urban Health in Developing Countries

5.6.1 Growing Importance of KM in UH in Developing Countries

Knowledge Management is an important emerging area. It deals with identification of information sources, their proper storage, usage and processing of the information to useful and easily understandable messages or knowledge and their effective dissemination.

Urban health is a relatively recently developed discipline and urbanization is growing at rapid rate leading to rapidly growing health needs of urban population and emergence of varied kind of challenges in providing health services to urban poor. In order to address these challenges various initiatives have been taken up by different agencies. For successfully addressing these urban health challenges and ensuring health services to all urban dwellers it is imperative that such innovative urban health initiatives are scaled up in all the cities. Such a large and rapid scaling up of successful initiatives there is an urgent need of documenting and disseminating the urban health related information, data, challenges and experiences from different urban health programs. For collecting the information, generating evidences and documenting program experiences a vibrant knowledge management

system is imperative. A robust urban health knowledge management system should be able to identify the information sources; it should also be capable to documenting and properly storing and widely disseminating the information so that the information could reach to all needy stakeholders.

The information that a KM system can collect and document may be from different kind of surveys and studies conducted on various aspects of urban health. The surveys through which data is collected may be of large scale such as census, demographic health surveys and other kind of similar surveys. In addition there could also be several smaller surveys and studies that provide crucial information on a issue in different socio-economic, political, cultural, spatial and temporal contexts. A sound KM system should be able to identify such well known and sparsely known surveys and studies. Another aspect that a KM system could deal with is collection of experiential knowledge. There are various successful and innovative urban health initiatives that have been developed for providing health services to varied nature of settings. Usually knowledge regarding the successful practices and strategies of such health programs remain with the individuals who carryout these programs. However, for getting full benefit of such initiatives and their scaling up would need collection of such information and institutionalizing the process of converting individual information in to a organized form that could be easily accessed by program planners, policy makers and other stakeholders. An effective urban health system should be able to identify the relevant information sources, documentation and collection of such information from the successful health initiatives.

5.6.2 Knowledge Sharing Avenues, Platforms and Approaches

A Knowledge Management System can disseminate and share information, data and experiences through various sources mentioned below:

Electronic dissemination of information is an efficient way of knowledge sharing through dedicated websites, web-pages and portals. Partnership with existing larger web-based networks and using them for information sharing can also help disseminating information to a wide range of stakeholders. ‘Urban Health in Developing Countries’, ‘Asia Urban Health Network’ and ‘One world South Asia Portal’ are some of the portals disseminating information on urban health issues. Establishing virtual networks of organizations and individuals working on the same issues can also help disseminating knowledge of successful programs, studies and researches. Workshops, seminars and other similar events also provide platforms for information sharing. Establishing health kiosks in slum clusters, phone based help lines and other similar methods could be helpful knowledge sharing avenues for end users or slum dwellers about disseminating information on optimal health practices, availability of health services and ambulance services in the event of health exigencies available in the neighborhood.

5.7 Conclusion

There is a clear urgency of the need to address urban health in the developing world, given the accelerated pace of urbanization, growing numbers of the urban poor without access to basic needs and inability of city health systems to cater to explosively expanding demand.

Action is required on multiple fronts for effectively impacting health needs of urban poor communities in developing countries. These include expansion in physical infrastructure and technical capacities of city health systems, inclusive services reaching the unserved and action on determinants of urban health through integrated approaches of urban health programming.

The challenge for developing countries, given their resource constraints, is to impact in an integrated manner urban health challenges on several fronts – unplanned urban growth and ineffective planning and governance, inadequate and inefficient health systems, lack of basic amenities and environmental and occupational health challenges.

There is now a rich and growing body of evidence from which such efforts can draw learning – whether it is community participation in health facility planning as in Dar es Salaam Urban Health Project, demand-supply linkage through community health workers as in Indore, NGO-managed health centres as in Bangladesh Urban Primary Health Care Project and creative low cost financing options like revolving funds in Vietnam or community health funds in Indore – all approaches offer a rich source of experience to inform urban health planning in other countries/cities with similar settings.

Effective solutions-oriented advocacy is the need of the hour, at all levels, to ensure proactive efforts in this direction. Moreover, central to these efforts have to be the urban poor communities. They have to be active agents of change, working together with governments and service providers to improve their conditions.

The picture of poverty, deprivation and poor health among the urban poor is the result of a complex of interrelated factors, best addressed through a convergent approach involving multiple stakeholders at all levels. It is hoped that growing policy and academic focus on this issue will spur concrete action at all levels towards multi-pronged response to the health and poverty related challenges of the developing world's growing numbers of urban poor.

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Chapter 6

A Pervasive Wireless Knowledge Management Solution to Address Urban Health Inequalities with Indigenous Australians

Nilmini Wickramasinghe, Indrit Troshani, and Steve Goldberg

Abstract A recent study by Adelaide Aboriginal and Torres Strait Islander Health (Gallaher et al., *In Our Own Backyard: Urban Health Inequalities and Aboriginal Experiences of Neighbourhood Life, Social Capital and Racism*, 2009) revealed some alarming findings concerning the health status of these groups. One of the key health areas that requires attention is that of chronic diseases in general and diabetes in particular. We propose using a wireless knowledge-based system developed by INET for enabling effective and efficient monitoring of patients with diabetes. We argue that systematic use of this solution can improve self-management and lead to positive healthcare outcomes. Key aspects of the wireless diabetes solution to facilitate self-management of diabetes patients are highlighted. Adoption facilitators and barriers, assessment criteria, and policy implications are also discussed.

Keywords Urban health inequalities • Indigenous Australians • Australian aborigines • Australian Torres Strait Islander people • Diabetes • Self-management • Pervasive technologies • Wireless • Healthcare

6.1 Introduction

Diabetes is a chronic disease that occurs when there is too much glucose in the blood because the body is not producing insulin or not using it properly (DA 2007). Considered to be an epidemic by many, diabetes is one the leading chronic diseases affecting Australians and its prevalence continues to rise (Catanzariti et al. 2007;

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AIHW 2008). An estimated 700,000 Australians representing approximately 3.6% of the population had been diagnosed with diabetes in 2004–2005 and between 1989–1990 and 2004–2005 the proportion of people diagnosed with this disease more than doubled from 1.3% to 3.3% (AIHW 2008). Diabetes not only reduces the patients' quality of life but it can also have serious complications. For instance, people with diabetes are at greater risk of developing cardiovascular, eye, and kidney diseases (Tong and Stevenson 2007; AIHW 2008).

What is particularly alarming is growing evidence that shows that this epidemic has had a disproportionate impact on the Australian Indigenous population compared with the total Australian population (AIHW 2008). For instance, in 2004–2005 Indigenous Australians, including Aboriginal and Torres Strait Islander people, were over three times more likely to suffer from diabetes than non-Indigenous Australians (ABS 2006). In the same years, hospitalisation and death rates due to diabetes for Indigenous Australians were approximately 11 and 12 times higher, respectively, than those of other Australians (AIHW 2008).

In general, many argue that Indigenous Australians are more susceptible to diabetes and associated complications than others due to a combination of genetic, biological, environmental and behavioural risk factors (Dixon and Webbie 2005; Thow and Waters 2005; Craig et al. 2007). Other contributing risk factors include the limited availability or accessibility of healthcare services for diabetes diagnosis and treatment (AIHW 2008). Additionally, “lack of available transport, financial difficulties and the proximity of culturally appropriate healthcare services present barriers to Indigenous Australians accessing healthcare, and feelings of marginalisation also present barriers to the efficacy of diabetes prevention strategies and treatment” (AIHW 2005).

Some of these risk factors are modifiable and, if eliminated or their impact reduced, diabetes management which consists of both medical and non-medical approaches can be significantly improved. The overall goal of diabetes management is to make the life of the patients that suffer from it as normal as possible (AIHW 2007; AIHW 2008). However, as there is no cure for diabetes, achieving this goal can be challenging because it requires effective lifestyle management and careful and meticulous attention and monitoring by the patient and health professionals (Britt et al. 2007).

In particular, to be totally successful, this requires patients to be both informed and active in their treatment regimen. Recognising existing healthcare disparities and the relative high susceptibility of Indigenous Australians to diabetes, a solution is required which provides the possibility for anytime anywhere monitoring of an individual's diabetes, thereby, contributing to its management.

This chapter focuses on non-medical approaches and investigates how a pervasive knowledge-based technology solution in the form of wireless enabled mobile phone application can be used to minimise the impact of selected modifiable risk factors on the urban Australian Indigenous population and in turn facilitate superior diabetes management. This solution is expected to enhance health outcomes by empowering Indigenous Australians and their communities living in urban areas.

6.2 Setting

6.2.1 *Current Australian Health Scene*

Both healthcare professionals and people with diabetes require quality information if disease conditions are to be effectively managed, detected early and/or prevented. Recent research shows that there are several deficiencies and gaps in the information provided by the existing system for monitoring diabetes in Australia (Dixon and Webbie 2006). First, data collected in hospitals are episode-based rather than patient-based which makes it difficult to determine statistics concerning individual admissions, re-admissions, and treatment patterns. Second, there is lack of data on incidence and prevalence by diabetes type that can help reliably assess the magnitude of the problem. Third, the accuracy of recording data in administrative data sets, such as hospital morbidity, mortality and general practice data is uncertain. Finally, clinical management information is derived from uncoordinated and fragmented data collections that are not representative of the entire population of diabetes patients which makes comparison, analysis and trend identification difficult.

These deficiencies are the result of the current health system setup. Based on fee-for-service episodic doctor-patient consultation, the current Australian health system can handle acute short-term illnesses involving a limited range of interventions including their diagnosis and treatment (Hunt 2007). However, this system is comprised of a mixture of fragmented private and public healthcare subsystems that provide both funding and healthcare delivery. Largely uncoordinated, these subsystems are deemed to be unsuitable for the treatment of long term chronic diseases in general (Dixon and Webbie 2006). Chronic diseases, such as diabetes, require teams of various health professionals and long term support to help sufferers make effective healthy lifestyle changes and constantly maintain them (Hunt 2007).

6.2.2 *Current Research*

Diabetes management involves a combination of both medical and non-medical approaches with the overall goal for diabetes patients to have a life which is as normal as possible (AIHW 2007; AIHW 2008). However, as there is no cure for diabetes, achieving this goal can be challenging because it requires effective lifestyle management and careful and meticulous attention and monitoring by both patients and healthcare professionals (Britt et al. 2007). In particular, to be totally successful, this requires patients to be both informed and active in their treatment regimen. Also known as patient empowerment, this is achieved by effective self-management which is a non-medical approach and which constitutes the focus of this chapter (Mirza et al. 2008).

Self-management is important as it empowers people with diabetes and it acknowledges their central role and responsibility for managing their healthcare (ICIC 2008). Recent research substantiates the notion that active participation of diabetes patients in self-management is a key strategy for managing their condition (Colagiuri et al. 1998; Wellard et al. 2008). Therefore, self-management is extremely important in reaching improved treatment outcomes for these patients (Poulton 1999; Rasmussen et al. 2001).

However, self-management is a constantly time-consuming task that requires significant self-discipline (Russell et al. 2005) and support strategies that include assessment, goal-setting, action-planning, problem-solving and follow-up (ICIC 2008). Moreover, because effective self-management may require patient interaction with various healthcare professionals, including general practitioners (GPs), diabetes educators, dieticians, optometrists and community nurses (Knuiman et al. 1996), difficulties can arise when people with diabetes encounter problems which range from making appointments to needing to travel to many locations (Zigbor and Songer 2001; Van Eyk and Baum 2002; Wellard et al. 2008).

Current methods used in Australia for achieving patient self management include various types of training and education and support options including peer-led, generic and tailored chronic disease self-management planning, training and support, telephone coaching etc. (Francis et al. 2007; Harvey et al. 2008). Although these were found to be effective to various extents, they are also resource-intensive and their long-term sustainability is questionable (Francis et al. 2007). Additionally, current research shows that quality improvement factors including timeliness, confidentiality, continuity, dignity, communication, access, education, cost, amenities and autonomy, still remain relatively elusive in the ambit of chronic disease services including diabetes (Tabrizi et al. 2008).

Although current research has provided solutions for supporting self-management (Chau and Turner 2006; Rudi and Celler 2006) these have not always been effective due to the reality that “patients did not learn how to do it [apply the solutions] or they did not understand the rules which were explained to them, or they are not sure enough of their knowledge, uncertainty entailing indecision” (Reach et al. 2005). Nevertheless, research shows that computer-assisted telemedicine can help people with diabetes improve both their self-management (Balas et al. 2004) and their relationship with healthcare professionals (Bodenheimer et al. 2002; Downer et al. 2006). Therefore, in this chapter, we investigate the development and application a pervasive mobile technology solution to facilitate superior diabetes self-management with a focus on Indigenous Australians.

6.2.3 Urban Health Inequalities with Indigenous Australians

A recent report conducted by researchers at Flinders University focused on indigenous urban health issues (Gallaher et al. 2009). The report underscores the importance of recognising both the existence of indigenous urban health communities and the fact that these communities can be heterogeneous. Nevertheless, some

common problems include urban-rural remote mobility which can be challenging for the healthcare system, health professionals and state governments.

Combined with the statistics showing that Indigenous Australians have a higher propensity and higher levels of diabetes than any other group in Australia, and that they receive at best poor healthcare delivery, the findings in this report suggest that additional support is required to helping them to monitor and control their diabetes conditions. Thus, long term and sustainable changes are necessary for urban healthcare of Indigenous Australians. One possible way to accomplish this is to adapt the INET pervasive and wireless knowledge-management solution for supporting superior diabetes self-management for urban communities of Indigenous Australians. This solution is described in the following section.

6.3 The Development of a Pervasive Mobile Technology Solution

We contend that a possible solution is to apply the INET pervasive technology solution which has proved successful in Canada and a test pilot in Chicago (Goldberg 2002a, b, c, d, e; Wickramasinghe and Goldberg 2003, Wickramasinghe and Goldberg 2004). Integral to this approach is the incorporation of a wireless enabled mobile phone that facilitates the ubiquitous monitoring of an individual's diabetes, thereby, contributing to diabetes self-management. The journey began by realizing that the traditional System Development Lifecycle (SDLC) was fundamentally flawed for healthcare initiatives. This was due to several reasons including the length of time it would take to realize the final application and the structures and inflexible stages that had to be traversed. Thus, INET developed a refocused SDLC model (Fig. 6.1a) and delivery framework (Fig. 6.1b). It was, thus, possible to keep the strengths of SDLC and yet move from start to finish in a much more compressed timeframe (Tables 6.1 and 6.2).

Successful web-based projects in healthcare require the consideration of many components. Figure 6.2 provides an integrative model for all key success factors that we have identified through our research (Goldberg 2002a, b, c, d, e; Wickramasinghe and Goldberg 2004; Wickramasinghe and Misra 2004; Wickramasinghe et al. 2005). What makes this model unique and most beneficial is its focus on enabling and supporting all areas necessary for the actualization of ICT initiatives in healthcare. By design, the model identifies the inputs necessary to bring an innovative chronic disease management solution to market. These solutions are developed and implemented through a physician-led mobile e-health project. This project is the heart of the model that bridges the needs and requirements of many different players into a final (output) deliverable, a "Wireless Healthcare Program". To accomplish this, the model is continually updated to identify, select and prioritize the ICT project inputs that will:

- Accelerate healthcare system enhancements and achieve rapid healthcare benefits. The model identifies key healthcare system inputs with the four Ps, namely, (1) *People* that deliver healthcare, (2) *Process* to define the current healthcare delivery tasks, (3) *Platform* used in the healthcare technology infrastructure, and (4) *Protection* of patient data.

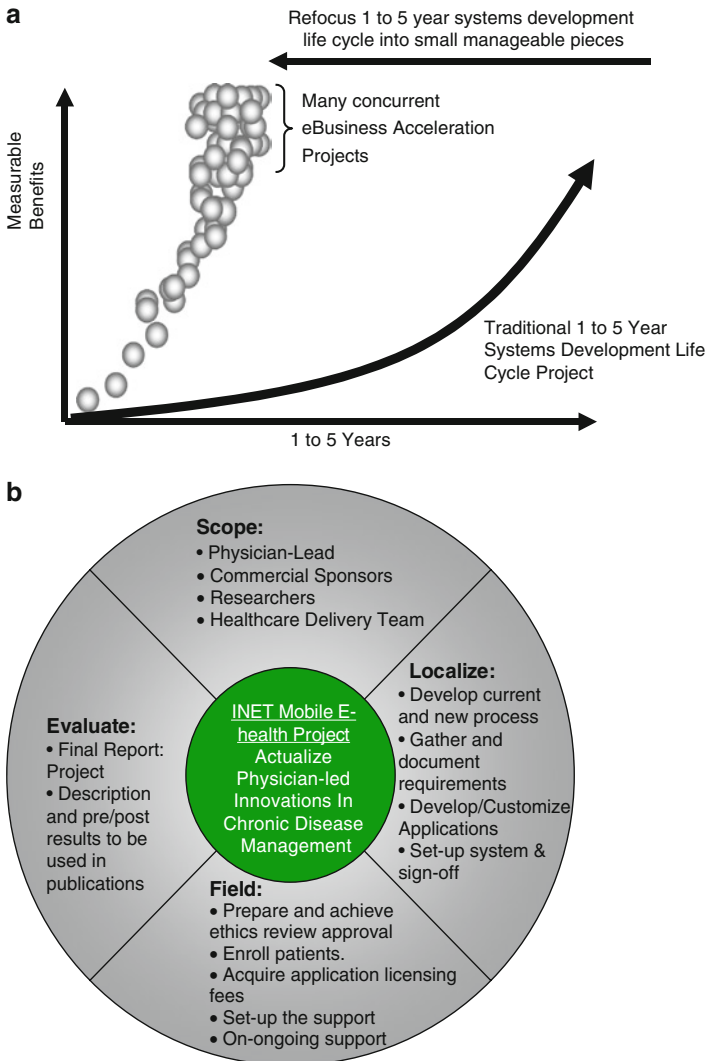


Fig. 6.1 (a) Re-focused SDLD model. (b) Components of the delivery framework

- Close the timing gaps between information research studies and their application in healthcare operational settings.
- Shorten the time cycle to fund an ICT project and receive an adequate return on the investment.

To successfully implement the business model described above it was, however, necessary to have an appropriate methodology. Based on this need the adaptive mapping to realization methodology (AMR) was developed (Fig. 6.3). The idea of the methodology was to apply a systematic rigorous set of predetermined protocols to each business case and then map the post-prior results back to the model. In this

Table 6.1 INET practice framework – compressing the SDLC

INET mobile e-health project		Localize	Field	Evaluate
SDLC (waterfall)	Scope			
I.T. Role & responsibility	Project management	Data analysis	Technical support	Account manager
	Business analysis	Technical tools expert Programmer Data administrator Network architect Database administrator Network administrator		
Investigation	Problem definition			Document solution, data analysis of outcomes, benefits and next steps
	Feasibility study – can objectives be met at a reasonable cost			
Analysis (logical design)	Project definition			
		Define what the IS must do to fix the problem Less temptation to follow existing practices which may not be best Define the user's requirements and priorities Develop logical design for the new system		

(continued)

Table 6.1 (continued)

INET mobile e-health project			
SDLC (waterfall)	Scope	Localize	Field
Design (physical design)		Define how the new system will work Detail schedule and budget Produce a physical design showing system inputs, outputs, user interfaces	
Implementation		Research technology product acquisitions Test programs, sub-systems and systems acquire or develop software Code programs Software developer manual System operators manual Purchase and Install hardware and software package Fix problem/solution determination	User's manual People changeover tasks Data conversion Technical changeover tasks
Maintenance			Fix database, network and 3rd Party products Fix security and access problems Fix learning curve time disruptions Fix collaboration problems

Table 6.2 Anticipated barriers and facilitators in Australia

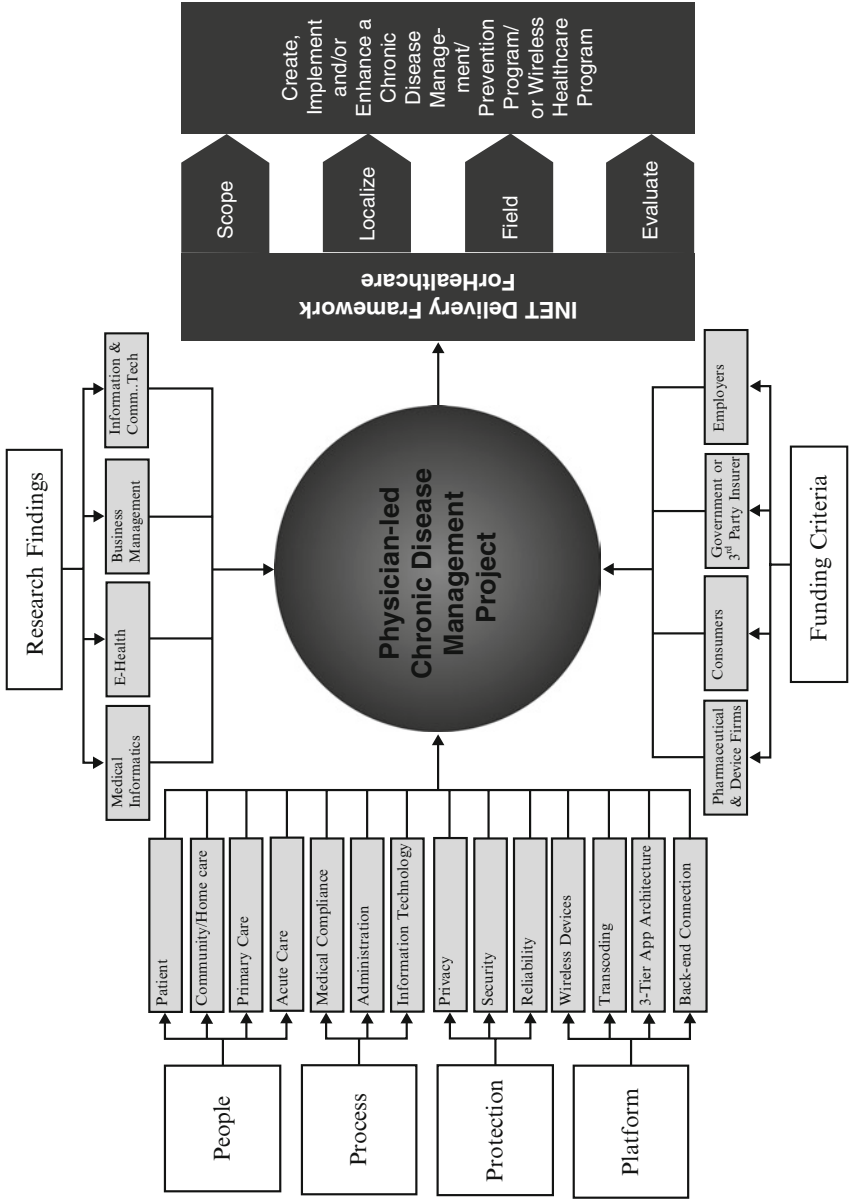
Issue	Description
Potential to reduce face-to-face interaction between patients and their clinicians	While this may be favourable for some patients, it may impact on the social needs of others for human interaction. This may lead to resistance or even rejection for adopting the proposed solution at both conscious and subconscious levels (Vanjara 2006). However, our solution incorporates mobile phones which are perceived to confer a social status amongst some segments of society which may well become an adoption facilitator. Furthermore, usage of mobile phones may also help eliminate the social stigma that can occur with alternative obvious devices that are used for monitoring chronic diseases (Mirza et al. 2008)
Mobile phones are location-independent making healthcare monitoring both flexible and ubiquitous, that is, not confined to specific settings, such as hospitals (Istepanian and Lactal 2003)	While also generating potentially significant cost savings (e.g. by reducing false positive or non-serious hospitalisations) for managing the care of non-critical diabetes sufferers our solution will also improve their quality of life (Norris 2002; Istepanian et al. 2004; Mirza et al. 2008). This may, thus, facilitate adoption of the proposed solution
The ageing population in Australia combined with the fragmented nature of the Australian healthcare system that is designed to treat episodic conditions, and the generally poor awareness of life style implications will increase the pressure on this system for better chronic disease treatment standards over longer periods (ABS 2003; Rowland 2003)	The pervasive nature of our solution combined with its ability to offer targeted and tailored health messages can contribute to ease that pressure, and consequently, become a facilitator for its adoption in Australia (Neville et al. 2002)
There is evidence suggesting that to date, some sectors of the healthcare system in Australia have not been convinced of the benefits of ICT in general and pervasive mobile solutions in particular (Yu et al. 2008)	At least partially, this is due clinicians' preference and bias towards traditional face-to-face forms of interactions with their patients (Skulimowski 2006). Furthermore, in a recent study, Australian nurses and clinicians considered that the vast majority of employers did not encourage ICT training, and for those for whom training was available, heavy workloads were considered to be major barriers for training uptake (Eley et al. 2008). Taken together, these factors are expected to become barriers for the adoption of the proposed solution. Organisational changes, including establishment or awareness and training are, thus, required for extended adoption and diffusion (Mirza et al. 2008)

(continued)

Table 6.2 (continued)

Issue	Description
Proposed wireless solution is expected to be highly cost-effective for people with diabetes	Costs to patients are estimated to be confined to data transfer charges which include the systematic texting (e.g. by SMS) of glycemic levels (measured by HA1C readings). With increasing competition amongst Australian operators, data transfer charges are expected to decrease in the future (Rao and Troshani 2007a). Another possible cost to patients may include mobile handset acquisition. However, with a very high mobile penetration rate in Australia, diabetes patients are likely to already be in possession of mobile phones (Rao and Troshani 2007a, b). Nevertheless, our proposed solution may require investment outlays from health providers. Initial setup, operational, and supporting infrastructure costs may be barriers for the smooth adoption of our solution in Australia (Khambati et al. 2008)
Perceptions of security and privacy are likely to have a strong bearing on the successful adoption of the proposed solution	Although the proposed model accounts for protection of patient information in terms of privacy, security, and reliability, both individual and organisational adopters are expected to require solid guarantees that continuous security improvements will reliably safeguard the privacy of patient data. Nevertheless, extant research shows that these concerns may dissipate overtime as mobile technology matures and benefits and convenience begin to be experienced on a wide scale (Mirza et al. 2008)
General inhibitors	Other factors that, in various forms, may become barriers for the adoption of our solution in Australia include existing disparate legacy systems and possible integration costs, lack of standards and limited bandwidth (Mirza et al. 2008). Additionally, prioritisation and decision-making processes concerning the introduction and diffusion of new health technologies in some areas in Australia are described to be 'ad-hoc' (Gallego et al. 2008). Budgetary constraints often drive uptake and diffusion of new technologies (Gallego et al. 2008)

Fig. 6.2 The key inputs include *people* (patient, community/home care, acute care and primary care), *process* (medical compliance, administration and information technology), *protection* (privacy, security, reliability) and *platform* (wireless device, transcoding, 3-tier application architecture and back-end connections). Funding criteria consists of any or all of the categories of pharmaceutical and device firms, consumers, government or 3rd party insurer, or employers. Research findings include but are not limited to medial informatics, e-health, business management and information and communication technology. All projects are physician led and follow the INET delivery framework i.e. focus on scope, localize, filed and evaluate categories



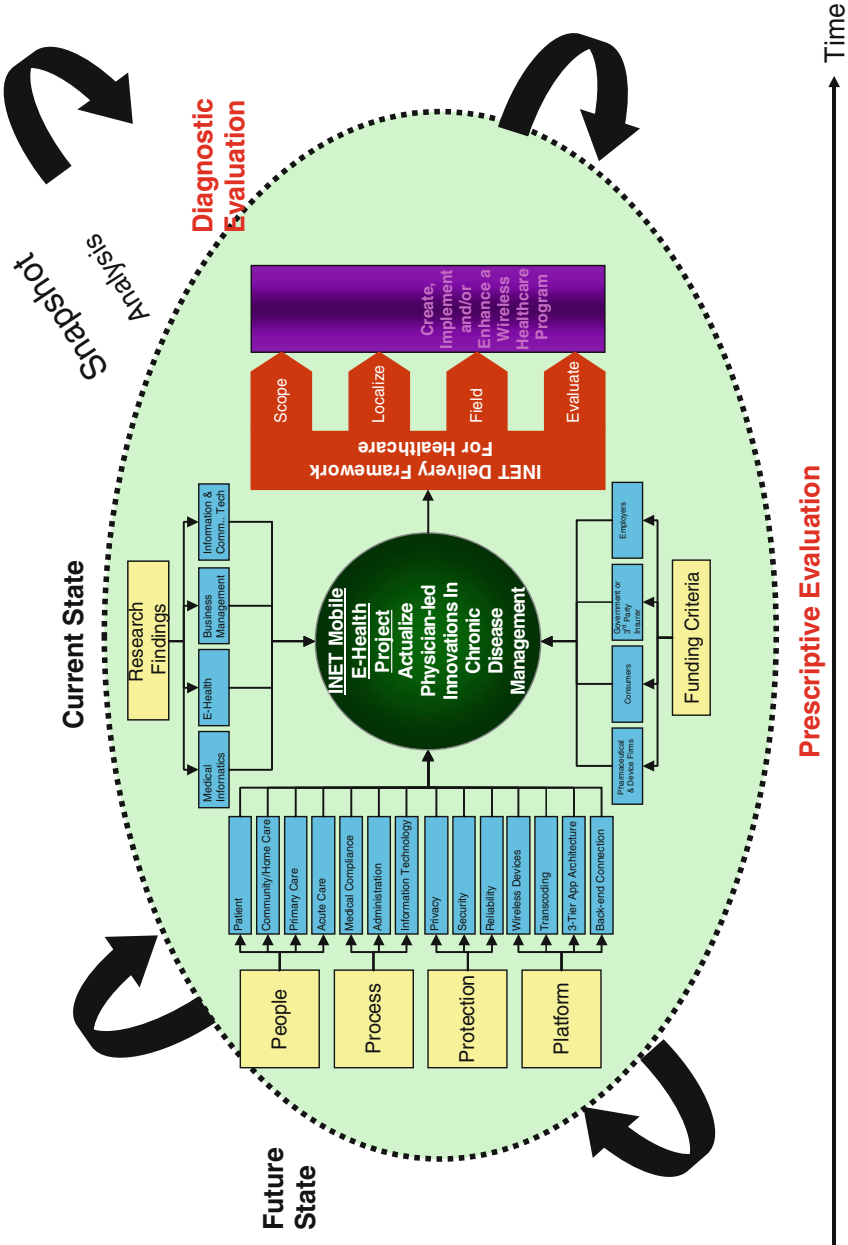


Fig. 6.3 AMR methodology

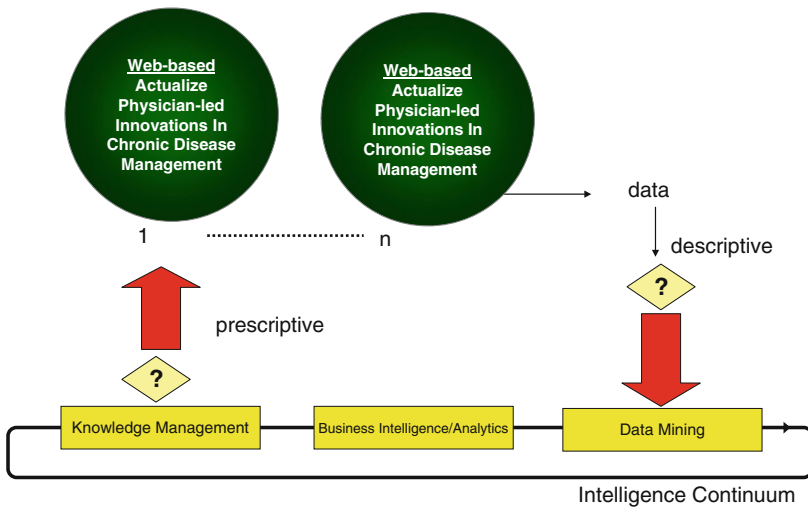


Fig. 6.4 Knowledge-based systems development model

way, it was possible to compare and contrast both *a priori* and *post priori* findings. From such a comparison a diagnosis of the current state was made and then prescriptions were derived for the next business case. Hence, each pilot study incorporated the lessons learnt from the previous one and the model was adapted in real time.

By applying the tools and techniques of today's knowledge economy as presented in the intelligence continuum (IC) it is possible to make the AMR methodology into a very powerful knowledge-based systems development model (Fig. 6.4). The IC was developed by Wickramasinghe and Schaffer (2006) to enable the application of tools and technologies of the knowledge economy to be applied to healthcare processes in a systematic and rigorous fashion and thereby ensure superior healthcare delivery. The collection of key tools, techniques and processes that make up the IC include but are not limited to data mining, business intelligence/analytics and knowledge management (Wickramasinghe and Schaffer 2006). Taken together, they represent a very powerful system for refining the raw data stored in data marts and/or data warehouses and thereby maximizing the value and utility of these data assets for any organization. To maximize the value of the data generated through specific healthcare processes and then use this to improve processes, IC techniques and tools must be applied in a systematic manner. Once applied, the results become part of the data set that are subsequently reintroduced into the system and combined with other inputs of people, processes, and technology to develop an improvement continuum. Thus, the IC includes the generation of data, the analysis of these data to provide a "diagnosis", and their reintroduction into the cycle as a "prescriptive" solution. In this way, the IC is well suited to the dynamic and complex nature of healthcare environments and ensures that the future state is always built upon the extant knowledge-base of the preceding state. Through the incorporation of the IC with the AMR methodology we then have a knowledge-based systems development model that can be applied to any setting, not necessarily to chronic disease management.

The power of this model is that it brings best practices and the best available germane knowledge to each iteration and is both flexible and robust.

6.4 Discussion

The preceding discussion has outlined a pervasive ICT enabled solution which while not exorbitantly expensive, it facilitates the superior monitoring of diabetes (Fig. 6.5). The proposed solution enables patient empowerment by way of enhancing self-management. This is a desirable objective because it allows patients to become equal partners with their clinicians in the management of their own healthcare (Opie 1998; Radin 2006) by enhancing the traditional clinical-patient interactions (Mirza et al. 2008). However, because most work has focused on specific applications and proof-of-concept studies, this chapter would be incomplete without considering the critical success factors, including facilitators and barriers, that are expected to affect the ubiquitous adoption of the proposed solution among the

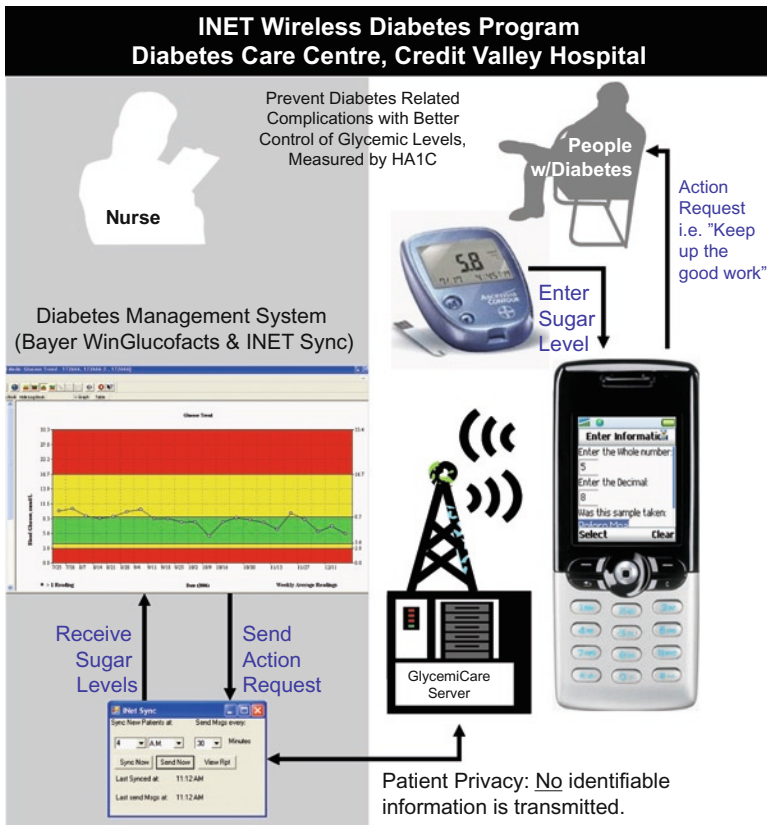


Fig. 6.5 ICT support for diabetes

Table 6.3 Assessment criteria of eHealth Solutions (adapted from (eHealthImpact 2006))

Assessment criteria	Description
Informed patients and carers	Direct access is provided to data, information, and knowledge concerning health, and the lifestyle impact on detection, prevention, wellness, treatment, healthcare facilities. This is necessary in order to accomplish effective decision making concerning health and lifestyles
Information designed around the patient	Data, information and knowledge should be patient centred in order to improve patient care
Timeliness	Data, information and knowledge are utilised in order to enable all possible kinds of healthcare to be scheduled at the appropriate time in order to meet the needs of the patients
Safety	Data, information and knowledge allow for the minimisation of risk, possible injuries and harm to patients
Effectiveness	Data, information and knowledge allow healthcare to be planned and developed from evidence and is provided to patients who need it while allowing healthcare providers to work effectively in multidisciplinary patient focused teams
Efficiency	Data, information and knowledge enable productivity improvements, optimal resource utilisation, and cost containment
Access	Data, information and knowledge help in order to enhance accessibility in that healthcare can be made available to all patients who need it

urban communities of Indigenous Australians (Gururajan and Murugesan *in press*; Mirza et al. 2008). In order to move smoothly from idea to realisation we summarise and briefly discuss these factors in Table 6.2.

We argue that the proposed solution can improve the quality of life and personal satisfaction of diabetes patients while diminishing possible complications as well as the overall burden of the disease (Coon and Zulkowski 2002). Although there is an increasing patient-oriented focus in healthcare, there are only limited studies that have systematically addressed the responsiveness of novel healthcare solutions toward patient needs and expectations (Kenagy et al. 1999; Tabrizi et al. 2008). Quality criteria have been discussed in past research focusing on structure, process, and outcome and are derived from observed facts, healthcare standards, and best practice guidelines to indicate poor or good quality healthcare (Campbell et al. 2003; Tabrizi et al. 2008). In order to assess the improvements in service quality provided by the wireless solution discussed in this chapter we propose adopting the quality criteria discussed in (eHealthImpact 2006). These criteria have been summarised in Table 6.3.

6.5 Policy Implications

The report concerning health of Indigenous Australians discussed previously points out the existence of stressful and unsupportive environments as one of the main reasons why Indigenous Australians engage in behaviours that might threaten their health (Gallaher et al. 2009). Consequently, while health education and awareness

have an important role, environments that support and promote health are also crucial to their wellbeing. Many health programs that attempt to promote prevention of chronic diseases appear to be based on behavioural change models rather than attempting to change the environment in which Indigenous Australians live (Gallaher et al. 2009). Thus, policy changes are required focusing on environments rather than only behaviour changes. The wireless solution proposed in this chapter can assist in implementing these adequate policy changes and in designing all-encompassing models of change. For example, the solution can help support Indigenous Australians through continuous positive reinforcement (see Fig. 6.5).

Another policy implication concerns the establishment of supportive networks which are recognised as an important determinant for ensuring the wellbeing of Indigenous Australians (Gallaher et al. 2009). Specifically, future research is currently being directed to investigate the manner in which social networks can be used jointly with the wireless solution proposed in this chapter to facilitate healthcare delivery (Goldberg 2009). Particularly, we believe that this can be achieved through the development of diabetes patient's own social network (e.g. in Facebook) in both urban and rural communities. In this way, we will not only be empowering diabetes patients in urban areas to take control and responsibility for monitoring and managing their own care but also making available to them as conveniently and as unobtrusively as possible access to the necessary community support via their social networks. Preliminary trials offer encouraging findings (Goldberg 2009). We firmly believe that such a model has large and far reaching implications for healthcare delivery in both urban and rural communities of Indigenous Australians.

6.6 Conclusions

We set out to present a case for the need to embrace a pervasive self-management technology solution for the superior monitoring of diabetes amongst Indigenous diabetes sufferers in urban Australia. We proffered the INET wireless solution as a suitable solution, for many reasons including that it is equally successful in controlling both type I and type II diabetes, is as effective irrespective of patient's age, socio economic standing or location and has minimal risks and a very slight learning curve (if at all). We contend that if this solution were to be incorporated into the healthcare of urban Indigenous Australians, the growing segment of the population suffering from diabetes would have a convenient, cost effective and superior means of monitoring and thereby controlling their diabetes while in turn enjoying a better quality of life.

The INET wireless diabetes solution facilitates governments, associations, pharmaceutical firms, researchers, healthcare professionals and other healthcare stakeholders that are looking for improved and measurable outcomes among patients suffering from diabetes. Specific benefits range from decreasing diabetes related complications to reducing the economic burden on the health system. We realise that

further research is required to test the proposed solution in the Australian healthcare setting with a focus on both Indigenous and non-Indigenous Australians that live both in urban and rural areas. Additionally, further research includes testing of aspects, such as perceived ease of use, perceived usefulness, etc. We conclude by warning that if a pervasive technology solution is not sought for the monitoring and support of diabetes self-management not only will this chronic disease become a silent epidemic but it will also be a very costly burden for both the healthcare sector and the community at large.

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Chapter 7

The Development of a Framework to Evaluate the Management of HIV/AIDS Programmes in Rural and Urban South Africa

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Abstract Nearly 40 million people worldwide are living with Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome (HIV/AIDS), with just 12% of those who urgently need treatment receiving it. South Africa has one of the highest cases of HIV infections in the world. Intervention efforts have not kept pace with the spread of HIV/AIDS, and a knowledge divide has been identified as a major factor in this. An initial empirical investigation suggests that HIV/AIDS organisations are working individually to address the problems, but there is no overall coordination between them, no system to share knowledge, and the organisations compete for the same funds. The result of this could be wasted resources and a systematic and systemic approach may assist in achieving better results. As mentioned above, a knowledge divide has been identified, and knowledge sharing between HIV/AIDS organisations is at best unplanned and at worst simply does not happen. Given these things, knowledge management would appear to be able to offer some ways forward. Combining systems thinking with knowledge management offers a powerful approach to addressing these issues. By using a hierarchy of systems complexity it may be possible to identify where approaches and possible solutions to problems have been incorrectly specified because they are addressing the wrong level. In this context, the right level refers to approaches of information technology, information systems and knowledge management. This chapter explains the background to HIV/AIDS in South Africa and the issues involved in addressing the management of HIV/AIDS programmes. The chapter outlines how these may be approached by using the concepts of knowledge management, systems thinking and the seven wastes of lean.

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7.1 Introduction

Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome (HIV/AIDS) is recognised as a global challenge and one of the most severe problems facing the world (Barnett and Whiteside 2006). AIDS was first recognised as a disease in the early 1980s and since then it has spread throughout the world (Agbola et al. 2004; Barnett and Whiteside 2006). In 2005 it was the leading cause of death in Africa; responsible for one in five deaths and it is the fourth most common cause of death globally (UNAIDS 2006).

Sub-Saharan Africa is the region most heavily affected by HIV/AIDS, accounting for 67% of the 33 million people in the world living with HIV/AIDS today and for 72% of AIDS deaths worldwide (UNAIDS 2008). South Africa is one of the countries hardest hit by the HIV/AIDS epidemic (UNAIDS 2006) and it is home to the largest population of people living with HIV in the world (Gillespie et al. 2007). South Africa currently has 5.7 million people with HIV and more than 350,000 South Africans have died of AIDS-related illnesses (UNAIDS 2008). In South Africa, an estimated 280,000 children (aged under 15 years) have HIV/AIDS and the estimated HIV prevalence of adults (aged 15–49 years) is 18.1% (UNAIDS 2008).

Intervention efforts have not kept pace with the spread of HIV/AIDS and a knowledge divide has been identified as a major factor in this (Sassman et al. 2008). An initial empirical investigation in South Africa suggests that HIV/AIDS organisations are working individually to address the problems, but there is no overall coordination between them and no system to share knowledge with the organisations competing for the same funds (Sassman et al. 2008). The result of this could be wasted resources and a systematic and systemic approach may assist in achieving better results. Such waste could be examined on an impromptu basis, but if a recognised approach is used it may provide results that are more transparent and more easily comparable with other studies. This research uses the concepts of the seven wastes of lean, systems thinking, and knowledge management to help address these issues.

The published literature reveals no frameworks that use knowledge management to help evaluate management of the development and implementation of HIV/AIDS programmes (Sassman et al. 2008). The combination of systems thinking with knowledge management offers a powerful approach to addressing the previously mentioned knowledge divide. By using a hierarchy of systems complexity it may be possible to identify where approaches and possible solutions to problems have been incorrectly specified because they are addressing the wrong level. In this context, there are three levels: information technology, information systems and knowledge management. These issues may vary between rural and urban areas.

7.2 A Comparison of HIV/AIDS in Rural and Urban Areas

Urbanisation has emerged as an increasingly important factor in the spread of HIV/AIDS, particularly in Sub-Saharan Africa. Contributing factors for this spread are improvements in transport infrastructure, with resultant increased migration. Communicable diseases, especially HIV/AIDS, spread faster and farther as road and transport networks expand (UN-HABITAT 2006). In Southern Africa HIV/AIDS first established itself in urban areas then moved into the rural areas along trucking routes, spread by the risky sexual behaviour of truckers and commercial sex workers (UN-HABITAT 2006). The spread of HIV/AIDS in Southern Africa also differs from other parts of the world because the virus is largely spread via heterosexual activity (Barnett and Whiteside 2006).

Data from other parts of the world shows that HIV tends to be concentrated in the larger cities, where opportunities for commercial sex work are higher and where drug use is more prevalent. In Argentina, for example, an estimated 65% of HIV infections occur in the capital, Buenos Aires, alone. Similarly, in Bolivia, the epidemic is concentrated largely among commercial sex workers in cities such as Santa Cruz and La Paz (UNAIDS 2004).

In South Africa the HIV prevalence rate in urban areas is higher than in rural areas, but the difference is marginal compared to that in other countries. In urban areas of South Africa the average HIV prevalence rate is 19.9% compared to 15.6% in rural areas (*see* Fig 7.1) (Shisana et al. 2005). The same study also shows that infection rates are highest in South Africa's poorest communities, in informal rural and urban settlements, where statistically more African people live than white, coloureds (mixed race) or Indian.

UN-Habitat (2006) defines informal settlements as 'residential areas where a group of housing units has been constructed on land to which the occupants have no legal claimed and/or unplanned settlements and areas where housing is not in compliance with current planning and building regulations'. These settlements (often referred to as squatter settlements or shanty towns) are common features of developing countries and are typically the product of an urgent need for shelter by the urban poor. They are often characterised by a dense proliferation of small make-shift shelters, degradation of the local ecosystem and severe social problems.

Shisana et al. (2005) found that adults (15–49 years) living in urban informal settlements had the highest HIV prevalence rate (25.8%), followed by adults living in rural informal settlements (17.3%) (*see* Fig 7.1). The same study also reported that 'Although only 8.7% of the total South African population aged 2 years and above lives in urban informal settlements, 29.1% of the total estimated number of new infections in South Africa are found in this residence geotype.' The reasons for the significantly higher HIV prevalence and incidence rates in informal settlements can be attributed to a number of risk factors that are associated with the conditions within informal settlements and socio-economic profile of the communities living in them. These include: overcrowding, poor access to medical facilities, high levels of mobility, poverty and substance abuse (Isandla 2007).

Regardless of the settlement type, the majority of people in need of treatment are still not receiving it, and campaigns to prevent new infections are lacking in many

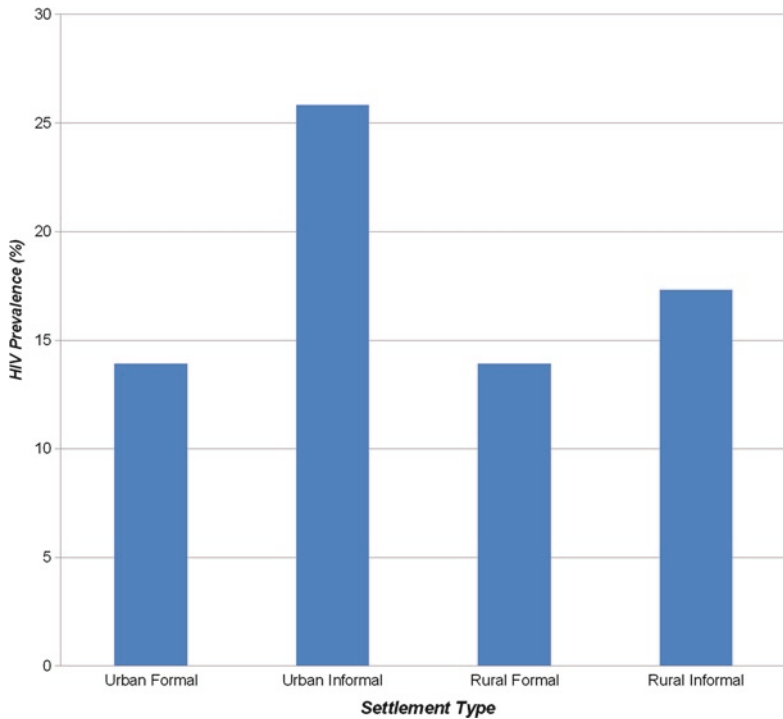


Fig. 7.1 HIV prevalence (%) per settlement type in South Africa (2005 HSRC/Nelson Mandela Foundation HIV/AIDS Study, Shisana et al. 2005)

areas (UNAIDS 2000). As part explanation for this, Bailey (2003) introduced the concept of the ‘knowledge divide’ in which a section of humanity is cut off from information and technologies that could help them. Despite the availability of technology to help control the disease, it has not been made widely available and people locally often do not have the knowledge to use the technologies effectively. Health data tend to be scarcer in poverty-stricken areas for example. This can result in a failure to ‘make the transition from information to action’ (Bailey 2003). It is postulated here that effective use of knowledge management (KM) may help to bridge this gap by helping knowledge to be disseminated appropriately.

7.3 Issues of Knowledge Management

The previous section indicated that there are culturally sensitive issues, a possible knowledge divide, and an uneven distribution of knowledge that contributes to some areas being affected by HIV/AIDS much more than others. It has emerged that managing knowledge more effectively and efficiently may be able to contribute to the more successful management of HIV/AIDS programmes.

Knowledge management (KM) is a new domain (depending on how defined) that appears as if it may help address some of the issues raised. Although knowledge management has been widely studied by academics, it has no universally accepted definition. Some principles however, are common in all definitions. For example, knowledge management involves people, processes, activities and technologies that enable sharing, creation and communication of knowledge. Lehaney et al. (2004, p3) derived the following working definition of knowledge management through theory, practice and reasoning.

'Knowledge Management refers to the systematic organisation, planning, scheduling, monitoring, and deployment of people, processes, technology and environment, with appropriate targets and feedback mechanisms, under the control of a public or private sector concern, and undertaken by such a concern, to facilitate explicitly and specifically the creation, retention, sharing, identification, acquisition, utilisation, and measurement of information and new ideas, in order to achieve strategic aims, such as improved competitiveness or improved performance, subject to financial, legal, resource, political, technical, cultural, and societal constraints.'

In essence, it is about systematically and routinely creating, gathering, organising, sharing, adapting and using knowledge, from both inside and outside the organisation, to help achieve organisational goals and objectives (Gupta et al. 2000; Milton 2004). Davenport and Prusak (1998) define knowledge management as 'a method that simplifies the process of sharing, distributing, creating, capturing and understanding of a company's knowledge.'

The foregoing definitions refer to knowledge management within an organisation, but the challenge in South Africa is different, because the delivery of health services is decentralised and each of the nine provinces is developing their own HIV/AIDS programmes (WHO 2007). This presents a knowledge management challenge. That is, how can managers allocate resources without accurate, timely information from the local and provincial levels? This has led to the development of several district and provincial health data-management systems. These are largely computer-based systems that require the input of massive amounts of locally-collected, high-quality data. Data collection and analysis has proven challenging and, in some cases, nearly impossible. Healthcare providers operate without clinical and patient care data management capabilities, with the majority of providers using paper, spreadsheets, or other low technology tools for these tasks. There is a need for information and data management interventions that would improve the ability to provide care to people living with HIV/AIDS, as well as the ability to manage the impact of the disease in their communities. Without this capability, providers significantly reduce their effectiveness in caring for patients, particularly in large numbers. For example:

- Records of patient demographics are not easy to maintain or change.
- Health status cannot be tracked over time. Test results, procedures, treatments, medications and other key clinical data are difficult to gather, sort, report, and analyse.
- 'Outlying' indicators cannot be flagged. Necessary follow-ups and a range of other care tasks cannot be acted on proactively.
- Clinical data for a single patient or for an aggregate of patients is not easily shared for outside support of the care-giving process or to promote and contribute to research and surveillance efforts.

- Healthcare providers are unable to acquire the associated skills that come with use of a data management system, which can contribute to the general strengthening of the healthcare sector and its human resources (WHO 2007).

The World Health Organisation (WHO) also recognised that improving strategic information and knowledge of the epidemic at local and national levels is ‘essential to guide planning, decision-making, implementation and accountability in relation to the response of the health sector to HIV/AIDS’ (WHO 2007). Wickramasinghe et al. (2004) discusses the benefits to the healthcare arena of incorporating these tools and techniques to make healthcare delivery more effective and efficient, and thereby maximise the full potential of all healthcare knowledge assets. Bailey (2003) suggests that ‘effective knowledge management in health can provide on an equitable basis the knowledge necessary for local innovation, and then produce new knowledge that is in turn fed back and shared in a dynamic regeneration process’. In organisations generally and in healthcare specifically, time, energy and resources are wasted because people repeat the same mistakes and develop new systems over and over again, rather than sharing what they know via reliable national networks so that they can learn from each other (Bailey 2003). One of the areas which has not yet fully utilised the advantages and benefits of knowledge management is managing HIV/AIDS. A literature search indicates that most research in this area focuses on simulation of HIV/AIDS (e.g. Simwa and Pokhariyal 2003; Xia 2003) and the development of information systems (e.g. Caceres et al. 2005; Zolfo et al. 2005).

The authors could not find any literature on the potential benefits of using knowledge management in the evaluation of the management of HIV/AIDS intervention and treatment programmes. The challenge is to establish a generic knowledge management-based framework with both theoretical and practical underpinning that is understandable and provide guidance for managers to evaluate the management of their HIV/AIDS programmes.

7.4 Development of Framework

The previous discussions indicate that a knowledge divide has been identified, and knowledge sharing between HIV/AIDS organisations is at best unplanned and at worst simply does not happen. Given these things, knowledge management would appear to be able to offer some ways forward. Combining systems thinking with knowledge management offers a powerful approach to addressing these issues. By using a hierarchy of systems complexity it may be possible to identify where approaches and possible solutions to problems have been incorrectly specified because they are addressing the wrong level. The seven wastes of lean enable a systematic and systemic approach to addressing what wastes might occur within the existing system and how they may be reduced by the use of an appropriate framework. In addition, a holistic and participative approach is likely to yield more successful results (Clarke and Lehane 2000).

7.4.1 *General Systems Theory and Boulding's Hierarchy of Systems Complexity*

Ludwig von Bertalanffy and Kenneth Boulding are considered the founders of General Systems Theory (Skyttner 2005). Bertalanffy started publishing his ideas on General Systems Theory in the 1930s and 1940s but only received recognition in the 1950s when his papers appeared in the American journal *Science*. The earlier work on Systems Theory developed largely from biology but has since been applied more directly to management related concepts (see Senge 1990).

Boulding (1964) formulated five postulates which are regarded as the starting point for the development of modern General Systems Theory. They may be summarised as follows:

- Order, regularity and non-randomness are preferable to the lack of order or to irregularity (chaos) and to randomness.
- Orderliness in the empirical world makes the world good, interesting and attractive to the systems theorist.
- There is order in the orderliness of the external or empirical world (order to the second degree) – a law about laws.
- To establish order, quantification and mathematisation are highly valuable aids.
- The search for order and law necessarily involves the quest for those realities that embody these abstract laws and order – their empirical referents (Skyttner 2005).

There are various ways of classifying types of systems. Boulding's (1956) 'hierarchy of systems complexity', Jordan's (1968) 'systems taxonomy', Checkland's (1971) 'systems map of the universe', and Jackson and Keys (1984) system of systems methodologies are examples. Boulding's hierarchy of systems complexity was one of the first major steps within GST, which 'aimed to provide a structure that could encompass all the disciplines and sciences' (Mingers 1997).

Boulding (1956, p7) describes two possible aims of GST:

'It aims to point out similarities in the theoretical construction of different disciplines, where these exist, and to develop theoretical models having applicability to at least two different fields of study. At a higher level of ambition but with perhaps a lower degree of confidence it hopes to develop something like a 'spectrum' of theories – a system of system which may perform the function of a 'gestalt' in theoretical construction. Such 'gestalts' in special fields have been of great value in directing research which they reveal.'

Boulding's (1956) complexity of systems hierarchy produced a classification of the different types of possible systems, ordering them in terms of increasing complexity. This is done by specifying a number of different levels, characteristics and by giving examples of each level and of relevant academic disciplines. Each level is said to include, in some way, the lower levels, and also to have its own, new, emergent properties complexity (Table 7.1). The first three levels are made up of physical and mechanical systems. The next three levels all deals with biological systems and the remaining three levels are of human, social and transcendental importance.

Table 7.1 Boulding's hierarchy of complexity (from Mingers 1997)

Level	Description	Characteristic	Example	Discipline
1	Structures and frameworks	Static, spatial pattern	Bridge, mountain, crystal, atom	Descriptive elements of all disciplines
2	Clockworks	Predetermined motion	Clocks, machines, solar system	Physics, astronomy, engineering
3	Control mechanisms	Closed-loop control	Thermostat, homeostasis	Cybernetics
4	Open systems	Structurally self-maintaining	Flames, cells	Theory of metabolism
5	Genetic-societal systems	Society of cells, functional parts	Plants	Botany
6	Animals	Nervous system, self awareness	Birds and beasts	Zoology
7	Humans	Self-consciousness, knowledge, language	Human beings	Biology, psychology
8	Socio-cultural systems	Roles, communication, values	Families, boy scouts, clubs	History, sociology, anthropology
9	Transcendental systems	Inescapable unknowables	God?	Philosophy, religion

Boulding (1956) explains the levels as follows.

The first level comprises static structures and relationships, called *frameworks*. These can all be described in terms of the static relationship, function or position. Examples are the arrangements of atoms in crystals, trees, houses, bridges and mountains.

The second level is called *clockworks*. This level is characterised by a predetermined dynamic structure repeating its movements. Examples are machines such as car engines, clocks and even the theoretical structures of physics, chemistry and economics.

The third level is that of *control mechanisms* or cybernetic systems. This level is often characterised by feedback mechanisms with transmission and interpretation of information. These mechanisms consist of a sensor, a control and an effector. A thermostat with its purpose-gear behaviour is an example for his level.

The fourth level is called *Open Systems*. This is the level where life begins and is often called the cell, the simplest unit of life. This level is different from the previous level in that it is an open system unlike the closed-system control mechanism in level three. Unlike the previous level this level can interpret the information it receives into the form of a knowledge structure. Flames and cells are examples for this level.

The fifth level is called the *plant* level. It is assumed that plants receive messages from their environment and translate it into some kind of simple image. Plants know when to do certain things in relation to their environment, e.g. seeding and flowering.

The sixth level is the *animal* where the main characteristics are various degrees of awareness and mobility. Specialised sensors convey information via a nervous system to the brain where information can be stored and structured.

The seventh level is *human*. The capacity of humans for gathering sensory information is not that much different from the animals at lower levels. What is different however is being able to organise information into large and complex images. Humans also possess self-consciousness and have a sophisticated language capability.

The eighth level is that of *social organisation*. The units of this level are the assumed *roles* and these are tied together by the channels of communication. Cultural factors are also significant for this level.

The ninth and final level is *transcendental*, or that of the unknowable. Very little description or explanation for this level is given.

The first three levels belong to the category of physical and mechanical systems and are mainly the concern of physical scientists. Levels of the cell, plant and animal are typically levels of biology, botanists and zoologists. The levels of human and social organisation lie in the interest of social scientists while the last level belongs to the area of philosophy.

By using a hierarchy of systems complexity in the proposed framework it may be possible to identify where approaches and possible solutions to problems have been incorrectly specified because they address the wrong level of complexity. As an example, an initial investigation indicates that information technology solutions are being applied to information systems and knowledge management problems, and this may result in waste.

7.4.2 *Seven Wastes of Lean*

In the 1950s, lean production principles were developed and successfully implemented by the Toyota Motor Company under the leadership of Taichi Ohno. These principles place an emphasis on systems to produce exactly what the customer wants at the lowest cost and with no waste. For example, Toyota strived to work towards the ideal of 100% value-added work with zero (or minimum) waste, with the outcome of increasing production efficiency (Ohno 1988). Womack and Jones (2003) define waste as any activity that consumes resource but adds no value as specified by the customer. Womack et al. (1990) noted that before addressing process waste, the typical Toyota plant devoted 20% of its physical plant and 23% of its worked hours to waste. After addressing process waste, Toyota managed to decrease the worked hours per car from 31 to 16, almost a 100% increase in productivity. In order to understand the waste, Toyota categorised the types of waste in order to 'learn where waste exists and to root it out systematically (Caldwell et al. 2005)'. These categories of waste are as follows:

- *Overproduction* – Producing things ahead of demand.
- *Waiting* – Inability to move to the next processing step.

- *Transport* – Unnecessary movement of materials between processes.
- *Over processing* – Inappropriate processing of parts, due to poor tool and or product design.
- *Inventory* – Storing more parts than the absolute minimum.
- *Movement* – Unnecessary movement of people during the course of their work.
- *Defects* – Production of defective parts (Womack et al. 1990).

Lean Principles are now being increasingly employed in service and public sector organisations in the UK and abroad (McCarron 2006). The most successful of these adaptations seem to occur when service organisations seek to manage the series of steps that produce value as a whole, rather than in bits. This systems approach has implications across the organisation, not least the measurement of productivity at system level rather than by unit, which focuses management effort on global rather than local efficiencies. McCarron (2006) suggests that lean can help to add detail to a systems view by encouraging managerial interest in the way work and information flows through the system, particularly where it flows freely and where there may be bottlenecks.

Most healthcare processes contain tremendous waste (Correa et al. 2005). David Sharbaugh, director of quality improvement at Shadyside Hospital in Pittsburgh, Pennsylvania, states ‘It’s not unrealistic at all to consider 40% and 50% waste in the healthcare system’ (Savary and Crawford-Mason 2006). A reason for this much waste is that *how* processes should work is not always clearly specified in healthcare operations, creating ‘inconsistency in healthcare operations, creating inconsistency in care, unreliable delivery systems and constant caregiver interruptions’ (Correa et al. 2005). These in turn create inefficiencies, higher operating costs, increased potential for errors and worker frustration (Jimmerson et al. 2003).

To eliminate waste, it is important to understand what waste is and where it exists. In Table 7.2 Correa et al. (2005) attempt to provide examples of the adaptation of the seven wastes of lean to particular circumstances of healthcare.

As mentioned earlier, lean principles or lean thinking as it is often referred to as well, seek to provide what the customer wants, quickly, efficiently and with little waste. An obvious application to healthcare lies in minimising or eliminating (within a framework of clinical excellence) delay, repeated encounters, errors and inappropriate procedures. Jimmerson et al. (2005) provide examples of its applicability in the United States while Jones and Mitchell (2006) provide an overview of lean thinking as applied to the National Health Service in the United Kingdom.

The literature does not appear to have examples of the use of lean principles applied to the management of HIV/AIDS programmes.

7.5 Conclusions

This chapter has outlined the current situation in regard to HIV/AIDS in South Africa, and has placed that in a world context. Reasons have been given for proposing a framework to address the evaluation of the development and implementation

Table 7.2 The seven wastes in healthcare (from Correa et al. 2005)

Wastes	Definition	Manufacturing	Healthcare
Overproduction	Producing more than the customer needs right now	Producing to stock based on sales forecasts Batch process resulting in extra output	Pills given early to suit staff schedules Testing ahead of time to suit lab schedule
Transportation	Movement of product that does not add value	Producing more to avoid set-ups Moving parts in and out of storage Moving material from one workstation to another Moving equipment	Moving samples Moving patients for testing Moving patients for treatment
Motion	Movement of people that does not add value	Searching for parts, tools, prints, etc Sharing tools, equipments, etc	Searching for patients, physicians, documentation, supplies, equipments, etc
Waiting	Idle time created when material, information, people, or equipment is not ready	Waiting for parts, inspection, information, equipments, etc	Patients waiting for bed assignments, admission to Emergency Dept., testing & treatment, discharge, lab test results
Processing	Effort that adds no value from the customer's viewpoint	Paperwork Over-tight tolerances	Retesting Excessive paperwork
Inventory	More materials, parts, or products on hand than the customer needs right now	Awkward tool or part design Raw materials Work in process Finished goods	Unnecessary procedures Bed assignments Pharmacy stock Lab supplies Specimens waiting analysis
Defects	Work that contains errors, rework, mistakes or lacks something necessary	Scrap Rework Defects Correction	Medication error Wrong patient Wrong procedure Missing information Poor clinical outcomes

of the management of HIV/AIDS programmes. These include the existence of a knowledge divide that helps to exacerbate the challenges, and the lack of a systemic approach that results in waste from organisations working independently, with no overall co-ordination. The proposed framework attempts to use systems thinking, knowledge management, lean principles, and a holistic and participative approach. The framework is being developed by considering how systems at each level utilise and depend on data (using IT), information (using IS) and knowledge (using KM). The foregoing discussion explains in detail why each of the proposed elements is included. The detailed framework will be published in a forthcoming paper.

The spread and incidence of HIV/AIDS varies significantly between rural and urban areas in many countries. In South Africa, whilst there is some difference between urban and rural spread and incidence of HIV/AIDS, that difference is marginal in comparison to elsewhere. The more noticeable difference is between formal and informal housing, with informal housing showing greater increases in the disease. Further work will focus on the knowledge divide, and the rural, urban, formal and informal housing factors.

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Chapter 8

The Potential of Serious Games for Improving Health and Reducing Urban Health Inequalities

M. Chris Gibbons, Rajeev K. Bali, Ian M. Marshall, Raouf N.G. Naguib, and Nilmini Wickramasinghe

Abstract The area of serious games is a relatively new academic area of interest. There are rich pedagogically sound contexts for using serious games particularly when applied to healthcare. This paper begins with a brief review of how serious games can be used as an effective learning and communication medium before applying the constructs to an Urban Health (East Baltimore) context. The paper outlines how, in this context, games can be used as a pedagogical tool to foster superior learning and understanding, support improved patient health outcomes and help address urban health disparities.

Keywords Serious games • Health inequality • Urban health • Gaming • Healthcare delivery

8.1 Introduction

It has been suggested that Health information technologies will become an important part of the healthcare delivery in the future. The field of Consumer Health Informatics is concerned with the development, utilization and evaluation of electronic health tools and applications designed specifically for patients and their caregivers. Growing evidence suggests that Consumer Health Informatics (CHI) tools can significantly improve patient health outcomes (Gibbons et al. 2009). Electronic games represent one genre of CHI tools and are also recognized as providing rich and effective learning contexts for participants/players (Prensky 2001; Gee 2003; Klein 1985; Stapleton and Taylor 2002). Historically, when applied to health and healthcare “serious games”, as they have been called are games used for training, advertising, simulation, or education (Herz 2002) that are designed to run either on personal computers (PCs) or video game consoles (e.g. Xbox or

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PlayStation 2). There are a growing number of video and computer games whose primary purpose is something other than to entertain (Jenkins 2004). Recent evidence suggests there may also be a role of serious games in behaviour change, medication adherence, wellness and disease self management.

The Woodrow Wilson International Center for Scholars (a public-private partnership) has as one of its goals to assist in the development of a new series of policy education, exploration, and management tools which utilize contemporary computer game designs, technologies, and development skills. As part of this goal the *Serious Games Initiative* plays a greater role in helping to organize and accelerate the adoption of computer games for a variety of challenges facing the world today (The Woodrow Wilson International Center for Scholars 2006).

8.2 Serious Games for Healthcare

The efficacy of serious games for a number of clinical and healthcare applications has been identified (Lowood 2006; Howell 2005) as there are numerous opportunities for using them in informing, educating and training patients, medical students and medical professionals in ways that ensure not only a more efficient but also a more enjoyable way of learning. In the healthcare environment, there is scope to:

- (a) explore the link between knowledge and behavior – an effective serious game can provide a useful environment for communicating specific knowledge, challenging skills and showing outcomes;
- (b) develop cooperative games which can enable players to increase communication inside and outside the game about self-care, and their feelings about their condition and understanding (for example, educating children about the dangers of smoking);
- (c) design games to encourage better health behavior and not just better health knowledge.
- (d) enhance health outcomes through the use of serious games to support traditional treatments and therapies.

8.3 American Healthcare

For the better part of the 20th century, and now into the twenty first century, The United States has been recognised as having one of the world's leading healthcare systems in terms of its use of leading edge techniques, technologies and application of latest medical findings to healthcare delivery (Starr 1982; Kongstvedt 1994). Looking at the miraculous cures, incredible surgical feats, control of infectious disease, and other aspects of American medicine, it is difficult to dispute the claim. But there is another story when one looks at the health of the nation's urban poor. The health care system in the United States seems to hardly touch many of the most vulnerable individuals and communities. Additionally, when medical care is

delivered, it is often inadequate to meet the complex health, social, economic, educational, and environmental needs of inner-city urban residents (Prewitt 1997).

The paradox of the modern American medical system is that, although it has an unparalleled capacity to treat and repair (particularly with regard to trauma and infectious disease), it is often ill-prepared to prevent illness, especially within the complex context of the urban environment. Although this contradiction has implications for the entire American population, its impact is greatest for those with the fewest resources, including the urban poor. For inner-city residents who often live close to large academic health centers, the paradox is all the more acute. Even though the “best care in the world” may literally be right next door, poor urban residents experience some of the worst health conditions, live in some of the least-healthy environments, and have some of the worst health indices of any population group in the nation – in some instances comparable to those found in developing nations.

8.4 The Challenges Within the Urban Environment

To understand the challenges with urban health in the US it is useful to consider East Baltimore as an appropriate microcosm. East Baltimore is home to about 100,000 residents, over 90% of whom are African American. Many East Baltimore residents suffer from not only poverty, but also poor health. In fact, despite its proximity to a prestigious academic institution (Johns Hopkins University), the East Baltimore community has experienced startlingly high rates of many preventable diseases and deaths. By the late 1990s, Baltimore’s health department statistics indicated that East Baltimore’s neighborhoods had the highest age- and sex-adjusted rates of morbidity and mortality from cardiovascular and cerebrovascular disease in the entire city. East Baltimore’s residents also suffered disproportionate incidences of diabetes, cancer, some pulmonary diseases, HIV-related illnesses, and substance abuse.

The rate of sexually transmitted diseases in East Baltimore was the highest in the country, and, in the case of syphilis, East Baltimore’s rates were higher than any city in the developed world. As many as 18% of the babies born in some East Baltimore neighborhoods were likely to experience complications arising from low birth weight, and as many as 12% of the first-graders presented with symptoms of asthma during the school year. East Baltimore had more than 10,000 residents (over one in ten) with alcohol or drug problems requiring treatment, was one of the nation’s most violent communities, and ranked near the top in reduced life expectancy (Beilenson 2002).

During the late 1990s and into the new millennium, the employment statistics for East Baltimore have been equally challenging. In a city with a relatively high unemployment rate (about 7%), the neighborhoods of East Baltimore suffer from higher rates of unemployment than anywhere else in the city. Ranging from about 10% to almost 14%, East Baltimore’s unemployment statistics provide another clear indicator of a community in distress (Baltimore Neighborhood Indicators Alliance 2004) Table 8.1.

Adequately addressing these health challenges is further complicated by long-standing attitudes of mistrust between the local University and the surrounding

Table 8.1 Challenges for urban health in East Baltimore

Urban health challenges
Poverty
Poor health
High rates of many preventable diseases and deaths
Highest rates of morbidity and mortality from cardiovascular and cerebrovascular disease
Sexually transmitted diseases rate the highest in the country
18% of the babies born likely to experience complications arising from low birth weight
12% of first-graders presented with symptoms of asthma
More than 10% with alcohol or drug problems requiring treatment
One of the nation's most violent communities
Reduced life expectancy
Higher rates of unemployment
Mistrust between the University and the local community
Disproportionate incidences of diabetes, cancer, pulmonary diseases, HIV-related illnesses and substance abuse

Table 8.2 Meeting some of the challenges with existing games (www.socialimpactgames.com)

Urban health challenges	Suitable game
• Poor health	Nutrition – feed the monster (health)
• Reduced life expectancy	A simple game to teach kids proper nutrition, sponsored by the National Dairy Council
• High rates of many preventable diseases and deaths	Infection – Nanoswarm: invasion from inner space A story of four teenagers and the game player piloting a miniature vessel through a human body to defeat a virulent plague of microscopic robots
• Highest rates of morbidity and mortality from cardiovascular and cerebrovascular disease	Heart attack awareness – “Heart Sense” A story-based game designed to increase heart attack awareness. The game targets “delay in calling 911” as its primary goal
• Sexually transmitted diseases rate the highest in the country	HIV/AIDS – “Interactive Nights Out” An interactive movie game in which the viewer chooses to be a male or a female who encounters situations with offers of sex, drugs, and alcohol. Topics addressed include definition of HIV, transmittal, risk factors and preventative measures
• Disproportionate incidences of diabetes, cancer, pulmonary diseases, HIV-related illnesses and substance abuse	
• More than 10% with alcohol or drug problems requiring treatment	
• 12% of first-graders presented with symptoms of asthma	Asthma management – Bronkie the Bronchiasaurus A side-scrolling adventure game that helps children and teens with asthma improve their asthma self-management

community. Many in the community believed that the local University was only interested in the community as a place to conduct research, and that it continued to build and increase its size at the expense of the community. On the other hand, many at the University were perplexed and resentful because they felt the community did not recognize the institution's commitment to programs and employment or the personal contributions of the University's faculty and staff in providing health care for the community Table 8.2.

8.5 The Potential of Serious Games for Reducing Health Disparities

The motivation for using serious games to combat health inequalities can be explained by goal-setting theory. From Tetlock and Kim (1987), we learn how individuals are motivated by goals, and the achievement of these same goals. Goals should be both accessible and attainable (Nash 2005a) and, in order to direct ourselves, we set ourselves goals that are:

- clear (not vague) and understandable
- challenging (to assure stimulation and avoid boredom)
- achievable (to minimize the chance of failure).

In explaining why people might want to play computer games, we can look to theories around intrinsic and interpersonal motivations which help us understand important features for game design and how to make a game fun. The reasoning behind why a person might be motivated to play a game can be explained by putting skills to the test (Malone and Lepper 1987; Dempsey et al. 1997), the popularity of a game (Malone 1980) or the way in which games can facilitate players to form and find subgroups within a "natural community", possessing common interests (Dyck et al. 2003).

An individual player's beliefs and values has an influence on their interest in a game (and motivation to play it), as does their social, educational, political and economic system (Inglehart 1997). When examining preferences in games and game design we should also consider the cultural, physical and communal environment that the player is embedded in (Joyner and TerKeurst 2006). Geographically defined consumer predispositions, and cultural aspects, are typically recognised as genre preferences in the games industry (TerKeurst 2002).

This genre preference can be explained by cultural differences (Hofstede 1994; Hofstede 1999) and their strong cross-cultural affinities for some genres. In order to better understand such preferences, it is necessary to study them in relation to the social and cultural infrastructure in which they operate (Fine 1983). By examining games, motivation and cultural inferences in this manner, we can consider a game's cultural elements that are constructed by members of a sub-society – or culture (Fine 1983).

Role playing games can be used to meet self-actualization needs (Abraham Maslow's *Hierarchy of Needs*); such needs revolve around the intrinsic growth

(Maslow 1970) of what is already in an organism (in this case, “bringing out” what is already within a person). In tandem with Hofstede’s work on cultural types, the *Hierarchy* allows us to better understand why people (or “sub-societies”) might like certain types of games and how these are played across different cultures.

A health-oriented serious game could be considered as a complex learning object; such a game could be extremely effective in scenarios (i.e. in East Baltimore) which involve a “social impact” or social problem. The pedagogy behind this game (in terms of learning objectives) would include enabling patients (learners) to practice decision-making skills, problem analysis, and cause-and-effect relationships. We agree with the fact that more detailed research is required in order to determine the relationship between various objects and learners’ motivation, self-concept, self-efficacy, and overall performance (Nash 2005b).

The selection of learning objects (Nash 2005b) and objectives therein should be selected so that they can be incorporated in the learner’s goal-setting system (i.e. via a game encapsulating a “serious” message). Any work or effort required to achieve the game’s objectives should be designed so that a student perceives it as being achievable. Learning object-driven instructional activities should be clear and easy to conceptualize, but also challenging enough to maintain intellectual engagement (Nash 2005b). Goal-setting (via games) that integrates a patient’s personal healthcare goals as well as helping attain his/her goals towards understanding can lead to “multi-pronged motivation” (Nash 2005b).

8.6 Discussion and Conclusions

The Information Age is continuing to necessitate changes in the way organizations operate; success for organizations is now inextricably linked to fostering and nurturing their intellectual assets. The East Baltimore health inequality example provided in this paper, coupled with the fast-paced environment of the Information Age, means that new learning techniques and pedagogies are also required to facilitate the learning experience and ensure superior, effective and efficient learning and transfer of knowledge ensues. To address this need we believe that the use of serious games to demonstrate clinical concepts, facilitate health education support patient behaviour change and enhance patient outcomes is an important initiative.

The stakeholder implications of this case study are important, especially for patients (end users) who are better prepared to understand clinical concepts which they have never experienced in a scenario which is both entertaining and educational (serious games). In this paper we have discussed the potential efficacy of using serious games in the urban health environment. Effective health games could, in the future, become an important means of improving access to life saving treatments and health interventions for those who have health insurance as well as the poor or uninsured. In so doing it could significantly improve urban disease prevention and wellness efforts and help to reduce health disparities. Given that the major challenges in East Baltimore urban

health scenario are consistent with the major challenges facing urban health throughout the US (Wisdom et al. 1997), we contend that the incorporation of serious games as a tool to help address healthcare delivery and outcome inequalities in urban environments should be further evaluated.

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Part III
Measures and Metrics for KM and Urban
Health

Chapter 9

A Scalable and Viable Strategy for Managing Organization: Typology of Intervening into Complex Healthcare Environment for Enhancing Its Continual Development

Murako Saito

Abstract Main topics in this Chapter are (1) classification of complex healthcare environment, by means of end-means hierarchy, two or three-axis models for categorizing clients and care-providers into strategic care units, (2) parallel distributed processing approaches for clustering the participants by their job consciousness and for disclosing the interconnectedness between the variables of job constraints and the criterion variables, provided with a Case Study, and (3) performance evaluation in individual and organizational levels in terms of ethical-social values and emotional-developmental values, by using evaluation indicators, such as team coherence, reciprocity, fairness or equity, together with performance reliability. Contextual performance is to be measured in addition with task performance for enhancing knowledge sharing and absorption in organization. Classification into strategic unit, or typology, is the first step in intervening and analyzing complex society and is a useful starting means to cope with diversified urbanization. Analyzing to see reality of your field is necessary step for making the participants work together without misunderstanding information presented and knowledge acquired in the process of organizational learning and for enhancing uniqueness of organizational culture.

Keywords Typology • Visualization • Classification • Performance evaluation • Job-consciousness • Viability • Organizational management

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9.1 Introduction

Scalable and viable strategy for managing organization is needed for meeting life value both of the clients whose life styles are diversified in urban area and of health-care service providers whose teams are composed of multidisciplinary professionals. Difficulty to move from one paradigm to another beyond cognitive barriers still exists in heterogeneous organization. We need multi-paradigmatic methodology for removing the scales from the established disciplines. Inter-subjectivity is a key to enhance and enrich the participants' individual development as well as improvement of organizational performance. Reciprocal mind of inter-subjectivity affected by value consciousness of their job, together with objectivity and subjectivity, plays an important role in enhancing creativity and vigorousness in the process of organizational learning. Developing reciprocal mind leads to enhancement of organizational resilience, adaptability and viability, in addition with keeping economic advantage in terms of marketing competition. What we say effective means to inspire the participants to be viable. Effective organization is a viable organization which has potentiality and absorption in coping with unexpected events induced by turbulence in society, and which also has an efficient problem-solving capability.

The focus in this Chapter was placed on scalable and viable strategies for managing organization in order to surmount cognitive barriers, by exposing difference in interpretation of information presented and difference of semantic processing, and by enhancing organizational atmosphere into more flexible/resilient. Without understanding information presented and its semantic judgment, vigorousness and creativity are hardly expected in the course of managing organization. Most of heterogeneous organization is hardly managed because of paradigmatic incommensurability.

Classification is the first step in intervening and analyzing complex and uncertain society and is a useful starting means to cope with diversified urbanization. Main topics in this Chapter are (1) classification of complex healthcare environment, by means of end-means hierarchy, two or three-axis models for categorizing clients, or care-providers into strategic care units, (2) parallel distributed processing approaches for clustering the participants by their job consciousness and for disposing the interconnectedness between the variables of job constraints and the criterion variables, provided with a Case Study, and (3) performance evaluation in individual and organizational levels in terms of ethical-social values and emotional-developmental values, by using evaluation indicators, such as reciprocity, fairness or equity, as well as performance reliability. Performance evaluation indicators are needed to measure the level of knowledge sharing and absorption enhanced in the process of organizational learning.

9.2 Classification of Complex Healthcare Environment for Making It More Scalable and Viable

Classification of complex healthcare environment by using ends-means hierarchical structure (Rasmussen et al. 1994) which was applied in a city located in the southern part of Japan, and also classification models by using two and three axes,

are introduced as the examples of the first step in scalable and viable strategy for managing complex, multi-disciplinary organization.

9.2.1 *Ends-Means Hierarchical Structure of Healthcare in Society*

Continuous healthcare services have been required to the hospitals in primary, secondary and tertiary levels, located in urban area. Classification by using ends-means hierarchical structure model in healthcare service is one of the examples for continuing appropriate healthcare service for the needs of people who live in an urban area in western part of Japan. Figure 9.1 illustrates one example constructed by four levels of means-ends hierarchy, such as hospital in tertiary level affiliated to University, rehabilitation center in secondary level, two situations, such as facilities for elders and socially handicapped in primary level, and living facilities and environment for whom are unable to live alone in most basic level of healthcare service. Accessible levels provided in community are the fundamental factors for sustaining appropriate healthcare and for achieving successful outcomes. Clients can have continuous healthcare service in means-ends hierarchical structure. Broad and intensive healthcare research viewpoints, such as in bio-medical and in bio-psycho-social aspects, are to be encapsulated in total ends-means hierarchy to bring most appropriate and also quick responses to clients for recovering from diseases and for rebuilding life environment How to connect hospital or facilities and GP, as shown in Fig. 9.2, is up to the developing level of urbanization and also up to economical and cultural constraints of the community. Top management is required to

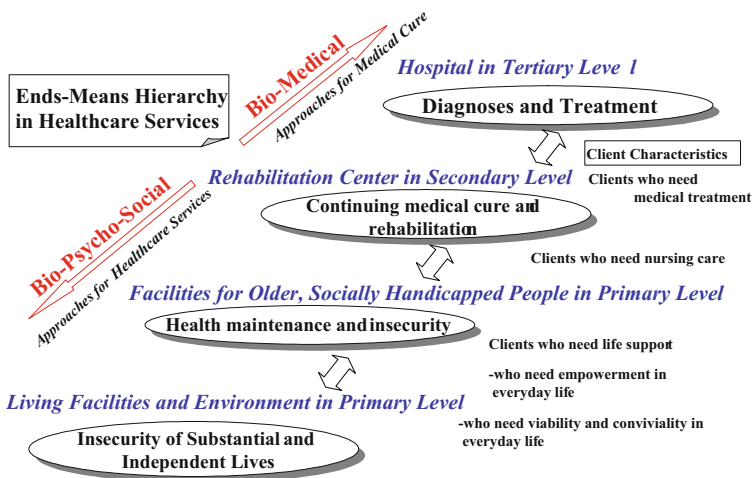


Fig. 9.1 Ends-means hierarchy classification in a community

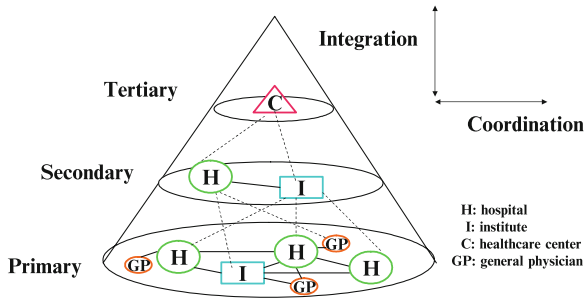


Fig. 9.2 Hospital, institute, center as component of health care system in community

make efficient and effective arrangement through trustful and strategic connection among hospitals, facilities in each level, and GP in local practice.

9.2.2 Two and Three-Axis Models for Categorizing Clients, Care-Providers into Strategic Care Unit

9.2.2.1 Two Axes Model, Life Style Evaluated by SES and by SDL in Care-Providers and, by SES and ADL in Clients

Positive association between social economic status (SES) and health has been reported in the field of Behavioral Medicine (Orth-Gomer and Schneiderman 1996; Weiss 1992, 1996). People who are the lower score of SES experience greater mobility and mortality of almost any diseases than those of the higher score (Syme 1986, 1996). The SES composed of income, education and occupational status is measured as the average of these components. Activity for daily life (ADL) is one of universal measurement of clients' activities in daily life in Rehabilitation Medicine. Support for daily life (SDL) is my proposition for comparison of women's occupational stress with men workers (Saito 1996a, b). Work stress of women worker with the higher of SDL was less than in the lower of SDL. Women workers were positive in working for promoting and also in the betterment of their family life. Women managers having children, or living with their parent who need care in daily life, can work as making good balance between work and family life, if their daily life is appropriately supported. Occupational outcomes in the case of working women are largely influenced by SDL and SES as well as by individual job competence (Frankenhaeuser 1996; Saito 1996a, b; Saito and Seki 1996). In the case of care-recipients/clients, their performances in daily life are influenced both by ADL and SES (Syme 1996; Chesney 1996). Scalable and viable strategy makes intervention of both care-providers and care-recipients more effectively feasible by applying classification of the stakeholders into strategic care units, as shown in Fig. 9.3, and then, by clarifying the relationship among social support, job stressors, or negative mood states.

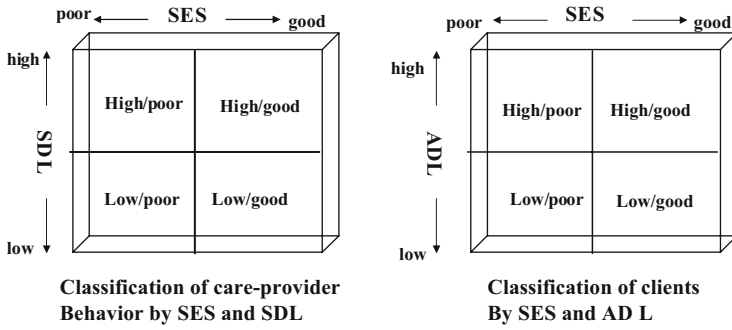


Fig. 9.3 Classification of care-providers’ behavior and of care-recipients by two axes, socio-economic status (SES) and support for daily life (SDL) in the case of care-providers, and socio-economic status (SES) and activities for daily life (ADL) in the case of care-recipients

Continuous intervention with classification into the types of care-providers and clients are to be taken to demonstrate the relationship among inadequate social support, job stress factors negative mood states. Job latitude or discretion of care-providers plays an important role for them to support their intervention into society and to promote their health. Research evidence addresses that workers’ job stress stems from the situation when they lose sufficient job latitude or discretion (Karasek et al. 1981; Karasek and Theorell 1990).

9.2.2.2 Visualization of Organizational Culture by Two-Axis Model by Economic Value and Controllability

It is very important in heterogeneous organization to visualize its visions and its strategies which all stakeholders have to understand and to share knowledge without misunderstanding. Two-by-two cell design is an example how to visualize. Two axes used in Fig. 9.4 are economic value and controllability of organization. You can select two axes depending upon your vision, constraints in work environment, and the situation you have confronted. As shown in Fig. 9.4, you can make four quadrants, innovative/creative type, competitive marketing type, controlled type and artist type of organizational culture, when you use two axes, economic value and organizational controllability. You can visualize current reality of your organization and also visualize a desired reality in the future. Visualization makes it easy and confident to understand the reality and future perspectives of your organizational visions among all stakeholders, which enforces knowledge sharing, creating new values, and ensures competitive advantage.

Visualization of current reality and desired reality is the first step for sharing future policy. According to the visions presented by the top manager, work procedures in strategic action have to be prepared by the actors who take action. Scalable and viable strategies are to be prepared by the actors who take responsibility of implementation. Before taking action, they have to understand by classifying, categorizing organizational complexity for sharing knowledge, especially procedural knowledge.

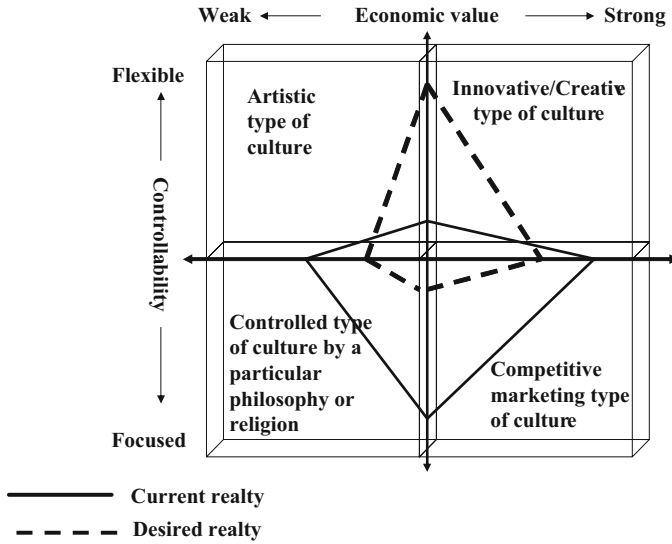
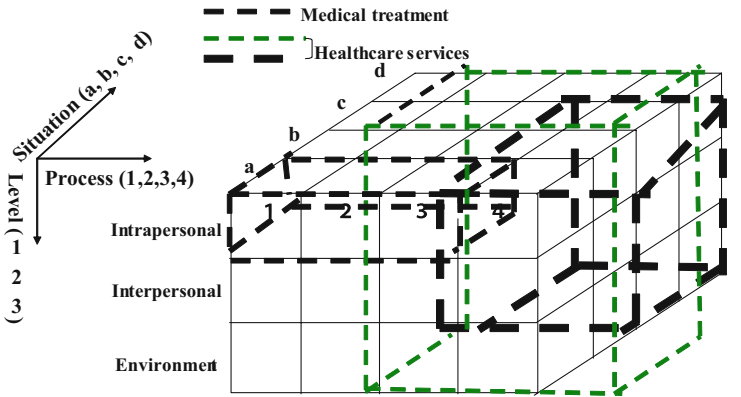


Fig. 9.4 Two by two cell design for diagnosing current and desired reality

They have to share procedural knowledge among different professionals by applying parallel distributed processing approaches (PDP), and by inspiring the participants to achieve their goals. Insight into a reality and a desired reality, processual perspectives and appropriate utilization of the constraints in workplace, which are all context dependent and are named to be a contextual intelligence (Mayor and Nohria 2005), are enhanced if they are combined with high level of IQ/or logical reasoning of the problem (Thurstone and Thurstone 1941; Schmitt and Chan 1998), and emotional intelligence (Boyatzis et al. 2000; Cherniss and Goleman 2001). Contextual intelligence makes workers help their interaction with different professional workers for enhancing organizational coherence, and makes them help to share knowledge for achieving their goals. Scalable and viable strategic process leads to a dynamic interaction for enhancing individual and organizational performance, if you can manage the strategic process appropriately.

9.2.2.3 Three Axes Model of Health Promotion Planning, Level, Process and Situation

Health promotion planning model was illustrated by three axes, such as level, process and situation (Weiss 1992). The focus in most researches in Medical Science had been placed on the patient in intrapersonal level and on medical check up, treatment process and rehabilitation. But, social aspects in the axis of situation and in interpersonal and environmental level were largely neglected. Family, job-related and social situations, however, are very important for recovering from diseases and for promoting healthy life. All the steps of process, such as health check up, treatment,



Process: 1. health check-up 2. treatment 3. rehabilitation 4. socialization
 1. information acquisition 2. information interpretation 3. analysis/decision 4. execution

Situation: a. individual/family b. provider intervention c. school/workplace d. community

Fig. 9.5 Classification of clients by level, process and situation

rehabilitation and socialization, more generally, information acquisition, information interpretation, analysis/decision and execution, are necessary for promoting health, as shown in Fig. 9.5. The example of classification in medical treatment was drawn by dotted line, and the examples in healthcare service were drawn by weak and bold dotted lines. Visualization of health promotion planning makes multiple disciplinary professionals understand correctly organizational goals and future direction and makes them being cooperative in coping with multi-factorial nature of the problem.

9.3 Clustering the Participants and Parallel Distributed Processing Approaches in Case Study

Parallel distributed processing approaches for setting prospective narratives, for exposing event sequences in heterogeneous organization constituted by multiple professions are useful for explaining causal relationship among the antecedents, mediators or moderators, and criteria. In this case study, two clusters, Group 1 ($N=95$) and Group 2 ($N=80$) were identified by clustering hospital nurses ($N=175$) by their job consciousness. Comparison of organizational performances, such as team coherence/reciprocity, performance reliability, job satisfaction, and fairness feelings adopted in terms of ethical-social values and emotional-developmental values, was made between two Groups, and causal relationship among constructs, such as work demand, organizational environment and criterion variable of fairness feeling, was also depicted by illustrating the difference between two Groups. PDP approaches help explore the depth below the surface of complex social events.

9.3.1 *Clustering the Participants by Job Consciousness, Such as Team Goal, the Goals in Disciplinary Area and Achievement Behavior*

Two Groups of significant different job consciousness, representing team goal, the goals in each discipline and achievement behavior, were obtained by clustering, as shown in Fig. 9.6 (Saito et al. 2007; Saito 2008). Job consciousness on individual professional goals in each disciplinary area tends to keep higher in the higher group, while the one in the lower group tends to become lower. As to behavioral aspect, this result suggested that achievement behavior in the lower group of job consciousness tended to keep slightly higher than the goals in each discipline and team goal. In the following Sects. 9.3.2 and 9.3.3, you will see significant difference in team performance between two Groups and causal relationship among structural variables and find some hints and tipping points in planning strategic management in your field.

9.3.2 *Comparison of Team Coherence, Performance Reliability, Job Satisfaction, Fairness, Between Group 1 and Group 2*

It was identified by our case study that team/or organizational performances evaluated by team coherence/or team reciprocity, job satisfaction and fairness feeling were significantly different between Group 1 and Group 2 clustered and shown in Fig. 9.6. Why and how this difference occurred between two Groups? You can really see the reason why, if causality among structural variables, such as the

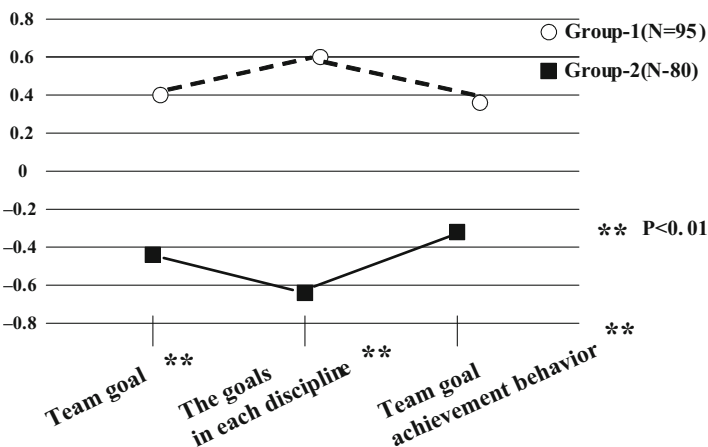


Fig. 9.6 Clustering hospital nurses by the degree of appreciation on goals and goal achievement behavior

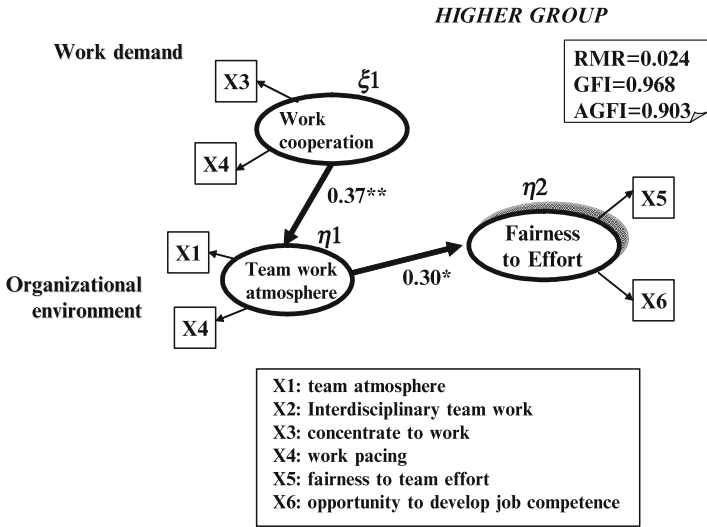


Fig. 9.7 Causal relationship among environment, work demand, and fairness of evaluation in the higher group in work appreciation

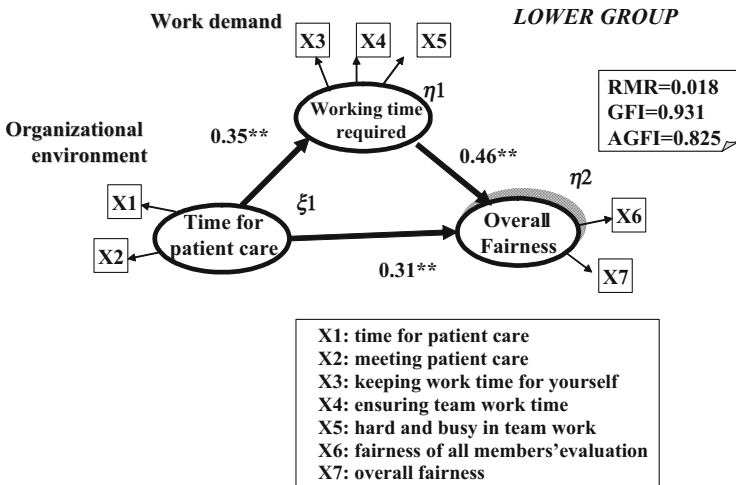


Fig. 9.8 Causal relationship among environment, work demand, and fairness of evaluation in the lower group in work appreciation

antecedents, mediators or moderators and the consequences in the field, is analyzed for identifying the structure of causation, as shown in Figs. 9.7 and 9.8 in next Sect. 9.3.3.

As to comparison of organizational performance, we used four indicators of performance evaluation, team coherence/or reciprocity measured by applying the TMX (Team member exchange quality, Seers 1989, 1995), performance

reliability by using nine common performance conditions (CPC's, Hollnagel 1998) which can be predicted human errors during work, job satisfaction by preparing six questionnaire items for this study including satisfactions about the work allotted, meaning of work and work pride. Fairness feeling of another indicator of team performance was measured in two aspects, fairness-1 signifies how subjects feel about team performance evaluation and fairness-2 means how subjects feel about individual effort-demand fairness (referring questionnaires by Janssen 2001) Organizational performances evaluated by these four indicators were significantly different between Group 1 and Group 2 (Saito et al. 2007; Saito 2008).

9.3.3 Causal Relationship Among Work Demands, Organizational Environment and Criterion of Fairness Between Group 1 and Group 2

One of causal relationships in the case of using the criterion variable of fairness feeling was picked up for this Chapter. Figures 9.7 and 9.8 are the examples adopted by one of the PDP approaches, i.e. covariance structure analysis, for unfolding event sequence and for setting narrations of the causation among structural variables, such as work demand, organizational environment and performance evaluation of fairness. Meanings of the variables represented are different between the higher Group and the lower Group of job consciousness. Work cooperation was represented in work demand, team work atmosphere represented in organizational environment and fairness to effort represented in fairness feeling in higher Group, while working time required was represented in work demand, time for patient care represented in organizational environment and overall fairness represented in fairness feeling in lower Group. Causal directions are also different between two Groups. In the lower Group, discrete causations were observed independently between work demand and fairness ($\beta = 0.46, P < 0.01$), and between organizational environment and fairness feeling ($\gamma = 0.31, P < 0.01$), while in the higher Group, the effect of work demand intermediated organizational environment ($\gamma = 0.37, P < 0.01$) was integrated as the total effect on fairness feeling ($\beta = 0.30, P < 0.01$).

Implementation strategy has to be prepared appropriately in each two Groups, since it was clarified that causal relationship among structural variables was significantly different between two Groups. There is no general narrative strategy, nor action strategy fitting to any fields. Reality in the field is a set of rhetoric, or of interpretation (Σ Rhetoric \in reality, Saito et al. 2007; Saito 2009) Analyzing to see the reality of your field is necessary step for the preparation of viable action strategy in order to enhance your organizational culture to be unique and to realize your desired reality.

9.4 Performance Evaluation in Individual and Collective/Organizational Levels

9.4.1 Individual Performance Evaluation

Multi-paradigmatic intervention to the field could be conducted by experienced facilitators and knowledge managers who can manage their organizational learning process and can also manage the ideas and the values generated from the process of reciprocal interaction among the participants. We do not need numbers of people, but the few people who can read their future, like a few of mavens as indicated by Rynes (2007). Only a small number of influential people who has insight into managing organizational context as well as job contents, can suggest how they had better go and indicate successful directions to make a big difference. This fact reminds us of Law of the Few (Gladwell 2002). A few of mavens, or early adopters of advanced technology are able to give strong influence, and experienced knowledge managers lead to change current states into a viable and resilient organization in order to ensure shared knowledge and shared prosperity. The participants who work as they are instructed, and who just follow technical manuals they are given, do not necessarily contribute as expected. We need people who can play influential roles to inspire coworkers with different professions, people who can manage to diffuse new values they created for bridging interdisciplinary gap, and people who can take care of new comers to their organization, depending upon the circumstances stemmed from your organizational constraints. The participants are not expected to have similar characteristics in knowledge, skills, attitudes and other characteristics. They are rather expected to be unique and creative as you are not substituted by any others. Individual performances of knowledge managers and mavens are to be evaluated as intellectual assets in terms of their uniqueness and their creative actions, referring to their contextual intelligence in addition with emotional intelligence.

9.4.2 Organizational Performance Evaluation

Evaluation indicators such as fairness, reciprocity, performance reliability, as explained in case study in Sect. 9.3, are useful as criterion variables in analyzing causal relationship among the antecedents, mediators or moderators and criteria. Fairness feeling, team coherence/or reciprocity, or equity are the representative indicators for evaluating contextual performance in organization and also for evaluating organizational citizenship behaviors. Performance evaluated by these indicators are different from input-output responses/or behaviors, but they are input-outcome behaviors/or actions. They are contextual performances, not just task performance (Borman and Motowildo 1997). Performance indicators which are inevitable in

managing organization in enterprise are incomes corresponding to financial inputs which are adjusted together with the outcomes of organizational behaviors and the outputs of technological systems reaction. Most of studies carried out in established academic areas do not deal with all together of these performance indicators. Academician deals with limited indicators by each discipline, but performance indicators of emotional and ethical values and job responsibility as well as economical indicators are to be adopted as organizational performance indicators.

9.5 Conclusions

9.5.1 Classification for Visualizing Complex Social Issues as the First Step for Removing the Scales from the Established Disciplines' Eyes

The feature of the professionals in heterogeneous organization is considerable autonomous and discretionary. They work independently, without reference to each other or to management. They are royal to their profession and committed to their clients rather than to their employing organization (Powell et al. 1999; Buchanan et al. 2007). It is hard to connect different professions in order to enhance knowledge sharing and to be responsible for their behaviors. The first step for aligning cognitive gap without misunderstanding is to visualize complex social issues they have confronted and to provide the basis for conversation among a range of discrete research areas. Visualization leads to sharing knowledge and to providing strategic narration in organizational learning process for achieving organizational goals, which removes the scales from the established disciplines' eyes and aligns cognitive gap among different professionals.

9.5.2 Narrative Strategy in PDP Approaches

Visualization makes the participants recognize reality and persuades them to be responsible in developing their work organization. Pursuing their goals is influenced by narrative strategy. Effective organizational performance is dependent upon how narration of probabilistic explanation to the goals are prepared. Reality is a set of rhetoric. There is no universal narration. It depends upon organizational context. There exists many ways of narration for unfolding event sequence of the causation among structural variables, namely business visions, organizational goals and environmental constraints as the antecedents, mediators or moderators in the process, and the consequences. One of the examples was shown in Sect. 9.3.3. By probabilistic explanation among three variables, such as work demand, organizational environment and performance evaluation of fairness, the difference between

two Groups, the higher and the lower in job consciousness, was clarified. Meaning of structural variables and path dependence between variables are different between two Groups. The PDP approaches help researchers explore the depth below the surface of complex social issues. There are no narrative strategies fitting to any fields. You can manage organization to achieve its goal and to be viable, if you properly analyze the reality of your field, and if you recognize the difference of your field from others.

9.5.3 Performance Evaluation

Performance of the participants is to be evaluated by measuring individual capability of relationship management competence/or social competence as well as self-management/or personal competence (Cherniss and Goleman 2001), not just by measuring the levels of knowledge, skill, attitudes and other characteristics (KSAO's, Schmitt and Chan 1998). The participants with high level of an organizational citizenship behavior like to accept being evaluated by team coherence, team reciprocity, fairness feeling rather than obligatory task or routine work which is given. Intelligence required in managing business organization is contextual intelligence in addition with emotional intelligence and IQ of basic logical reasoning. It is necessary for the participants who are expected to act as an organizational citizen to be evaluated by contextual performance (Borman and Motowildo 1997) as well as by task performance. The participants are inspired to develop their carriers in workplace where they are appropriately evaluated by contextual performance in addition with task performance.

9.5.4 Direction for Future Study

Future study on multi-paradigmatic methodology in knowledge management remains for realizing a desired reality both in healthcare providers and care recipients and in fact, in all the stakeholders in order to ensure knowledge sharing and enjoy shared prosperity. Research aspect of organizational alignment into a viable organization is still in embryonic state. Urban life values are changing under the influence of global economy underpinned by advanced information technology. People need empowerment of addressing what they can do for society, in addition with skill development of high technology. Future research has to be responsible to their needs which they themselves desire to have power of active participant and to change society by sharing knowledge with people in other world. Researches on development of explanation for the disclosure of complex interconnection of social event and on providing prospective scenario to a desired reality for all the stakeholders are left for future study. In developing narrative strategy, three approaches of action planning, such as pre-active planning, reactive planning and interactive

planning, and of solution of social issues, such as to solve by modern scientific approach, to resolve in clinical or experimental approach, and to dissolve in idealized/deconstructionist's approaches, as reported by Ackoff's logics of action triangulation (Ackoff 1999), are indispensable for managers to transform workplace environment into being innovative and viable. Most of researchers tend to concentrate and work inside their disciplinary boundary established and they act in quite limited area dependent upon their disciplinary constraints. Triangulation of logical thinking makes researchers or professionals who work in heterogeneous organization, recognize social issues and regulate relationship management in organization.

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Chapter 10

Amplifying Resonance in Organizational Learning Process: Knowledge Sharing for Overcoming Cognitive Barriers and for Assuring Positive Action

Murako Saito

Abstract Changing urban life requires us some approaches for aligning complexity emerged from contingency and uncertainty in advanced information society. Sharing knowledge without misunderstanding is of importance to provide effective and ethical services as well as efficient and secure services without mistake. Organizational environment in which people can trust each other and create new values is necessary for heterogeneous teamwork like in healthcare settings as well as in industry. Redesign of organization for continuing appreciative inquiries and for sharing necessary information without misunderstanding can be realized by strategic management, such as systemic management, cybernetic management and other strategic ways. Main topics in this Chapter are (1) strategic management of organization which enables to enhance individual job competence and organizational competence by holistic principle on the basis of systemic management and cybernetic management and (2) process activation of organizational learning by utilizing organizational constraints. Through organizational learning, knowledge can be appropriately and effectively shared among different professionals without misunderstanding and resonant mood at work is amplified among the stakeholders.

Keywords Knowledge sharing • Resonant mood • Cognitive barriers • Value alignment • Organizational performance • Organizational culture • Management of organization

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10.1 Introduction

Urban life has been diversified with the differences in life style, cultural background as well as generation and gender. Retired couples tend to move into rural countries, while some of older couples move into urban areas where they expect efficient and effective healthcare support than in rural areas. Changing urban life makes us to inquire the approaches to the alignment of complex urban life, i.e. value alignment by knowledge management. We need the place where we communicate and exchange our ideas in trustful atmosphere, however, there are very few to have mutually trustworthy relationship and to enable to share knowledge for overcoming cognitive barriers. In the healthcare delivering process, knowledge sharing without misunderstanding is of importance to provide efficient and secure service without operational mistakes. Healthcare team performance can be enhanced by amplifying resonant mood at work among all stakeholders. Amplifying resonance among stakeholders leads to the improvement of cultural resilience in organizational environment to withstand shocks and remain sustainable and makes people play roles of citizenship behavior for taking social responsibility in individual and collective levels.

Hierarchical organizations and closed type of organizations are still observed in Japan. The top in the organization had financial and management power, but did not necessarily have adequate and appropriate technological know-how for execution of strategic knowledge management. Cognitive barrier between the top and his followers persistently exists and causes to misunderstand and conflict between them. Cognitive barriers also exist among professional groups, among multiple disciplines and among different cultural backgrounds. Cognitive barriers exist even within the same discipline, and between the ones who have experience and the ones of freshmen or newcomers in the same discipline. Cognitive barriers are caused by the lack of appropriate sharing knowledge and alignment of cognition in individual and collective levels, i.e. the lack of value alignment among all stakeholders of the organization. Information sharing without misunderstanding and valuable alignment among individuals and between individuals and organizations enhance to bridge cognitive gap and to connect people together.

Asymmetrical relationship of knowledge between medical professionals and patients is still problematic due to inappropriateness of professionals' accountability and responsibility of their performance and also due to deficiency of necessary information in care-recipient side.

Bridging the gap builds an atmosphere of trustful and trustworthy workplace, in which resonant mood/atmosphere is amplified. Organizational environment in which people can trust each other and create new values is necessary for heterogeneous teamwork like in healthcare settings as well as industrial areas. It is very important to redesign organizational environment to perpetuate appreciative inquiries and to share necessary information without misunderstanding. Organizational transformation can be realized by strategic knowledge management, such as cybernetic management, systemic management.

This Chapter deals with two aspects, such as (1) Strategic management of organization for enhancing individual job competence and organizational competence to adapt to social changes, (2) Process activation in organizational learning by effectively utilizing organizational constraints for enhancing knowledge sharing. Discussions are made on the transformation of organization into which knowledge sharing is fast and correct and diffusing to overcome cognitive barriers, and into which resonant mood at work is amplified among the stakeholders.

10.2 Strategic Management of Organization for Enhancing Organizational Competence

Cognitive barriers make difficult to share knowledge among different disciplines. We need management strategies for sharing knowledge correctly without misinterpreting and misunderstanding the information presented. Facilitating procedural knowledge is the real knowledge transfer. People may not understand declarative knowledge until they recognize how they might act on it (Rousseau 2007). Strategic knowledge management, such as systemic management (Schwaninger 1996; Schwaninger 2000, 2006), cybernetic management (Wiener 1948), the second cybernetics (Maruyama 1963, 1992), is of importance to align cognitive barriers among heterogeneous professionals observed in healthcare settings as well as in the other business areas.

10.2.1 The Role of Systemic Management to Enhance Knowledge Sharing

10.2.1.1 Holistic Principle for Empowering the Stakeholders' Action by Systemic Management

Systemic management was developed by Schwaninger (2000, 2006). I found it provided three principles, such as the participative principle, the principle of continuity and the holistic principle reported as operating principles of interactive planning by Ackoff (1999). Figure 10.1 was depicted to image the total organization of a hospital by applying the essence of systemic management and three principles of human action objectives. Management of three-level coordination in horizontal direction and management of integration in vertical direction, as shown in Fig. 10.1, enhance knowledge sharing to overcome social and cognitive barriers among different professionals. Cognitive barriers enable to be overcome by continuation of mutual interaction through systemic management in both directions, coordination in horizontal and integration in vertical directions.

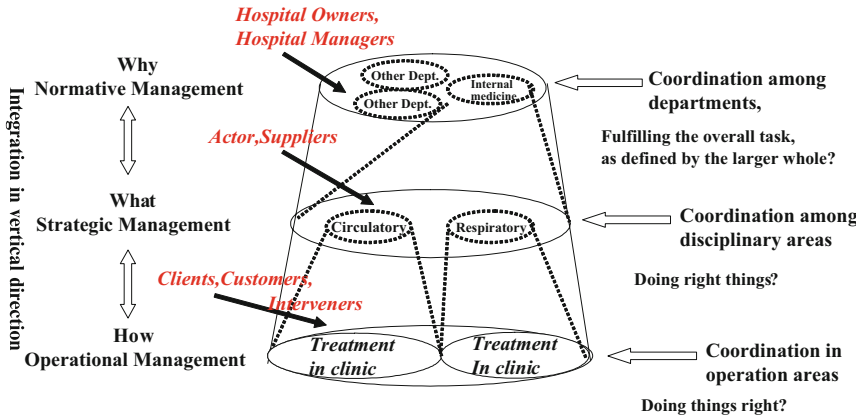


Fig. 10.1 Holistic principle for empowering the stakeholders' actions by systemic management, coordination in horizontal direction and integration in vertical direction

Professionals insist their disciplinary knowledge and tend hardly to accept what the researchers in other areas say. It is very difficult to begin to surge and to amplify resonant mood, because professional organization tends to hoard information acquired and hardly to open to other areas. Professionals in medical science area are still closed type of their decision-making and are far from operating principles of interactive planning in making strategic knowledge management, such as in systemic management or in dynamic cybernetic management excepting a few medical professionals. Knowledge sharing throughout organizational learning, if it is continued, helps converge interdisciplinary thinking into an agreement and acceptance, which makes a resonant atmosphere in organization.

In the front line providing medical treatment and healthcare service to patients or clients, medical and healthcare providers work efficiently under the rule-based operations asking 'doing things right?' In the middle line managed by section leaders, such as leader of respiratory section, circulatory section, and other medical sections, they work ethically by asking "doing right things?" In the top of the organization managed by department heads, such as department of internal medicine, other department, they work effectively and ethically with social responsibility by asking "fulfilling the overall tasks as defined by the larger whole?" Simultaneously, integration in vertical line, such as operation management, strategic management and normative management based by holistic principles is also required in systemic management for sharing knowledge and for developing stakeholders' actions. Systemic management in hospital as well as industry leads organization to be flexible and resilient to fit to the changes happened in its insides and outsides. Systemic management designed by three levels of management in both directions of horizontal and vertical, as shown in Fig. 10.1,

enhances knowledge sharing and develops organizational competence through amplifying resonant atmosphere in learning organization.

10.2.1.2 Case Study on Organizational Performance by the Type of Organizational Learning

Case study carried out in an industry in Japan suggested holistic principle in systemic management plays significant roles in enhancing self-discretion and team reciprocity (Onozato 2004; Saito et al. 2007; Saito 2009). Three clusters are identified in the industrial workers, as shown in Fig. 10.2. Most of knowledge workers belong in Cluster1 in which significantly higher in what type and why type of learning and significantly lower in how-type of learning. The other two Clusters 2 and 3 were smaller groups than Cluster 1. Small numbers of general workers were in Cluster 2 in which significantly higher in how type of learning, while significantly lower in what and why types of learning. The most of part-time workers who are controlled by management are in Cluster 3 in which the lowest in all three types of learning. Significantly higher in self-discretion representing work environment, interpersonal relationship representing team reciprocity were in Cluster 1 of knowledge workers in comparison with Cluster 2 and Cluster 3, as shown in Figs. 10.3 and 10.4. How type of learning is efficiently treated almost automatically in the group of knowledge workers, because knowledge and skills in how type learning are rule-based, and the workers in Cluster 1 do not have to learn case by case. They focus effectively on what and why types of learning. Their work motivation is kept significantly higher due to strategic organizational learning. Knowledge workers take action in keeping in their minds holistic principle embraced in systemic management.

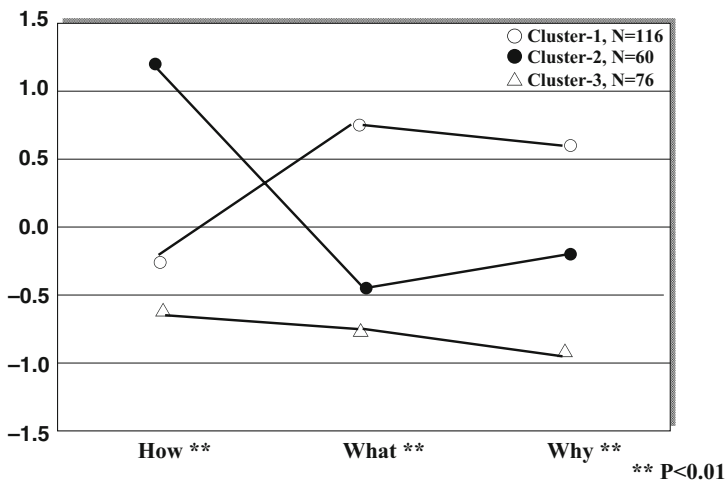


Fig. 10.2 Clustering employees by learning type, how, what, why

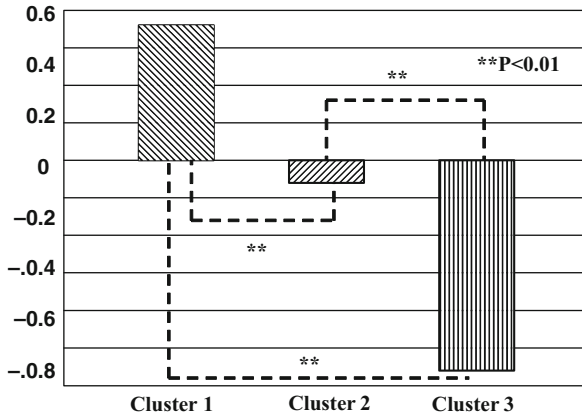


Fig. 10.3 Self-discretion by learning type, cluster 1, 2 and 3

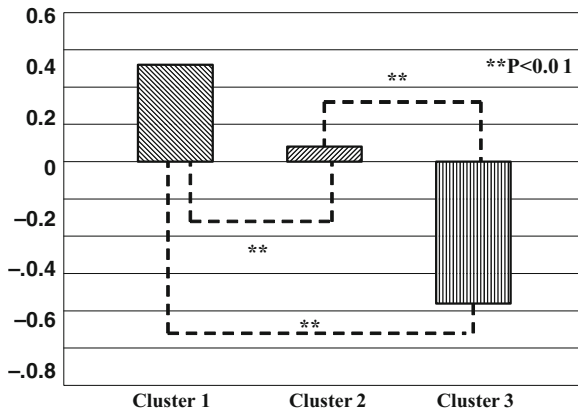


Fig. 10.4 Interpersonal relationship representing team reciprocity by learning type, cluster 1, 2 and 3

10.2.2 *Cybernetic Management for Amplifying Resonance Among Different Professions*

10.2.2.1 **Basic Structure of the Second Cybernetic Loop and Other Strategic Ways**

Fundamentals of cybernetic management are in the structure of cybernetic loops of intervening process into the field, such as observing, analyzing assessing and implementing. The fundamental structure of Cybernetics (Wiener 1948) was the process to counteract the deviation from the standard through single loop learning, while the Second Cybernetic developed by Maruyama (1963) were designed into the process to amplify deviation through alternative appreciation of complex social

events. Basic cybernetic loop is a negative feedback loop, and is quite limited (Wiener 1956). The second Cybernetic is a positive feedback loop for amplifying deviation. Both ways in Cybernetics and the Second Cybernetics are to be complementarily applied through perpetuate and recursive learning in complex organization. Alternatives or different ways from the standard, as reported in Second Cybernetics (Maruyama 1963, 1992, 1994), lead to create ideas and to inspire for people to take an innovative action.

In the same way as seen in the Second Cybernetics, double loop learning was conceptualized by Argyris and Schon 1978. Conceptual development was proceeded to triple loop learning (Flood and Rom 1996; Jackson 2000). How type approach in day-to-day operation through single loop learning, what type approach in internal perception through double loop learning, and why type approach in the reality desired and idealized through triple loop learning, as shown in Fig. 10.5, are critically interacting in real workplace by amplifying deviation of mutual causal processes.

We need some strategies to amplify resonant relationship among different professionals. In order to align cognitive barriers among different disciplines, between researchers and practitioners, and among care-providers and clients, knowledge, especially procedural knowledge in implementing, is to be carefully shared without mistake among different professionals. Cognitive bias exists even within uni-discipline, because people have different mindscape types, as indicated by Maruyama (1994). Cognitive bias stemming from different mindscapes is the asset if it is managed well, as Maruyama (1994) explained. We need a strategic management, such as systemic management, cybernetic management in order to overcome cognitive barriers and to create ideas to be shared.

Externalization of knowledge to be explicit from being tacit or implicit through recursive process of SECI cycle (Socialization, Externalization, Combination and

Desired/ Idealized reality

<p>Think about why this work is proceeded</p>	<p><i>Why-type approach</i></p>	<p>Triple Loop Learning (Flood,R.and Romm,N.R.A.1996, Soft Cybernetics,Jackson,M.,1998)</p>
<p>“ought to be”(Why should we do?) Management balancing the needs in short and long term</p>		

Perceived reality in internal process

<p>Do right things, as the way you think this is right</p>	<p><i>What-type approach</i></p>	<p>Double Loop Learning (Argyris,C. and Schon,D.,1978, Maruyama,M.,1965, 2nd Cybernetics)</p>
<p>“could be”(What should we do?) Management for better performance in long term</p>		

Day-to-day reality

<p>Do how you are given, as being rule-based</p>	<p><i>How-type approach</i></p>	<p>Single loop learning (Wiener,N.,1948)</p>
<p>“is”(How should we do?) Day-to-day operation in short term</p>		

Fig. 10.5 Organizational learning and cybernetics

Internalization cycle model, Nonaka and Nishiguchi 1998; Nonaka and Kono 1998) is the way to reduce the barriers through socialization. We need to utilize cognitive difference as an asset of enterprise in order to create another possibility, alternatives and new values through SECI cycle. Sharing information and its value are needed for activating organizational learning and for providing fast and better service. It is crucial to interpret information without misunderstanding and then to draw a road map for team members and other stakeholders to take an appropriate action to their desired goals through cybernetic loops.

In the process of recursive organizational learning, deliberate interplay and interconnection are made between explicit and implicit knowledge and among different disciplines. Throughout the process of knowledge sharing, continuous inquiry and appreciation make the problem for the stakeholders to be acceptable, collaborative and provocative. Fundamental inquiries by engineering steps of 5W1H (what, when, where, why, who, and how), as you will see in Sect. 10.3.1, are asked and analyzed, such as what is the problem, where and when it happened, by who, why and how it happened, asking what we could manage the problem. It is more important to inquire what we can do, instead of just thinking what will be without any scenarios and any actions.

We have to utilize variety of cognition emerged in multi-disciplinary organizations. We need the change of organizational culture into more acceptable and provocative by amplifying resonant relationship among different professionals. In doing so, we need context alignment process as well as content control. Contextual intelligence (CI, Mayo and Nohria 2005; Nye 2008) is required as well as general intelligence of verbal and special dexterity evaluated by IQ and emotional intelligence (EI) (Boyatzis et al. 2000; Chernis and Goleman 2001) If they aware of organizational citizenship behavior (Organ 1997) and also organizational competence as global corporate citizenship as Schwab stated in Davos, Switzerland (2008), knowledge enables to be effectively and ethically shared among different professionals for realizing a desired reality.

Precedent researches on appreciation, such as, the appreciative process through hermeneutics cycle (Vickers 1965; Checkland and Howell 1998; Checkland and Scholes 1999), an inquiry into the good (Nishida 1911, 1990), intelligent organization by systemic management (Schwaninger 2000, 2006) provide us important theories and management tools for developing organizational learning into being more interactive and effective and for amplifying resonance among different professionals.

10.2.2.2 Strategic Management by Applying Basic Functions of Organization

Sharing knowledge enhances organizational learning, collaboration and resonant mood in workplace. Organizational climate/culture changes throughout appreciative process in organizational learning, and changes knowledge hoarding culture into knowledge sharing culture. Sharing knowledge is accelerated by effectively applying some of basic organizational functions, such as the functions of hub-type, web-type, chain-type and set-type, depending upon. organizational objectives and constraints.

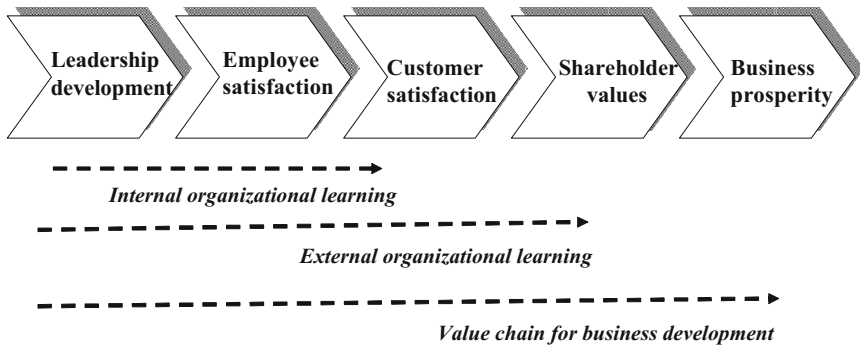


Fig. 10.6 Value chain to emerge business prosperity through organizational learning

Strong procedural functions are enhanced by organizational function of chain type, such as observed in supply chain management and value chain management. Value chain for business management, as shown in Fig. 10.6, enforces business prosperity by the steps of internal organizational learning and external organizational learning in accordance with organizational objectives.

Strategic management by means of effectively applying basic organizational function types, enhances knowledge sharing, and improves organizational performance. Organizational performance is improved by shared leadership as well as by applying basic functions of organization. Organizational performance is significantly improved by higher level of shared leadership in web-type organization (Carson et al. 2007). Another excellent example for amplifying resonance among different professionals is intelligent organization structured by polyhedra which is consisted of different and independent elements (Schwaninger 2000, 2006). Each element has autonomy and act in a discretionary manner. There is no center or peripheral position in the group or organization. Each member is professional and has responsibility for his/her action. Redesigning organization is expected for enhancing resonant mood in organization by utilizing basic organizational functions, by sharing level of leadership, by creating new types of professional team, and other trials which fit to real situation.

Amplifying resonance by means of shared leadership, interplay among professionals and shared responsibility, helps improvement of individual and team performances, and changes organizational culture. There are various roads access to a desired reality. There is no predetermined and generalized ways without contingency to reality.

10.3 Process Activation in Organizational Learning by Effectively Utilizing the Constraints

Two key concepts in context-bound approach are behavior-shaping objectives and behavior-shaping constraints (Rasmussen et al. 1994). Human action in the process of organizational learning is context-dependent, and is not critically reproduced.

Effective utilization of organizational constraints, i.e. incentives, organizational climate or culture provokes the participants' mood states at work for effectively sharing knowledge and for achieving organizational goals. The incentives in organizational learning and organizational culture as organizational infrastructure are described in Sect. 10.3.1. Case study in Sect. 10.3.2 provides examples of probabilistic scenario setting.

10.3.1 Incentives and Antecedents

Incentives, such as opportunity for personal growth, teamwork, trust, or interpersonal relationship, facilitate to activate organizational learning and change organizational culture. Incentives are activated if they are effectively interlinked with the antecedents in the organization, such as flexible styles of decision-making, of leadership, communication, or job discretion. Matrix composed by incentives and the antecedents of organizational culture types is shown in Fig. 10.7. The cells in the matrix may work when appropriate cells are chosen by considering organizational objectives and constraints, and activation in the cell develops organizational resilience to ensure successful performance. Any cells may work when appropriately being adopted. It is important to inspire and to provoke the participants' cognition and mood states at work as suggested by our case study depicted in the following Sect. 10.3.2.

Practical steps in the recursive process of organizational learning are illustrated in Fig. 10.8. The participants are required to appreciate, analyze, assess and take action while they ask how to perpetuate the steps of 5W2H (What, Why, When, Where,

Incentives Org. culture type	Opportunity for Personal growth Incentive-1	Teamwork Incentive-2	Trust Incentive-3	Interpersonal relationship Incentive-4
Decision-making style type-1	Incentive 1 X Type-1	Incentive-2 X Type-1	Incentive-3 X Type-1	Incentive-4 X Type-1
Leadership style type-2	Incentive 1 X Type-2	Incentive-2 X Type-2	Incentive-3 X Type-2	Incentive-4 X Type-2
Communication style type-3	Incentive 1 X Type-3	Incentive-2 X Type-3	Incentive-3 X Type-3	Incentive-4 X Type-3
Compliance/ discretion type-4	Incentive 1 X Type-4	Incentive-2 X Type-4	Incentive-3 X Type-4	Incentive-4 X Type-4

Fig. 10.7 Matrix composed of incentives and organization culture type

Step	Action
Step 1	Adequate communications among stakeholders <i>(Why/What is)</i>
Step 2	Determining the problems solved by sharing information <i>(What/Why is)</i>
Step 3	Identifying incentives and organizational culture type <i>(How/What/When might be)</i>
Step 4	Determining practical feasibility among the possibilities shown in the matrix (incentive x organizational culture type) <i>(How/What/Who/When might be)</i>
Step 5	Preparing scenario of desired future <i>(What/Where/ with Whom could be)</i>
Step 6	Consensus for the future scenario and implement <i>(What/Where/ with Whom could be)</i>
Step 7	Forming practice team and preparing practice strategy <i>(How efficient and effective/How much incomes will be)</i>

Fig. 10.8 Practical steps for activating organizational learning (5W2H) and in addition, how ethically does it work

Who, and How, How much does it cost) and in addition, I think, the participants are also required to ask how ethically does it work in the organizational learning process. Action steps are summarized in Fig. 10.8.

Organizational climate changes through appreciative inquiry in organizational learning process, dependent upon organizational goals and the constraints. The antecedents to organizational activities should be effectively utilized by the participants for changing organizational atmosphere into becoming acceptable, applicable, collaborative, and into becoming very unique as their own atmosphere, before investing big budget without consideration on organizational constraints. This helps share knowledge for enhancing individual work competence and for assuring positive action in organizational environment.

10.3.2 Case Study on Prospective Scenario Settings in Organizational Learning Process

Prospective/probabilistic scenario is an explanation how to connect or interplay many variables of context-dependent factors which exist in real workplace. Process narratives are dependent upon the context rather than the contents given. Social issues which are full of indeterminacy and contingency are explained by probabilistic and path dependent scenario. Innovative path in work organizations are usually complex and unpredictable, so that probabilistic scenario settings are carefully

arranged to get most effective access to organizational goals. The following case study was carried out by using hospital nurses who were classified into two clusters by communication style (Saito et al. 2007). This case study suggested that there were simple pathways in the causation among communication, organizational climate and team reciprocity and there were different pathways between different communication types. Pathways by written communication mediated through computer (computer mediated communication, CMC) are linearly linked to be discrete, not integrated with other factors. Direct path between communication and criterion variable of team reciprocity and also direct path between organizational climate and team reciprocity were identified, as shown in Fig. 10.9, while communication by face-to-face (FTF) are integrated with the factor representing organizational climate and indirectly linked to criterion variable representing team reciprocity, as shown in Fig. 10.10.

Another example in our case study suggested that different pathways existed between higher and lower groups of job cognition level in hospital nurse (Saito 2008; Saito 2008; Saito 2009). It was very interesting to be observed that physical factors, such as working time, time taken for patient care were represented for work demand and organizational environment in the lower group of fairness feeling on the evaluation of individual and team performance, while the meanings of job, participation, such as work cooperation, team work atmosphere, instead of physical factors, were represented in the higher group of fairness feeling. Our case studies suggested that probabilistic scenario settings were context-dependent, one case was by the level of job consciousness and another case was by communication type (Saito et al. 2007; Saito 2008a, b; Saito 2009).

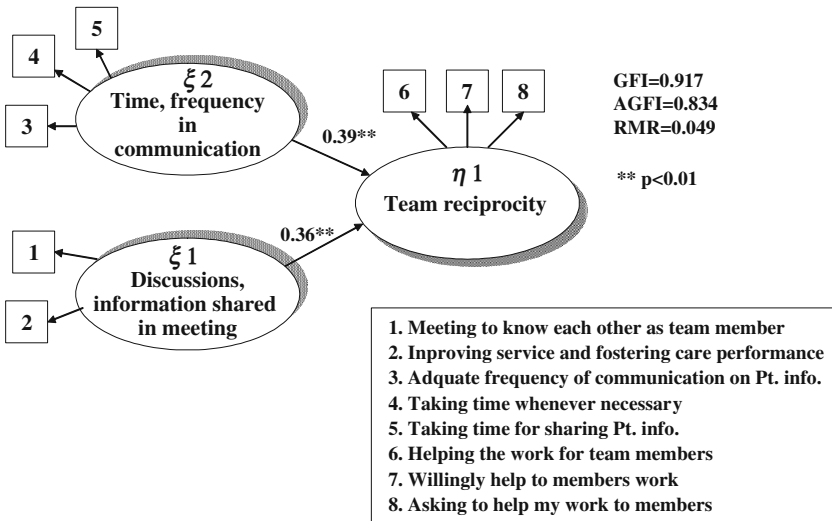


Fig. 10.9 Causal relational among organizational climate, communication, team reciprocity in CMC type

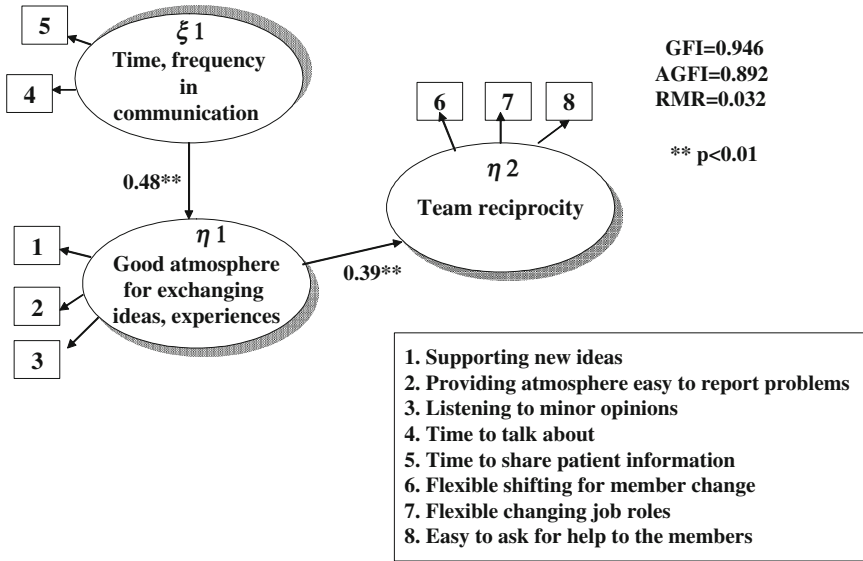


Fig. 10.10 Causal relational among organizational climate, communication, team reciprocity in FTF type

The change of complex organization is not reproduced again as it was in the same manner even though the complexity on the theoretical basis is analyzed by advanced mathematics. The organization continues to change and never stop until destruction of the organization. Probabilistic explanation is to be made in accordance with organizational objectives and its missions in order to adapt to changing society.

10.4 Conclusions

10.4.1 Knowledge Sharing and Its Diffusion by Overcoming Cognitive Barriers Through Strategic Management

Knowledge sharing through the recursive process of organizational learning may help overcome cognitive barriers among multi-disciplines, or between care-providers and clients, and simultaneously may create new values for both sides of healthcare demand and supply. Systemic management and the second cybernetics are excellent theories providing effective and ethical management tools for enhancing organizational competence.

Knowledge created in a particular organization can be spread into the other sections of the same organization and into the other organizations, and also into

external organizations, if cognitive barriers among different professions can be well aligned and overcome. Knowledge sharing through appropriate interpretation based on correct understanding in trustful atmosphere of work organization realizes desired reality of the participants. Achieving the goals and diffusing knowledge are ensured in such an organization as knowledge sharing organization, not in knowledge hoarding organization observed in hierarchical organization. Strategic management of organization, such as systemic management, cybernetic management, as discussed in this Chapter, plays a crucial role in sharing knowledge and its diffusion.

10.4.2 Effective and Ethical Utilization of the Incentives and Organizational Culture Types as Organizational Infrastructure

The interplay between the incentives, such as teamwork, trust or interpersonal relationship with organizational culture types, such as leadership style, communication style or decision-making style enhances organizational competence to achieve their goals and social missions. Effective utilization of the constraints in organization helps to activate organizational learning and to enhance organizational competence. Probabilistic scenario settings make possible to provide path ways access to the goals, or their desired reality, and to overcome cognitive barriers among multi-disciplinary professions. Effective and ethical utilization of the incentives and organizational infrastructure by means of prospective scenario helps disclose knowledge created and not to hoard knowledge. Organizational events are context-dependent, so that constraint-based approaches play critical roles in aligning cognitive barriers and in enhancing organizational competence. Significant path ways between different job consciousness and between different communication types are identified by our case studies.

10.4.3 Amplifying Resonance Among Healthcare Stakeholders

Amplifying resonance among multi-disciplinary professionals and among healthcare providers and clients with their families enables to change organizational climate/culture where stakeholders are so inspired to learn and trust each other, and to share knowledge and its values that they can have a power to continue to change organizational culture, so as to improve their services to clients. Knowledge sharing for transcending cognitive barriers and for assuring positive action is enhanced by strategic management, as discussed about systemic management and cybernetic management which will play crucial roles in empowering healthcare organization if it is adopted well, effectively and ethically.

10.4.4 Future Research Directions

If people feel a resonant atmosphere there, people may willingly join in the organization, even though they feel uncertainty for a while. Probabilistic scenario for redesigning a desired reality in the future can be set and developed in recursive process of organizational learning. Future researches are left for constructing a desired reality, for shifting organizational infrastructure or organizational culture, and are left to explore human cognition-action coupling process by considering behavior-shaping objectives and behavior-shaping constraints of the organization. Effective and ethical utilization of organizational constraints brings an unique organizational performance to the stakeholders.

This Chapter includes case study materials introduced in the book authored by Saito, M. Wickramasinghe, N. Fujii, M. Geisler, E. entitled “Redesigning Innovative Healthcare Operation and the Role of Knowledge Management”, IGI-Global, Hershey, Pennsylvania, USA.

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Chapter 11

Developing New Urban Health Metrics to Reduce the Know-Do Gap in Public Health

Carlos Castillo-Salgado and Michael Christopher Gibbons

Abstract Recently, development and implementation of the knowledge component of urban health are being promoted by knowledge management (KM) methodologies and the establishment of Communities of Practice. However, the existing health measuring tools used for formulating health policies are not yet very effective in synthesizing the operational links between knowledge of social determinants and health equity in urban settings. The rapid expansion of urban conglomerates requires a dynamic process of measuring the health status of city dwellers. Core indicators from different knowledge domains (social, demographic, economic, morbidity, mortality, access and utilization of health care) need to be systematically measured to identify their distributions. Socio-epidemiological measurements are recognized as essential tools for assessing the impact of health determinants on the unequal distributions of health risks, hazards, diseases, disability, premature mortality and quality of life.

The objective of this chapter is to discuss how developing new and revised health metrics for urban settings will provide useful tools and knowledge-based guidelines for local and national urban stakeholders. Evidence-based health metrics will improve the effectiveness of strategic interventions and responses to health and health care available to urban populations.

Keywords IKM • Urban health • GIS • Health measurement • Health metrics • Healthy spaces

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11.1 Introduction

Public and civil society institutions that shape public policies in urban health have long been producers and consumers of social, economic, demographic and health information. Recently, development and implementation of the knowledge component of urban health policies and programs are being promoted by knowledge management (KM) methodologies and tools and stimulated the establishment and operation of Communities of Practice (Wenger 2006; <http://www.co-i-l.com/coil/knowledge-garden/vc/index.shtml>; Metzler 2003). However, the existing health measuring tools used for formulating health policies are not yet very effective in synthesizing the operational links between knowledge of social determinants and health equity in urban settings.

The existing information systems needed to generate the empirical evidence for analysis and prediction of the health status and trends for different population groups in urban settings are generally fragmented, uncoordinated and difficult to access at the level of aggregation needed for effective urban health programs.

Urbanization has become an explosive and intense socio-demographic process that is occurring on the global scale and affects both developed and developing countries. The rapid expansion of urban conglomerates and the constant pressures of multiple health determinants over different population groups, particularly disadvantaged populations in neglected urban areas requires a dynamic and constant process of measuring the health status of city dwellers. Core indicators from different knowledge domains (social, demographic, economic, morbidity, mortality, access and utilization of health care) need to be systematically measured to identify their frequency distribution. Socio-epidemiological measurements are recognized as essential tools for assessing the impact of health determinants on the unequal distributions of health risks, hazards, diseases, disability, premature mortality and quality of life.

Policy makers dealing with urban policies weight many factors as they consider adopting and promoting public health interventions for different urban groups. A central question – especially in this time of emphasis on knowledge based practice and policy- is whether there is sound scientific evidence and the tools needed for the timely provision of specific public health interventions for targeted urban populations. Also, it is important to know how to translate the available scientific knowledge into practical and effective health interventions. One of the most central Information and Knowledge Management (IKM) findings in public health is the recognition that there is an enormous gap between what is known in public health and what is applied in regular public health programs. For most public health programs, frequently there is a 20–25 year gap in applying the accepted scientific health knowledge to the regular public health interventions.

The objective of this chapter is to discuss how developing new and revised health metrics for urban settings will provide useful tools and knowledge-based guidelines for local and national urban stakeholders. Evidence-based health metrics will improve the effectiveness of strategic interventions and responses to health and health care available to urban populations.

The chapter includes three sections, the first documents the rapid expansion of urbanization at all global levels and the need to better address the health needs of

disadvantaged populations of urban conglomerates. The second summarizes the different working theoretical frameworks proposed to organize the work of urban health metrics. The last section includes the description of useful and practical health metrics recently developed, particularly those using socio-epidemiological information and geo-spatial analysis. These urban health metrics are proposed to address the health equity gap as well as the IKM's know-do gap.

11.2 Unprecedented Global Urbanization, A New Challenge for Public Health

The world is becoming increasingly urbanized. In 1999, world population reached the six billion mark (Population Division 2009). According to UN Habitat (World' Cities Report 2006), the year 2007 marked also a turning point in history. One out of every two people was living in a city. Also, it was reported that one out of three city dwellers – nearly one billion people – is currently living in slums, questioning the notion of future urban sustainability. This UN Habitat Report indicated that in 2005, the world's urban population was 3.17 billion out of a world total of 6.45 billion. By 2008, for the first time in history, half of the global population is residing in cities (United et al. 2006). This dramatic urbanization was observed in all regions of the world. However, more than 80% of the population in the Region of the Americas currently resides in urban areas (Pan American Health Organization 2008). Current trends predict that the number of urban dwellers will keep rising, reaching almost 5 billion by 2030 out of a world total of 8.1 billion. Also, UN-HABITAT predicted that between 2005 and 2030, the world's urban population is expected to grow at an average annual rate of 1.78 per cent, almost twice the growth rate of the world's total population (United Nations Human Settlements Programme (UNHabitat) 2004).

These historic milestones have created widespread global attention to the different social and economic consequences of this accelerated urbanization. These changes have opened opportunities for a new dialogue for the development of better and healthier intersectoral interventions and for the development of public-private policies that contribute to better healthy conditions for urban populations. Of particular importance is the need for transforming the current measurement and monitoring mechanisms of the health status of the growing urban population groups.

11.3 Theoretical Frameworks for Urban Health

Developing a set of urban health metrics implies, having a conceptual framework within which to organize them. In the current debate on urban health metrics, there are three main approaches: the health equity framework, the socio-epidemiological approach and the strategic management approach.

The health equity framework has been proposed and recommended by the WHO's Global Commission of Social Determinants of Health and its Knowledge Network on Urban Settings (WHO 2008). The basic principle of this framework is

to reduce health inequities through action on the social determinants of health. Its central premise is recognizing that “poor and unequal living conditions are the consequence of poor social policies and programmes, unfair economic arrangements, and bad politics. Action on the social determinants of health must involve the whole of government, civil society and local communities, business, global fora, and international agencies” (http://whqlibdoc.who.int/hq/2008/WHO_IER_CSDH_08.1_eng.pdf). For this framework, there is a need for expanding the traditional measuring tools of the health sector adding indicators measuring the “conditions in which people are born, grow, live, work, and age”. This approach proposes measuring and analyzing the specific links of the social determinants of health in their specific context and evaluating policies and programs aimed at reducing the high burden of illness and health gaps among and between population groups and not only reducing the average level of health indicators. A complete review of the recommendations contained in the final report of this global commission is available at the WHO website (WHO 2008).

Traditionally, epidemiological knowledge has been of critical importance for developing the existing paradigm of public health for interventions in rural settings. Maternal and child programs, immunizations and prevention and control of communicable diseases such as diarrheal diseases, malaria, and tuberculosis have been for several decades the key programs to address the health and health care of billions of people, mainly in rural areas. However, as a consequence of the rapid and accelerated global urbanization, the traditional model of public health based on rural dynamics needs constant revision to specifically incorporate the dynamics of urban processes. In addition, this model requires a reformulation for better understanding of how the social and environmental factors contribute to disease, disability, and health inequality in the cities and of the way different urban populations respond to health burdens and health care. Also, it opens the discussion for a comprehensive reassessment of the role IKM has in the needed integrated and multi-sectoral approaches for knowledge and action in urban health (National Institutes of Health 2005).

Historically, Urban Health frameworks have been lacking in the depth to which they integrate our present understanding of the biology of disease, particularly at the cellular and molecular levels. The Sociobiologic Integrative Model (SBIM) has been proposed as an attempt to overcome this limitation (Gibbons et al. 2007). The SBIM suggests that individuals are constantly coming in contact with many health-impacting environmental exposures. These exposures are often modified, directly or indirectly, to increase or attenuate their effects via other biologic and environmental factors. In turn, metabolic, digestive, and/or detoxification systems act to remove, degrade and or otherwise inactivate potentially harmful factors or exposures. If bodily defense or regulatory mechanisms are overwhelmed, illness and or disease will occur. Finally the model is conceived as operating on the cellular, individual, and population levels, temporally proceeding from input (exposure) to outcome. Each level can be sub divided into other relevant sublevels as needed (i.e. individual – family, neighborhood and community) (Gibbons et al. 2007).

A strength of this model lies in the fact that it is not based on geography or statistics per se, but rather on quantifiable pathways from exposure to outcomes.

As such it does not need to be refined or updated as communities become increasingly urbanized. Also this model suggests that single causative agents that may occur at any one level of organization may be less important than groups of factors which predictably occur together and result in defined outcomes at the individual and population levels. Finally, this model enables the development of metrics based on identifiable and measurable social and biological pathways known to be operative among individuals and populations. Beyond the characterization of health status of individuals or populations at any given point in time, this model facilitates the development of metrics which enable the dynamic quantification of population level risk and relative changes in risk factors over the life course. Metrics which quantify population level “sentinel events” or conditions which may precede actual disease outcomes or outbreaks may be possible as are metrics which quantify the degree of population level harm reduction achieved over time.

It is increasingly recognized that many of the problems facing Urban health are so complex that they defy simple solutions. Understanding the social environment, the relationship of this environment to individuals and populations in the context of often simultaneous synergistic, antagonistic and potentially co-active dynamic (changing over time) exposures is challenging. It is challenging to model or simulate so many complex and important factors and interrelationships. Systems thinking has emerged as a useful approach for understanding and integrating knowledge from a wide variety of interrelated factors. Along these lines, a systems approach can be defined as a logically consistent method of reducing complex problems to simple components that can then be used by decision makers, in conjunction with other data to arrive at a best solution. This approach has its theoretic roots in strategic planning, general systems theory and organizational management. Metrics derived from this basis involve the iterative characterization of existing and emerging issues (both positive and negative) as well as continuous reevaluation of the interventional entity (Governments, Health Departments, NGO’s etc.) At its core this approach is action oriented and results driven. Strategic Management driven approaches have emerged as useful approaches for managing accountability and change in complex systems, not just measuring it (Barten et al. 2007; Glouberman et al. 2006).

11.4 Gaps in Urban Health Equity: Need for New and Revised Metrics for Urban Health

As reported by several publications (Kawachi and Berkman 2003; Galea et al. 2005), urbanization initially had a positive impact on health (e.g. longer life expectancy rates). However current statistics and reports (Bell 2004; Burkart and Endlicher 2009) show that urbanization has exacerbated ill-health conditions and is affecting the quality of life of large population groups. This situation has obliged national and local governments and global institutions to pay closer attention to urban health issues.

Of special importance is the debate of how statistics and metrics on the health status of urban populations have practical value for policy-makers and urban stakeholders.

Various recent reports (http://whqlibdoc.who.int/hq/2008/WHO_IER_CSDH_08.1_eng.pdf; Mercado et al. 2007; Vlahov et al. 2007) show that inequalities in social well-being continue to increase in most cities of the world. The widening health gap between rich and poor is one of the most serious social problems of contemporary societies, and no urban public policy has been able to address it satisfactorily. Frequently, public health intervention models still operate under a rural and general “one size fits all” design. Commonly, public health practitioners lack necessary knowledge about the local interaction of the social determinants of health in specific urban areas or neighborhoods and about the resulting behavioral patterns and access to and use of public health and medical services.

The challenge for urban health in this globalized world is to address the health gap using better methodologies and information systems capable of identifying inequalities and unmet health needs not only in health services but, mainly in health status and quality of life. This new approach is based on the premise that individual and group health are linked to different multilevel conditions (genetic, individual, family, neighborhood and other social characteristics and environmental pressures). Conventional metrics that basically measure individual vulnerability should be complemented with other measurements related to living conditions and people’s perceptions. It is proposed that better methodologies and theoretical frameworks are needed for metrics to measure the epidemiological attributability of social conditions. The concept of attributability made its appearance some 30 years ago. However, its use for developing new health metrics is still in its infancy. Its main purpose is to establish what percentage of the risk of becoming ill or getting injured can be attributed to external or collective factors such as housing, employment, education, environmental conditions, etc. The use of this socio-epidemiological concept will help in determining the extent to which specific social and environmental factors affect the level of health and quality of life in urban populations.

In general, health and social statistics related to urban conglomerates are partial, fragmented, outdated and difficult to obtain. It is evident that current information systems based on national averages are useless for formulating sufficiently targeted urban health policies. Traditional health statistics in general do not allow stakeholders to recognize the existing level of health inequalities within and between cities or to compare the relative cost-effectiveness of different interventions, such as, the reduction of infant mortality by focusing interventions on prime urban risk factors versus generic care activities without adjustments for the synergistic effects of main health risk factors. At a time when expectations by civil society for more public healthy interventions are growing and funds are tightly constrained, health and populations measurements are essential to assist the rational allocation of resources. This means that new metrics and information systems must be designed or re-engineered to permit: (1) collection and analysis of disaggregated health related data in district, neighborhood or small homogeneous urban areas; and (2) the incorporation of non-traditional measures for accountability and governance. This, together with IKM tools and the effective use of available information technology, such as Geographic Information Systems (GIS), will facilitate communication and help convince the different stakeholders to formulate better and more effective local health intervention strategies.

Although traditional measures and metrics are still useful for the assessment of health status and quality of life in urban conglomerates, new metrics should benefit from including information about physical, social and economic environment as well as lifestyles. Also, there is a need to incorporate existing sources of commercial information, such as data on the purchasing of relevant products, alcohol, smoking and dietary preferences or availability of healthy food by neighborhood.

A recent pioneer health assessment movement addressing the equity gap has been promoted by the recommendations of the WHO's Global Commission of Social Determinants (WHO 2008). Examples of such movement are the creation of the Knowledge Network on Urban Settings (KNUS) (<http://www.who.or.jp/urbanheart/index.html>), the PAHO/WHO's Regional Urban Health Forum (Pan American Health Organization. Gobierno Federal, Mexico 2008), the development of 12 Public Health Observatories in England including the Association of Public Health Observatories (APHO) (<http://www.apho.org.uk/>) and the launching of Urban Health Observatories in Brazil and Mexico.

11.5 PAHO/WHO's Urban Health Forum for the Americas

In November 2007, the Pan American Organization (PAHO) with the participation of 12 countries launched the "Urban Health Forum for the Americas" in Mexico City (Pan American Health Organization 2008). This initiative was developed as an innovative mechanism to facilitate greater collaboration of the scientific and academic communities, local and federal governments, civil society, and private sectors on new approaches to confront the challenges of urban health in the 21st century. The work of the Forum is concentrated in the debate and recommendations of two important strategic knowledge areas: (1) governance in urban health; and (2) new urban health metrics and health information systems.

City governance is recognized as an important determinant in urban health policies. Also, the report of the Knowledge Network on Urban Settings of the WHO Commission on the Social Determinants of Health (<http://www.who.or.jp/urbanheart/index.html>) underscored that serious failures in city governance have led to greater health inequalities and lower quality of life of urban residents. Therefore, it is necessary to develop measures that make it possible to ascertain whether each party/stakeholder involved in urban health policies performs its duties and responsibilities satisfactorily. To this end, it is necessary to work together with local governments, civil society and the private sector to define the criteria, standards, and metrics that will be applied.

One feature of the urban health metrics component of the PAHO forum is to explore potential metrics that will allow area residents and urban stakeholders to identify urban conglomerates suffering from minimum healthy surroundings or "healthy conditions deserts". Healthy conditions deserts may be defined as small population conglomerates such as neighborhoods with high social-health inequality gaps and poor access to minimum healthy conditions. This approach follows a similar

initiative proposed by Larsen and Gilliland (Larsen 2008) when they addressed the problem of supermarket accessibility and mapping Inner-City populations living in “food deserts” in the City of London, Ontario.

11.6 Neighborhood Health Profiles of City of Baltimore

In the fall of 2008, the Baltimore City Health Department launched for the first time its Internet based “Neighborhood Health Profiles – 2008” (Office of Epidemiology and Planning 2008) to better understand the unequal distribution of the health status of its population. These health profiles include measurements of major health outcomes of 55 neighborhoods or Community Statistical Areas in the city of Baltimore. Each Neighborhood Health Profile is organized into three sections. The first section provides an overview of demographic information – the age, race and ethnicity, and average socioeconomic level of neighborhood residents. The second section provides data on life expectancy, mortality and causes of death. The third section provides data on maternal and child health outcomes. The final assessment summarizes how each neighborhood compares to the city as a whole across all the major health indicators. The methodology used in these profiles included life expectancy for small area estimates developed by the South East Public Health Observatory in England (<http://www.sepho.org.uk/viewResource.aspx?id=8943>; Williams et al. 2005).

An important finding of these measurements was to document the enormous difference between the best and worse neighborhoods in most of the key health indicators. In 2006, the infant mortality (IM) rate for the City of Baltimore was 11.7 per 1,000 live births. However, during the period 2002–2006 there were 12 neighborhoods with IM of 20 or higher. Six of those neighborhoods had IM ranging from 30 to 40.7. These infant mortality rates are more than double of the rates of several Central American Countries. Life expectancy at birth from the best Baltimore City’s neighborhood was 82.9 versus 62.5 in the worst area. This 20 year gap in life expectancy is observed in populations residing only a few miles apart. These measurements illustrate the unequal distribution of these important health status indicators and support the need for developing ad-hoc health interventions for these high risk areas and populations.

11.7 Development of New Health Inventories and Information Platforms

In the USA, the National Association of County and City Health Officials (NACCHO) published in 2007 the “Big Cities Health Inventory, 2007” (Urban America 2007). This publication lists key health outcomes and determinants performance in the 54 largest cities of the United States of America. These health inventories are needed to serve as baseline and benchmarks for monitoring the health status of city populations.

A very important transformation of health information systems has been implemented and sustained by the Pan American Health Organization and the Brazilian Ministry of Health. After the systematic revision of thousands of indicators collected but generally not used, it was recognized that there was a need for a set of standardized and highly validated core health indicators. 117 indicators were selected as “Basic Core Health indicators” (BCHI). These indicators are summary measures that include 4 domains (socio-demographic, economic, morbidity-mortality and access and utilization of health care) and are essential for measuring the health status of the population and the performance of public health programs. These indicators are systematically used to describe and monitor the health situation of different population groups at local, national and global levels. They also have served as baseline health information for characterizing spatial and temporal trends of health, hazards, and exposures to risk factors over person, time and place. These indicators are collected and validated annually in 46 countries and territories of the Region of the Americas (Pan American Health Organization 2008).

These information systems are web-based and have been maintained for more than 10 years (Pan American Health Organization 2004; <http://tabnet.datasus.gov.br/cgi/idb2007/matriz.htm>). They are critical resources for the different health situation analyses needed in urban health levels. The National Council of Municipal Health Secretaries (CONASEMS) of Brazil (http://www.conasems.org.br/cgi-bin/pagesvr.dll/Get?id_sec=2) jointly with a network of national scientific and policy experts participates in the production, validation and publication of these important core indicators.

The Association of Public Health Observatories (APHO) (<http://www.apho.org.uk/>) in England has pioneered the development of innovative tools and methodologies for public health. In 2009, the Association launched its “*Health Inequalities Intervention Tool*” (The Association of Public Health Observatories 2009) providing an update of the existing gaps in life expectancy rates between spearhead areas of England. Also, they produce and analyze Health Profiles 2009 by County Districts, London Boroughs, Unitary Authorities and Metropolitan Council Districts.

11.8 UrbanHEART Tool

As part of the work of the WHO Commission on Social Determinants of Health (CSDH), the WHO Centre for Health Development (WHO Kobe Centre) was designated as the hub of the Knowledge Network on Urban Settings (KNUS). This Center with different global partners, including UN-HABITAT proposed the development of the “Urban Health Equity Assessment and Response Tool” (UrbanHEART) (<http://www.who.or.jp/urbanheart/index.html>) as a new basic metric for measuring levels of health inequalities in urban areas. Currently this tool is in the final phase of field testing in five cities in different countries (Brazil, India, Iran, Philippines and Zambia).

The main objective of this tool is “to help policy-makers and key stakeholders achieve a better understanding of the social determinants and risk factors and the

associated health outcomes faced specifically by the urban poor and other vulnerable groups” (<http://www.who.or.jp/urbanheart/index.html>). The tool has two components: (a) an assessment component and (b) a response component. In the first component, the instrument includes a cluster of indicators grouped in four “Policy Domains”. The four policy domains of the tool are: (1) physical environment and infrastructure, (2) social and human development, (3) economics, and (4) governance and politics. For the assessment component, the core indicators selected should represent each of the four policy domains and should be selected by availability and consensus. These indicators should enable comparative inter-city or inter-country assessments of policy performance in urban health.

Table 11.1 Includes a list of suggested Health Outcome Indicators and their corresponding equity disaggregation.

The response component of this tool contains a menu of evidence-based interventions that have been described in both grey and published literature as derived from the review process of the Knowledge Network on Urban Settings. The interventions are mapped out according to five different suggested entry points where the health sector plays a key role. The purpose of the matrix is to show that improvements may be made in different policy domains through multiple actions by multiple actors at multiple levels. Table 11.2 includes examples of the five proposed entry points and relevant potential actors/stakeholders of the response components. A full description of this tool can be accessed on the WHO website (<http://www.who.or.jp/urbanheart/index.html>).

Table 11.1 Urban health equity assessment and response tool (UrbanHEART)

Health outcome indicators	
Aggregate indicator	Equity indicator
1. Life expectancy at birth	1.a. by locale: poor vs. non-poor district 1.b. by gender: male vs. female
2. Infant mortality rate	2.a. by locale: poor vs. non-poor district 2.b. by gender: male vs. female
3. Under-five mortality rate	3.a. by locale: poor vs. non-poor district 3.b. by gender: male vs. female
4. Maternal mortality ratio	4.a. by locale: poor vs. non-poor district 4.b. by education: no education/primary education vs. tertiary education
5. Specific disease morbidity and mortality rates (e.g. HIV-AIDS, tuberculosis, malaria, cardiovascular disease, diabetes, injuries, mental illness or other critical/high-burden infectious and noncommunicable diseases)	5.a. by locale: poor vs. non-poor district

Source: WHO Kobe Centre (2007). Urban health equity assessment and response tool (UrbanHEART)

Table 11.2 The response component: entry points and the relevant stakeholders

Entry point/approach	Examples of relevant stakeholders
Slum-upgrading	Organizations of the urban poor Lane or street leaders Women's groups Nongovernment organizations and civil society Ward or borough leaders Community health workers
Urban primary health care	Staff of primary health care centers NGOs and civil society District health systems City and municipal health officers
Healthy cities/ settings	City and municipal health officers and their teams Healthy cities coordinating bodies Health councils City councils Mayors
Local government and urban/ metropolitan planning	City planning and coordinating bodies Governors Representatives of urban districts in state legislatures Metropolitan health officials Metropolitan emergency and disaster response officials Hospital chiefs in metropolitan areas Provincial, state or district health authorities and managers of service delivery
National policy and decision-making	Minister of health National programme managers (e.g. health promotion, disease control and prevention, disease surveillance and quarantine services, community-based programmes, social health insurance, social determinants of health, health sector reform, healthy settings, environmental health, violence and injury prevention) Regional or state level health officials for health policy and planning President/prime minister Parliamentarians Health committees in the legislature Health advocacy groups on tobacco control, women's health, reproductive rights, etc. Housing ministry Transportation ministry Education ministry Finance ministry National media (health reporters)

Source: WHO Kobe Centre (2007). Urban health equity assessment and response tool (UrbanHEART)

The main applications of this tool are: (1) *Comparative performance of cities* – This summarizes the performance of cities or urban areas in the different policy domains and program indicators. Also, it provides a relative comparison of their accomplishments, and (2) *Comparative effectiveness of policies and programs* – this provide a

general view of the effectiveness of policies and program interventions as reflected by their indicators.

It is expected that based on the results obtained by the application of this tool, a joint UN-Habitat/WHO Global Report on Urban Health linked to health equity will be launched in 2010, the global health year dedicated to Urban Health.

11.9 Index for Healthy Conditions in Urban Settings

One important charge for urban health professionals is providing evidence-based information and analysis to assist policy formulations aimed at the reduction of health inequalities between different population groups living in urban conglomerates.

Very few cities and urban conglomerates currently produce regular and routine disaggregated health data by socioeconomic status, geographic area, gender, etc., which is critical in determining health needs and inequities.

The identification of those populations having greater unmet health needs is recognized as an essential public health function. Health needs in a defined urban geographic area or population group are usually characterized by the analysis of variables and indicators that represent different health conditions. However, unmet health needs should not only be expressed through morbidity and mortality indicators. A long-standing problem of epidemiological and public health assessments is that many of them concentrate on measures of morbidity, mortality and disability rather than of health and healthy conditions. As they are related to core health determinants, socioeconomic and environmental indicators and indicators of resources, access, and health services coverage area are also important sources of information for the assessment of such needs.

In contrast, when looking at health in terms of quality of life, where more weight is given to the determinants than to the consequences of the disease, a healthy situation will arise where better living conditions, availability of resources and greater well-being exist.

To support health policy formulations and to facilitate a more rational and equitable allocation of resources, it is essential that available information be synthesized into useful metrics. Those metrics should take into account the different aspects of specific urban health situations, be simple to calculate and consider the distribution of all groups. For urban health, geographical patterns are also important.

Following these requirements, Castillo-Salgado et al. (Castillo-Salgado et al. 2004) developed a procedure to calculate a simple "Healthy Conditions Index" that has been used to guide decision-making in public health. Originally this health metric was developed for the assessment of the health situation of the countries of the Americas. The index included indicators for the first sub-national disaggregated level (e.g. departments, province or states) following the recommendations and standards of the PAHO's Core Health Data System (Pan American Health Organization 2008).

The selection of indicators for the "healthy conditions index" in urban settings should be based on the following criteria: (1) availability for all the studied urban

areas (neighborhoods, urban conglomerates); (2) representativeness of important dimensions of health and its determinants; (3) accepted validity; and (4) sufficient variability to discriminate between selected conglomerates. Following these criteria, indicators should reflect a healthy environment and infrastructure (population coverage of potable water and of sanitary disposal of excreta), community development (access to public libraries or social services), availability of health resources (primary health physicians per conglomerate), and access to health services (coverage of vaccination in infant populations). Other important indicators of human development capital (literacy rates) and well-being (life expectancy at birth) should be included.

Once the indicators from different “healthy conditions” domains are identified, it is methodologically important to describe how to combine indicators with different units of measurement (rates, proportions, years of expected life, etc.) into the calculation of a single metric or index. Different procedures have been proposed, but a simple and statistically robust one consists of standardizing all of the units into a single scale, particularly when the frequency distributions of the indicators are normally distributed or have been normalized. To this end, *Z-scores* are calculated. *Z-scores* represent one of the most commonly applied methods (Castillo-Salgado 1988) used in measuring and characterizing individuals with regard to their populations. They measure the distance between the value of an observed unit (neighborhood) and the distribution average (city or expected achievable level). A complete description of the procedures used to obtain the *Z-scores* of this metric can be found in the following article (Castillo-Salgado et al. 2004). Once the scores are obtained for each study urban area, they are ordered and re-classified in quantiles in order to identify the urban population/areas with the highest total scores, that is, those with the best health conditions. These results of this healthy-conditions metrics are presented in thematic maps for easy visualization of the results.

New technologies and methodologies are very valuable for the development of these types of health metrics and they are now being applied and expanded for application to urban development and urban health. Of special consideration are the Geographic Information Systems (GIS) and geo-spatial analyses. Given these technological advances, a Composite Health Index calculation tool has been developed for Geographic Information Systems applied to public health and it is available in the SIG-Epi (Geographic Information System in Epidemiology) software (Martínez et al. 2001). This public health domain software is accessible at the website of the Pan American Health Organization (http://www.paho.org/English/DD/AIS/sigepi_web2003en.htm).

The characterization of healthy conditions, healthy places or healthy municipalities and the monitoring of their determinants are considered essential elements to reorient efforts to reduce health inequalities through health promotion and ad-hoc health care and public health intersectoral interventions. The use of metrics and indices that summarize information on various dimensions of health and human development are essential tools to assist in making the process of decision-making more effective and efficient in promoting urban health. Furthermore, the development of these urban

health metrics has been facilitated by the use of GIS, providing better management, query, visualization and analysis of the information. In Urban Health, the promotion, collection and use of disaggregated information of health and its determinants are highly recommended at the level of neighborhood or any relevant Urban Community Statistical area. In summary, from the perspective of health promotion and healthy spaces in urban settings, the detection and evaluation of healthy conditions is a critical step for assisting in the formulation of priorities and for the selection of the type of intersectoral work in health. In addition, these health metrics also assist in the provision of better urban ad-hoc interventions that are equity oriented.

11.10 Recommended Websites Related to Urban Health

Urban Observatories. http://www.unhabitat_rolac.org/observatorios_urbanos.asp?id_secao=14&id_idioma=2

Johns Hopkins Urban Health Institute <http://www.jhsph.edu/urbanhealth>

Journal of Urban Health <http://www.springlink.com/content/1468-2869/>

Urban Health Initiative <http://www.urbanhealth.org>

WHO/Europe – Healthy cities and urban governance <http://www.euro.who.int/healthy-cities>

The International Society on Urban Health <http://www.isuh.org/>

7th Conference on Urban Health <http://www.icuh2008.com/>

WHO-Urban Settings Knowledge Network http://www.who.int/social_determinants/en/

Social Determinants of health, reference document <http://www.euro.who.int/document/e81384.pdf>

The Documentary Series on Social Determinants: Is equality making us sick? <http://www.unnaturalcauses.org/>

UN-HABITAT State of the World' Cities Report 2006/7. http://www.unhabitat.org/downloads/docs/Press_SG_visit_Kibera07/SG%205.pdf

WHO. Urban Health Equity Assessment and Response Tool (UrbanHEART). <http://www.who.or.jp/urbanheart/index.html>

United Nations Human Settlements Programme (UNHabitat) 2004. Urban Indicators, Guidelines. Monitoring the Habitat Agenda and the Millennium Development Goals. http://www.who.or.jp/2008/urbanh/Urban_Indicator_Guidelines_UNHABITAT.pdf

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Office of Epidemiology and Planning. Baltimore City Health Department. Neighborhood Health Profiles – 2008. <http://www.baltimorehealth.org/neighborhoodmap.html>

South East Public Health Observatory. Life expectancy calculator: LA and ward level. <http://www.sepho.org.uk/viewResource.aspx?id=8943>

The Association of Public Health Observatories (APHO) includes a network of 12 public health observatories (PHOs) located in England, Scotland, Wales, Northern Ireland and the Republic of Ireland. <http://www.apho.org.uk/>

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Chapter 12

Recommendations on Evaluation and Development of Useful Metrics for Urban Health

Carlos Castillo-Salgado and M. Chris Gibbons

Abstract Even as the field of Urban Health continues to emerge, the need for useful metrics and measurement tools is becoming apparent. Currently many attributes of factors found in the urban environment may be measured. We also can measure the magnitude and psychologic or physiologic impact of common many elements, exposures and other realities common to the urban environment. However a robust summary statistic of Urban Health that takes into account sociocultural, environmental, biophysiologic, economic, healthcare and urban assets or resources does not exist. This chapter highlights the inherent complexity of this goal by exploring select major issues and challenges with accomplishing this objective and in so doing, helps to highlight the need for Knowledge Management principles and expertise to be an intricate part of the process.

12.1 Urban Health Metric Development Process

The utilization of a replicable systematic process will facilitate the development of valid and reliable urban health metrics. As such this report represents only the first step in this process. Over the next several months, it is envisioned that key stakeholders will remain engaged and use this report as the basis of a discussion of relevant policy questions related to the development of novel urban Health metrics. These discussions will then enable participants to identify a fundamental set of critical domains that collectively can be used to characterize health status among urban populations. Once these domains have been identified and consensus achieved the selection of appropriate metrics can be accomplished. In some cases

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it may be found that suitable metrics cannot be identified, and as such they must be developed. All metrics then should be pilot tested for feasibility prior to implementation in collaboration with the observatories in urban health. Finally, prior to global dissemination of the new metrics, there should be a period of iterative evaluation and refinement to enable the development of valid metrics with the widest possible applicability.

12.2 Urban Health Metric Developmental Strategy Options

From the outset it should be recognized that development of high impact urban health metrics will be facilitated by input from a wide variety of perspectives. Across these varied disciplines at least two developmental strategies may be employed. Each strategy has both strengths and weaknesses and will be briefly discussed below.

The Epidemiologic Development Approach – Because this approach is conceptually familiar, to many individuals, particularly social scientists, it will not be discussed in great detail, except to say that it is based largely on notions of causation, causal inference, frequency distributions, measures of effects and measures of association. This is true whether we are talking about the incidence or prevalence of disease, the degree of poverty existing in a given population or the quality of the social environment in which people live. Here the basic components of epidemiologic inference are incidence rates. As such metrics developed from a purely epidemiologic perspective will largely involve counting occurrences of interest in relation to the people or time spans in which they occur. This data oriented approach has its theoretic basis, in large part, in statistical reasoning, has enabled researchers and practitioners to exquisitely measure events of concern in society and has historically had far reaching influences on individual and population health (Rothman and Greenland 1998).

The Strategic Management Development Approach – It is increasingly recognized that many of the problems facing urban health are so complex that they defy simple solutions. Understanding the social environment, the relationship of this environment to individuals and populations in the context of often simultaneous synergistic, antagonistic and potentially co-active dynamic (changing over time) exposures is challenging. It is simply very difficult to simultaneously comprehend so many complex and important factors and interrelationships. Systems thinking has emerged as a useful approach for understanding and integrating knowledge from a wide variety of interrelated factors. Along these lines, a systems approach can be defined as a logically consistent method of reducing complex problems to simple components that can then be used by decision makers, in conjunction with other data to arrive at a best solution. This approach has its theoretic roots in strategic planning, general systems theory and organizational management. Metrics derived from this basis involve the iterative characterization of existing and emerging issues (both positive and negative) as well as continuous reevaluation of the interventional

entity (Governments, Health Departments, NGOs etc) At its core this approach is action oriented and results driven. Strategic Management driven approaches have emerged as useful approaches for managing accountability and change in complex systems, not just measuring it.

At this preliminary stage in the process of Urban Health Metric Development it is neither necessary nor advisable to go into further depth regarding the methods and tools of either approach. Rather, it would be useful to think, in depth, regarding potentially desired processes and outcomes of this urban metric process. In so doing it may facilitate a decision regarding the broader implementation of one of the two approaches outlined above. Indeed, a third possibility consisting of a hybrid approach involving some elements of both approaches may be deemed desirable.

12.3 Literature Strengths, Weaknesses and Gaps

Several researchers have hypothesized pathways that attempt to explain how the sociobehavioral environment is related to health and health inequalities. Historically, these conceptual frameworks have formed a solid foundation upon which science was built. Indeed the unique perspectives of each scientific discipline have both strengths and weaknesses. However, because addressing social determinants of health and eliminating health inequalities will require working across many fields and disciplines, careful consideration must be given to several issues which if not addressed, could lead to unintentional cross disciplinary confusion and ultimately hinder progress towards achieving global health equity. The first issue related to the lack of depth to which most currently available conceptual models of social determinants of health integrate current scientific understanding of the biology of disease. While the work of this commission is to focus on the Social Determinants of health, attempts to understand health status and outcomes without an appreciation for how those determinants affect biology is problematic and may be seen as such by those stakeholders having this orientation. In the same way, attempting to characterize biological pathways without an understanding of the critical interplay of the social determinants of health will inevitably lead to an incomplete characterizations of reality. This does not represent an attempt to “medicalize” the “Social Determinants of Health”. Rather it is an assertion of the universally held notion that it is not possible to become unhealthy or sick without altering, perturbing, overwhelming or otherwise impairing one or more biological processes (psychological or somatic) of individuals or populations. Whether or not all individuals in a given population are impacted to the same degree, by the same set of social determinants resulting identical effects on biology again, is not relevant for this discussion and should be the subject of scientific inquiry. Rather an appreciation for these interactions is critical.

The second issue relates to the terminology used in the literature to characterize the effects of “causal” agents or factors. Unfortunately this terminology has not been standardized across disciplines and is derived from several fields including toxicology, biostatistics, epidemiology, sociology (Baron and Kenny 1986), and the

clinical/bench sciences (Minamoto et al. 1999; Gibbons et al. 2007). For example across these fields, the terms cause, mediator, moderator, regulator, effector, interaction, and mechanism of action have vastly different meanings, which may not be readily apparent to all investigators. Epidemiologists and statisticians tend to use the terms mediators and moderators to describe distinct aspects of an observed association between two independent variables, largely without reference to the underlying biophysiological processes. On the other hand, toxicologists and clinical/bench scientists tend to use the terms mediators, moderators, and regulators almost synonymously as descriptors of factors, substances, or agents that alter some characteristic of a known or unknown biophysiological mechanism. They also tend to reserve the term “cause” or “causal” pathway to describe an agent or series of biophysiological events that must occur to result in a given outcome.

Finally the third issue that may unintentionally lead to confusion when working across disciplines relates to the fact that scientists, practitioners and investigators trained in the clinical and bench sciences generally consider discreet, quantitative exposures (viral, bacterial, toxicological, psychological, etc.) as the etiologic agents of disease. Historically, these exposures were studied in isolation from the broader sociobehavioral contexts in which they exist. On the other hand, social scientists often consider more qualitative social factors like poverty, socioeconomic status (SES), and racial segregation as the key determinants of health (LaVeist 2002). They often assert that other more quantitative exposures are factors, which alter the nature of the association between the social factor and a given health outcome. When social scientists are describing causal factors, they draw a distinction between proximal social factors, which they define as the settings in which people live (family, work, school, and neighborhood), and distal social factors, which they define as the pervasive forces in society (culture, SES, and race relations).

As is implied above, a greater understanding of how community contextual characteristics may affect health will require thinking about mechanisms linking contextual characteristics to specific health outcomes (Gibbons et al. 2007). The contextual characteristics associated with cancer among the elderly are not necessarily the same characteristics implicated suicide among adolescents. Unless we attempt to study rather specific health outcomes, it will be difficult to know which contextual characteristics are important for which health outcomes. This specific outcome/mechanism approach is but one way forward and needs to be applied more rigorously across a range of potential health outcomes relevant to contextual influences on health and inequalities. Along these lines, it is entirely possible that many contextual characteristics are likely to be empirically implicated in a range of health outcomes (e.g., poverty). Moreover, there is significant potential for clusters of exposures to interact in producing disease. None the less, the general principle of moving toward a search for greater conceptual and mechanistic specificity (both social and biological) of contextual influences on health is important to enable a comprehensive understanding of health and inequalities in the urban setting.

Another limitation of the social determinants of health conceptual literature relates to thinking about which stage in the natural history of a health outcome is of concern. For instance, it is possible that contextual characteristics may play

little simultaneous role in the pathogenesis of heart attack, but social determinants may be very important in the quality of life and access to resources of people who have survived the heart attack with some functional limitations. For many health outcomes, especially chronic disease outcomes, there is likely early exposures to certain risk factors such as a high fat diet or cigarette smoking which then cause only increased susceptibility. At a later stage there may be triggering mechanisms that lead to an event such as a heart attack or stroke. Assuming the person survives he or she will live with some level of functional limitations, in part related to one or more contextual factors. As such it is likely that different aspects of social determinants of health could affect these processes differently. Because there is no single pathway to health, there is not a unique set of contextual characteristics that will be universally important for all health outcomes or at all stages of the outcomes.

Finally it may at times be misleading to develop metrics based solely on contemporaneous contextual exposures. Chronic diseases have latency periods implying that exposures from across the life course may be important in the development and progression of these diseases. This does not mean that there are not important proximal contextual characteristics related to the triggering of events. However, it is important to think carefully about how measured exposures to social determinants match up with the temporal logic of the stage of the outcome. It is therefore critical to consider the potential effects of community contextual characteristics through a life course perspective. It is possible that exposure to current environmental conditions per se has little to do with the current distribution of inequalities in the incidence of chronic disease outcomes like rates of heart disease or cancer. Rather, they may more strongly reflect both contextual characteristics and individual influences from earlier in the life course. This recognition means that both individual and social exposures over the life course are of interest in better understanding contemporary health and inequalities in chronic disease health outcomes. Exposures in early life can have both direct and indirect health effects (Gibbons et al. 2007). Biological and social exposures co-evolve over the life course, so that social determinants at one point may eventually become an “individual characteristic” later in the life course.

12.4 Critical Urban Health Metric Key Questions

- (a) What is the most appropriate Urban Health Metric Developmental strategy (Epidemiologic, Strategic Management, Hybrid)
- (b) Should metrics quantify the magnitude and impact of social determinants which occur in cities (but could also occur in rural areas) or should metrics quantify the health of populations living in cities?
- (c) Can the health of populations be comprehensively characterized by only considering social determinants of health status occurring within those populations?
- (d) Should UH metrics that are based on contextual factors (social determinants) be developed in terms of specific health outcomes?

12.5 Urban Health Metrics Development Recommendations

1. Carefully consider the above key questions. They will help lay the foundation for the development of high quality metrics.
2. Consider carefully the cross disciplinary challenges and solutions to developing high quality Urban Health Metrics. The success of the push for global health equity will be in direct proportion to the ability of leaders to motivate and galvanized constituents from distinct and varied backgrounds and perspectives. Furthermore, cross disciplinary collaboration and action will be facilitated when diverse stakeholders are able to effectively communicate about common problems. Unintentional confusion related to language, terminology and disciplinary philosophical perspectives can be significant and will hinder the development of high quality metrics if not carefully addressed.
3. Consider the value of developing an Urban Health Metrics “toolbox”. Much like a carpenter’s toolbox has many tools because no one tool is appropriate for every job, so to it is recommended that several evaluative tools be developed. The tool development process should continue over time employing successive phases of planning, development and iterative pilot testing and metric refinement. Planning should include discussion regarding potential categories of tools.
4. Because urban health is the result of complex interactions among many factors, it is recommended that attempts should be made to define one or more urban health profiles. A profile is defined as a defined cluster of characteristics. Potentially such profiles might represent an urban “fingerprint” that may uniquely distinguish one urban center from another. While it is conceivable that many such profiles may exist in a given urban center, it is also probable that a standard urban profile may be able to be developed. In this case, this standard set of factors could be measured across cities. While the basic constituents would not change across cities, the magnitude of these factors or the observed relationships between these factors may vary such that cities may be distinguished on this basis.

12.6 Approach of the Johns Hopkins Urban Health Institute

In the fall of 2005, The Johns Hopkins University began working to bring together university scholars with community leaders and develop a plan that could change the trajectory for children and youth and families in Baltimore. The underlying assumption of the conceptual model that has emerged is that changing the trajectory for children, youth and families in Baltimore will take a generation of committed work. A three to five year demonstration project will not work to make sustained change. It will require the collaboration of local citizens of Baltimore with the diverse community organizations that serve it, the private philanthropic community, local state and federal government. It will require the collaboration of city and state police, education, justice and educational infrastructures. And it will require significant political will. What follows is a model designed for East Baltimore but is

also generalizable to other urban communities in Maryland, across the United States and around the world.

Underlying Assumptions: Any web of supports needs to fully utilize the existing publicly funded programs and initiatives where they exist rather than building a privately supported parallel set of interventions. So, for example, where there is social service or health care service funding available from city or state resources those should become part of the initiative. In the model that follows, many core services currently exist. Where they do, they will become fully integrated into the East Baltimore Initiative.

Where services do not exist that are needed or where existing services are insufficient to meet the needs of the community, governmental and private sector supports will be sought to develop, implement and evaluate those components with the goal of institutionalizing support for them as well.

Organizational Structure: The development and operations for the *East Baltimore Initiative for Children, Youth and Families* (or The EB Initiative) will be under the leadership of a newly established 501c3 not-for-profit organization comprised of local citizens from communities we aim to serve as well as the political, philanthropic and CBO sectors. The Board will have representation from both Johns Hopkins University and the East Baltimore Development, Inc. but will be independent of both. Rather, it will be community-based and community-driven.

It will have as its mission the development of the human infrastructure that will assure that the service network developed in our community achieves its goal of helping young families establish and sustain a new life course for their children and themselves.

12.7 The Service Network and the Web of Supports

12.7.1 Prior to Conception

Any effective intervention to improve the outcomes for children and youth needs to start prior to conception. Perhaps the single most effective intervention for women and children is family planning and pre-conceptual health care of women so that children are born wanted and healthy. The goals should include: child spacing of at least 18 months between births, women who enter pregnancy free of sexually transmitted infections; women with a pre-pregnancy nutritional status sufficient to carry a pregnancy to term without nutritional deficits for either herself or her child.

Thus, this model begins with family planning services as part of a community-based health service that would provide for STD screening, volunteer counseling/testing (VCT) and comprehensive reproductive health services for women of child-bearing age. While the evidence is clear that effective pre-conceptual health services make a substantial for women and the children who are subsequently born wanted, that is only the first and very small step.

12.7.2 Pre-natal Care

Once a woman becomes pregnant a far-reaching set of intensive interventions and supports are needed; and these supports while changing across the first two decades of a child's life, must be sustained through high school and beyond.

Too often children are born in our community already disadvantaged, having experienced in utero to nutritional deficiencies, drug environments, alcohol, genital tract infections and more. There is a mounting evidence that fetal development not only is determinative of health outcomes during infancy and childhood but across the lifespan influencing many of the chronic conditions such as cardiovascular disease, obesity and diabetes that in turn contribute so much to the health disparities we see in our community. Thus, what are needed to assure a healthy start are services that provide for diagnosis and treatment of the prenatal conditions that influence birth outcomes. Such obstetric and related care should be coupled with the gynecological services described in the *Prior to Conception* section above.

In both the pre-conceptual and pre-natal health care services we propose working closely with the Department of Obstetrics and Gynecology at the JHU School of Medicine and the Wald Clinic of the JHU School of Nursing. We plan to use existing sources of funding where available; but no child, youth or family in our catchment area should ever be denied any health care service due to lack of insurance or the inability to pay.

12.7.3 Community Health Workers

There is ample evidence that providing solely for clinical/social services without the human supports to de-mystify those services and to assure appropriate and full utilization of them is simply not sufficient. Effective programs use community workers/family liaisons (CW/FL) to bridge between individuals and the services available. Such community workers *come from the community* where the services and programs are being developed and have had personal experiences facing many of the same issues that the women of child-bearing age now face (e.g., domestic violence, STDs, substance use, incarceration, etc.). The effectiveness of any program rests on the credibility of these individuals to provide consistent and on-going support to women and subsequently to the children of those women in the community that we will serve. They are people who "have been there" and having survived want to help the next generation avoid some of the challenges they faced. Previous research suggests that a ratio of one community worker to between 15 and 20 clients/families is ideal. It is suggested that community workers continue to stay engaged with their client panel for a *minimum of five years* post-delivery. At Johns Hopkins, there is substantial expertise in the use of community workers. Currently, Chris Gibbons MD, MPH, Associate Director of the UHI, runs such a CHW program serving the elderly in the East Baltimore community. Anne Duggan PhD,

Professor of Pediatrics, has evaluated home health workers in Hawaii and elsewhere. So too, Dean Martha Hill PhD, RN and colleagues in the School of Nursing have extensive experience training and collaborating with community health workers (CHW).

12.7.4 Family Support Center

Recently, Friends of the Family awarded a grant to the East Baltimore Development, Inc. for the establishment of a Family Support Center in East Baltimore. Such a center is focused on children from birth to age 3 years and their parents and will provide a range of services to assure that children thrive:

- Parent skills training
- Nutritional supplementation and nutrition counseling
- Developmental assessments
- Well child care and health education with links to illness care
- Infant stimulation program
- Speech and language development
- Extended day care services through at least 7 p.m.; respite care on a 24 h/emergency basis
- Peer support programs
- Job training referrals for young mothers and fathers
- Mental health counseling especially for issues of maternal depression

12.7.5 Social Worker

As is true for the need for the CHWs, there is a need for skilled social worker support for these families and particularly the women and children. The needs to be addressed include but are not limited to:

- Mental health
- Violence
- Employment
- Housing
- Substance abuse
- Ex-offender reentry

A ratio of approximately one social worker to 25–30 households will be the goal; and again, a long-term relationship between social workers and the panel of families they serve will optimize outcomes. We envision teams to include two CHWs and one social worker.

12.7.6 Public Health Nurse

From the work of David Olds and others, the data are very compelling that home visitation programs using public health nurses have not only short-term benefits, but when such visitations are continued through the first 2 years the positive outcomes are sustained for at least a decade. In the present model, public health nurses would be linked with CHWs and would start home visitations on an every-other-week basis through the first two years of life. Here the focus will be on parenting skill building, normal infant and child development; and in addition to direct services nurses will provide support to the CHWs.

12.7.7 Pre-kindergarten

There are a number of well researched pre-kindergarten programs that show very positive evidence of long-term impact (e.g. Perry pre-school). As we begin to plan a K-8 school model through support from Atlantic Philanthropies we need to first assure that the children entering into kindergarten are at grade level and ready to learn. A pre-K school model that focuses on speech and language, learning readiness, social skills development and assists parents in learning the skills needed to support their children will create a climate that will enhance their outcomes once they begin school.

12.7.8 K-8 Community School Campus

At its core this is the Atlantic Philanthropies proposal. Atlantic Philanthropies has identified East Baltimore (through the East Baltimore development) as one of four priority communities for the establishment of community school campuses. The vision for this initiative is that it will be a single location for health, social service and education.

It is important to note that the experience of others that have done comparable programs is that on-going reading and math enrichment will be needed since those who are disadvantaged due to parental, economic and/or educational deficits are more likely than peers to fall off the educational trajectory at every step along the way. Strategies will include: extended day, extended year, and after school programming. We envision the active involvement of the JHU community (both faculty and students) to be involved in tutoring, mentoring and after school enrichment programs. So too, we envision the active involvement of the local faith, NGO and neighborhood adult communities to provide a range of supports and enrichments for these young people. Additionally, on-going social supports

through the community worker and the social worker have, in other settings, proven to be critical elements. For us, this community school campus needs to bridge with the other elementary and junior high/middle schools in the immediate East Baltimore area. Current planning includes collaboration with KIPP Academy and Dunbar Middle School. While it may well be that those who are not attendees at the community school itself would not benefit from the core educational programming, it is very possible that the teacher training, principal supports, health services and social supports can be expanded to reach and benefit all children throughout our proximal geographic area.

12.7.9 High School

While high school is not a core component of the Atlantic Philanthropy proposal, to bring children along through middle school and not have as thoughtful and detailed support system for them during the high school years is extremely problematic. In the East Baltimore community the Dunbar High School is the predominant 9–12 grade school. Johns Hopkins Medical Center has a unique relationship with Dunbar and as the initiative at the pre-K-8 school moves forward we are well positioned to work with the Dunbar and Baltimore schools leadership to develop a model collaboration to assure that when the children who are graduates of the 8th grade in the community school and Dunbar Middle are ready to transition to high school in the East Baltimore community, that the neighborhood school can assure that all who enter will graduate. With the development of a new Biotech park as part of the East Baltimore development, there is now the need as well as opportunity to educate the next generation to assume a range of positions in the health sciences and biotechnology. To accomplish this will require the full commitment of both JHU and the Baltimore school system to rebuild Dunbar to its preeminent educational status. As is true for the younger grades, this will require committed leadership, skilled teachers who are “kid magnets”, extended day and year school, after school programs and strong community-school-parent collaborations. But it will require more. As collaboration with JHU, there is opportunity for one-on-one mentoring with students and faculty from the Schools of Medicine, Nursing and Public Health. There is need for after school work opportunities in laboratories, community research projects and clinics; and there is the need for summer work opportunities far beyond those that currently exist. For some young people all that will be needed will be the availability of opportunity; for others, it will require pre-employment training so as to assure that any work experience will be successful (e.g., work readiness skills).

At the high school level there is also the need to establish “second chance” programs for those who have dropped out of school and wish to obtain their GED. And there is need for ex-offender programs for young men and women who have been incarcerated and are now looking for educational and employment opportunities.

12.7.10 Volunteers

The opportunity to attract volunteers to work with children and youth is extraordinary. Johns Hopkins University has a vast network of undergraduate and graduate students as well as faculty who can serve as Big Brothers and Big Sisters, provide tutoring, and assist in recreational and after-school programs. Effective programs akin to the ones that we are envisioning actively and effectively use volunteer networks to support children and families.

Likewise, there is both the need and opportunity for neighborhood citizens to serve as volunteers. *Experience Corps* is an example of a model where community seniors volunteer to work with young people in schools and community settings and benefits accrue to both age groups.

But not only is there a need for the Hopkins and East Baltimore adult communities to serve as volunteers, so too, there is a need for young people themselves to have opportunities to contribute to their community whether it is working with Meals-on-Wheels programs, helping a senior, community clean-up projects, park development and maintenance, peer tutoring.

12.7.11 Enrichment Programs

One of the realities for children in East Baltimore is that they simply have less access to many of the same enrichment programs that are readily accessible to middle and upper income children: sports clubs and teams, music lessons, arts programs, and travel. What we propose is a set of recreational opportunities (e.g., linked with the Carmelo Anthony Youth Center), sports leagues, dances as social events (e.g., those sponsored currently by Peace Makers) music classes (e.g., linked with the Peabody) and chess clubs. In addition, we will offer opportunities to visit and explore some of the cultural centers within Baltimore and Maryland, to have camp experiences outside of the inner city and to travel beyond the confines of their current geographic experience to Washington, New York and elsewhere. Within the proposed model, we will build in a wide range of enrichment opportunities after school, on weekends and during the summer.

12.7.12 Employment Training and Post High School Education

Central to the effectiveness of a model such as what is envisioned and described above is that at the end of the process, there are real prospects for future education and employment. Our vision is that all children who enter pre-K will graduate 12th grade. It is our vision that all who will choose to go to college will have that opportunity open to them and for those who choose vocational training options,

that there are those opportunities as well. For those on a vocational trajectory, we would envision developing a job guarantee program so that the message is clear and the rewards equally visible that if one stays in school and achieves the grade appropriate landmarks, with appropriate vocational training and successful completion of the components of the program as we envision it, a job will be available for them. We would anticipate that Johns Hopkins University would have a lead though not an exclusive role in such a work guarantee program; rather, Hopkins initiatives would be coupled with private sector collaborations to make this a reality. For those who are on an educational trajectory, we would envision a tuition waver program modeled after the Baltimore Scholars Program currently supported and developed by Johns Hopkins University whereby students who meet the entry criteria to local colleges and universities from Baltimore public schools are admitted with full tuition support for 4 years.

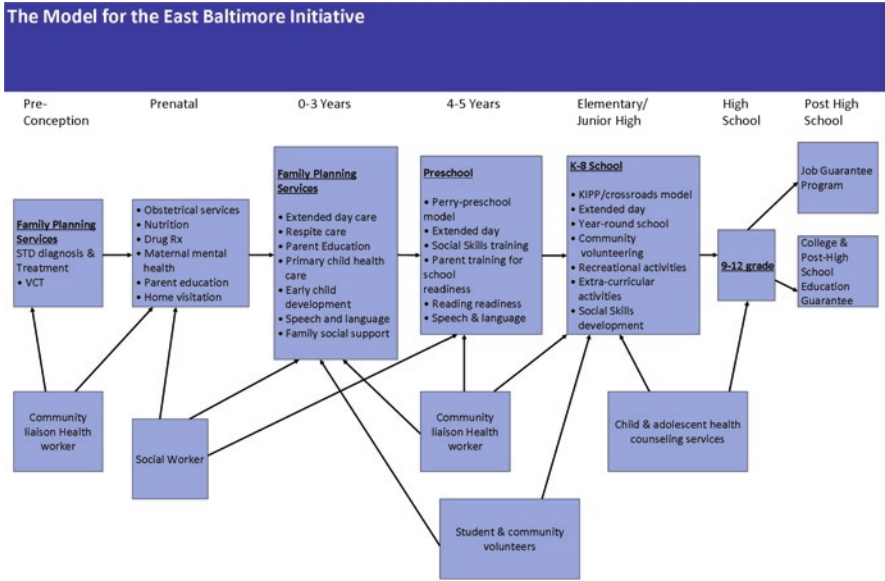
We will know that our East Baltimore community is vibrant when those who graduate our schools go on to vocational school and university to subsequently return to our community for employment.

12.8 Conclusion

The central role of communities and neighborhoods is in service to the families who live there; and likewise, the fundamental function of family is to provide strong supports to the children who they are rearing. Thus, underlying the model described above is a fundamental view that sees strong families nested in strong communities. To achieve that vision we need to work with local citizens and community organizations not only to assure that their voices are heard in every aspect of the *web of supports* to be developed but that community capacity is enhanced through skills development, leadership training and supports.

Clearly, what is proposed here is an ambitious model that has multiple components. The reality, however, is that there is a substantial evidence base for each and every one of the components being envisioned; and we know a lot about what makes effective services and programs work. What has yet to happen in Baltimore or anywhere else in the country is for all of the elements to be put together in a coordinated and sustained manner. While, at first glance, it may seem costly and outside our reach; the costs to our young people and to our City of failing to do so are so much higher.

What is envisioned is a generation of work and not a 3-year project. As we embark on a Family Support Center and a Community School Campus this prospectus proposes that we both think and dream big and from the beginning develop a model with strong community support and participation based on evidence of what we know works to transform the outcomes for children, youth and families of those who live in the East Baltimore community. We know if we can accomplish this it will serve as a model for the city, the state, and the nation.



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Chapter 13

Making Sense of Urban Health Knowledge

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13.1 The Power of Knowledge Management

In contemporary terms, the view of KM can be summarized as “The process of lowering the transaction costs associated with creating, sharing, and applying knowledge, and developing improved strategies to support these activities” (Prusak and Matson 2006). After careful evaluation it can be concluded that humanistic factors can be attributed to the intricacies experienced in present day KM (Prusak 2001; Prusak and Matson 2006; Ichijo and Nonaka 2007). The process of knowledge creation and sharing is inseparable from its human cognition (Ichijo and Nonaka 2007; Pemberton et al. 2001; Baumard 1999; Tsoukas and Vladmiron 2001). Failing to appreciate the importance of these factors has misinformed organisations embarking on a KM strategy (Wickramasinghe 2006; Walsham 2001; Wernerfelt 1984; Swan et al. 1999).

KM has been construed and viewed in different perspectives, some view as synergy, some as Intellectual Capital (IC), competitiveness, a decision making tool, customer focus strategy, employee relation and development, lowering costs, customer value addition, etc (Chourides et al. 2003; Sveiby 1998). Healthcare organisations, including those operating in the urban context, have started to believe that long-term profitability and business sustainability are primary concerns and are to be addressed outside the individual healthcare domains. So to achieve this, an organization-wide KM strategy has to be adopted (Ichijo and Nonaka 2007; Kasvi et al. 2003).

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This suggests that KM has to be viewed more in terms of leveraging than managing. Limited, objective-based exposure has removed knowledge from a holistic concept and forced business managers to view it as a resource which can be managed (Wernerfelt 1984; Swan et al. 1999). A more proactive approach would refer to the unbounded subjective nature of knowledge and rather conclude that knowledge should be leveraged (Prusak 2001). Since KM has been in use for over a decade and has been well established in both academic and organizational domains, it will be appropriate to term all knowledge activities under KM, in spite of the fact that KM should focus on leveraging knowledge (Walsham 2001; McDermott 1999).

Knowledge creation is still considered entirely as a cognitive process (Thomas et al. 2001; Prusak and Matson 2006; Bell 1999; Ichijo and Nonaka 2007; Pemberton et al. 2001; Baumard 1999). This process has not been completely understood by modern day biological science and hence forces knowledge workers to look at it as a black box. From an organization's perspective, the focus should be on the conducive environment for knowledge sharing to create new knowledge (a knowledge cycle) among individuals within the organization (Thomas et al. 2001; Baumard 1999). Hence importance has to be given to knowledge cycles, thereby assisting in the transcending process of creating a knowledgeable organisation. KM oriented activities, strategies and processes aim at achieving a favourable environment that implicitly propagates productive knowledge cycles.

The objective nature of knowledge was seen as an opportunity by many KM solution providers. In the 1990s such KM solution providers exploited organisations which showed interest to invest in their readymade technological based KM solutions (Prusak and Matson 2006; Walsham 2001; McDermott 1999). Irrespective of the huge investments incurred in implementing such technology-based KM solutions they utterly failed to deliver the much promised returns on such huge investments. This resulted in a negative view on KM; progressively organisations were wary about committing to future KM initiatives (Walsham 2001; McDermott 1999). This caused overexposure on non-core KM issues, which deprived KM of the much needed maturing time. This misunderstanding can only be corrected by refocusing KM on its precise core issues i.e. humanistic aspect. Liebowitz (2005) acknowledges the importance of people and culture as 80% in successful KM and attributes the remaining to technology. In spite of the problems there is a growing interest in KM, particularly in urban healthcare organisations. They have started to realise the potential of KM by concentrating on the humanistic attributes of knowledge creation and sharing (Davenport 1995).

KM has been accepted as a strategic management science (Drucker 1993; Argyris 1992; Senge 1990). Especially in organisations where exigencies as mentioned earlier are profuse, KM is looked upon as the antiphon (Disterer 2002). Organisations have recognised both sticky and leaky features exhibited by knowledge (Brown and Duguid 2001). We have enumerated that the nature of knowledge and the incidence of it can only be manifested through humanistic traits (Ichijo and Nonaka 2007; Walsham 2001). In addition to this, any organisation, especially

those in urban health, is identified as people-centric and the importance of human nature within knowledge in organisations has been clearly underlined (Walsham 2001; Chourides et al. 2003). Every individual's physiognomy has its own complexion- rules, morality and economic associations, and this renders a unique phenomenon attributed to that particular individual.

Any organisation can be viewed as a layered model from the knowledge perspective (Ichijo and Nonaka 2007). The core of the model is human psychology, as mentioned earlier all knowledge originates at this level. Knowledge creation also takes place at this level. Human psychology either acts as a knowledge enabler or a deterrent. Human values and beliefs are important factors for urging the individual to share knowledge withheld in the individual's cognition. The stickiness manifests in this layer, this can be attributed to the cognitive facet of knowledge creation. The knowledge leakiness can also be associated to this layer as it is related to individuals leaving the organisation.

At this level, Maslow's theory of human needs can be an ideal mechanism to explain and draw parallels regarding the motivating factors for emphasizing knowledge creation and sharing (Maslow 1943). There are different theories that explain factors which have a strong relationship in explaining an individual's view on knowledge sharing with other individuals from a personal perspective. Personal level ego based human attributes influence the individual's intent to share knowledge (Durkheim 1958). These factors are not permanent and may fluctuate based on the environment to which the individual is exposed and its combinatorial effect on the individual's cognitive framework.

The second layer in the model is social psychology; this plays a major role in sharing knowledge and in creating knowledge at group level. Some knowledge theorists concur that "the sum is greater than the individuals" (Bresnen et al. 2003). Any organisational team is a permanent/semi-permanent or temporary agglomeration of individuals with a common purpose of achieving organisational objectives in time and to deliver the set goals within stipulated resources; such organisational structure creates a social bond among the team members. Even though sociological aspects can only be deduced from a psychological perspective, a collective sense can stem from human's social nature.

Epistemic barriers can arise due to the complexities existing within a formal organisation. Polanyi argues that social component is mandatory in all forms of knowledge creation and sharing (Polanyi 1966). This concept of belonging and inter-responsibility can have an adverse impact on how as a group the team will share the acquired knowledge not only created within the organisation's temporal continuum but also knowledge already possessed by the individuals. The individual's cultural, ethnic and education background affects the intensity with which the individual will share knowledge (Fernie et al. 2003; Brown and Duguid 2001). The individual's inclination and eagerness to share knowledge can be dampened by the current organisational culture. It can aid or deter the individual by creating social apprehensions, peer pressure and aloofness among the group (Fernie et al. 2003; Brown and Duguid 2001; Newell and Huang 2005).

13.2 Sharing Knowledge

The concept of “Communities of Practice” (COP) is mostly constituted among peers who are equal in stature in the organisation; this does have its inherent advantages such as uninhibited knowledge sharing through cross-fertilization of ideas (Brown and Duguid 2001). Individuals pool their knowledge resources and act as temporary think-tanks within the organisation; this can be mapped to the social psychology layer. This type of COPs can be sustained beyond individual activities for which these COPs were constituted within the organisation; thereby creating a forum which can be looked up for finding solutions which are difficult from an individual’s capacity (Newell and Huang 2005; DeFillippi 2001). These groups would put the organisations betterment over individual’s gain.

Experts concur that lack of proper recognition and appreciation will abrogate the “stickiness” of knowledge, but on the contrary, this will facilitate the generation of knowledge-islands in organisational environs. Incessant support to such knowledge-islands creation would ultimately result in ineffectiveness of the organisation’s functional group due to a decline in innovation and creativeness. The stickiness can only be abated by supportive strategies addressing the social and communal apprehensions rather than the individual’s beliefs (Hall and Sapsed 2005). This discussion would take the concept of social groups such as COPs to the next level by expanding them to play a bigger role in sharing knowledge irrespective of the individual’s position in the organisation’s domain (Hall and Sapsed 2005). All the organisational staff should be forthcoming in sharing their knowledge at the right time which can make a huge difference in the organisation’s success or failure. The knowledge sharing culture should be viewed as a holistic characteristic of the team and the organisation has to cultivate such an environment which can thrive and sustain a cordial atmosphere for expansive knowledge sharing.

The next layer in the model refers to the organisation’s cultural environment which is vital for creating an enabling atmosphere for knowledge creation and sharing (Lytras and Pouloudi 2003; Stonehouse and Pemberton 1999). This atmosphere should cater to the psychological stratum at both the personal and the social level (Fernie et al. 2003). A strong and dedicated leadership and top management which has self belief in knowledge creation and sharing as an intrinsic organisational activity are mandatory (Marr 2004). Only dedicated management which sets itself as role model can propagate a knowledge enabling culture. Moral support and encouragement originating from the top management alone can sustain a knowledge environment throughout the organisation (Marr 2004).

Durkheim in his book on social theories postulates that when human subjects are intentionally or unintentionally made to follow a routine and repetitive enforcement of constraints this would gradually give rise to habits and internal tendencies which render the constraints unnecessary in future (Durkheim 1958). Similarly, routine knowledge creating and sharing attitudes can be ingrained within the organisation’s work ethics. This would not only ensure a holistic application of knowledge but also enable new individuals joining the organisation to be overwhelmed by the

positive culture towards knowledge and embrace it wholeheartedly, which results in the inhibition of psychological aspects in the individual and a social approach alone will be gleaned out (Durkheim 1958). Through these features, the organisation can realise its potential related to the beliefs, tendencies and practices of its members. This eventually culminates into a truly knowledge-based social phenomenon. The organisation's infrastructure has to be viewed as an enabler for the knowledge environment (Stonehouse and Pemberton 1999). Many simple tools such as an e-notice board, e-fora, blogs, discussion boards, mailing system, and a database for useful information are vital (Wernerfelt 1984; Swan et al. 1999; McDermott 1999; Liebowitz 2005). Providing access to facilities for knowledge retrieval and sharing are fundamental at this level, but every organisation has to realise that technology can play only a supporting role and cannot replace the humanistic core of KM (Wernerfelt 1984; Tissen et al. 2000; Liebowitz 2005).

If urban healthcare organisations can focus on the aforementioned aspects of a knowledge-based organisation model, they can harvest many positive outcomes. The outcomes are not only limited to a better execution of activities within the organisation, but also increase the values of the organisation's different facets such as Intellectual Capital (IC), Social Capital (SC) and Knowledge Capital (Tissen et al. 2000; Prusak 2001; Marr 2004).

13.3 Beyond KM

Two conflicting perspectives were discussed by experts, Wernerfelt (1984) views knowledge as a resource that could be managed as any other in an organization. Wernerfelt (1984) further details that knowledge exists as an independent entity from its creator and creation context. Whereas Berger and Luckmann (1967) view knowledge as a culmination of shared belief, prospering in social domain and extensive social interaction enhances knowledge creation (Cicmil 2005). This discussion draws its strength from Berger and Luckmann's views and expands and details the importance of humanistic core of knowledge. SECI framework (Socialization, Externalization, Combination and Internalization) of Nonaka and Takeuchi (1995) is acclaimed for its focus on socialization as a tool for creating and sharing knowledge (Ichijo and Nonaka 2007). Some of the challenges which are to be addressed in organisational environs are as follows (Ichijo and Nonaka 2007):

1. Knowledge crossing boundaries between team members of different disciplines
2. Invisible boundaries between hierarchical management layers
3. Inter-disciplinary knowledge sharing is stronger than intra-disciplinary
4. Group discussion can create new knowledge generation
5. Integration of knowledge from different stakeholders
6. Encouragement to collective learning and inter-organisational learning

When the various humanistic knowledge aspects mentioned earlier are addressed appropriately, any organisation can evolve into a knowledge-based organisation.

As solutions, many initiatives such as rewards, recognition, employing knowledge gate keepers/enablers have been suggested (Fong et al. 2005; Cicmil 2005). Organisations and academia had accepted that rewards and recognition would encourage knowledge sharing, but this works only on a short-term basis (Fong et al. 2005). These schemes of appreciation are difficult to measure and benchmark, since the knowledge being shared/created is beyond quantifiable mechanisms due to its rich tacit knowledge content. This may force the organisation's staff to take advantage of knowledge sharing as a means for personal benefits, rather than for the betterment of the organisation as a whole.

This discussion on factors beyond KM, highlights the fact that all knowledge managed staff should come forward to indulge and propagate knowledge sharing eventually creating new knowledge without expecting specific compensation for such acts. They should accept knowledge sharing as a culture and discharge knowledge creation activities as a part of their regular activities. Hence a holistic concept of knowledge sharing and acceptance are imperative for all future knowledge managed organisations. Some organisations had employed a knowledge worker as a gate keeper of knowledge and they are expected to not only assist in knowledge creation but also enable the free flow of knowledge across organisational boundaries (Walsham 2001; Bresnen et al. 2003; Marr 2004). But this approach is only intended as a short term arrangement and ultimately all organisations have to embrace knowledge and do sharing as a routine process. In addition, they will become liabilities to a knowledge system (Bresnen et al. 2003). Their own personal egos, moods and prejudice can hamper the free flow of knowledge (Lytras and Pouloudi 2003). To overcome the above-mentioned shortcomings, knowledge workers have to be replaced by the entire team (executing a knowledge worker's function as a group) and thereby the organisation can realise an unrestricted flow of knowledge paths not only at the intra level but also at the inter-organisation level. This can easily be expanded into organisation wide knowledge flow paths and even parent organisation's conglomerates and partners can involve themselves actively in the organisation's free knowledge sharing (Cicmil 2005).

Urban healthcare organisations should not only commence KM based initiatives but should be focussing more on sustaining such initiatives for a longer timeframe. This allows the whole organisation to address new challenges by creating new knowledge and sharing them as part of their routine activities. That is when one can realise a complete knowledge focussed urban healthcare organisation. Many KM models and frameworks have been proposed by experts specifically for healthcare-based organisations (Whelton et al. 2002; Prencipe et al. 2005). The current discussion highlights that such organisations have to select the best framework for their environment; they may even employ a hybrid of more than one framework for maximum efficiency (Whelton et al. 2002; Prencipe et al. 2005). Irrespective of what model/framework is selected, due focus on humanistic aspects has to be dealt at the core level for achieving the maximum efficacy of KM.

The differentiation of explicit knowledge and information is of paramount importance when applying KM to the urban health field. The concept and efficacy of KM within urban health is not always understood and the notion of such critical

terms as “information” and “explicit knowledge” are often (incorrectly) regarded as being interchangeable. Clear differentiation between these terms is essential and, equipped with this new understanding, even novices can clearly comprehend these fundamental elements and avoid using them as misnomers. This ensures that knowledge and its components will be properly addressed in both clinical and non-clinical domains.

13.4 The Importance of People

KM has been acknowledged as an integral part of management culture which provides methodologies through models, frameworks and approaches with appropriate objectivity via rigorous studies. These studies test theories to formulate metrics and benchmarks for effective business management. The core of KM is knowledge. KM identifies how knowledge is created and shared among different stakeholders in a business paradigm. Knowledge is dichotomised based on its existence; it is termed tacit (when coupled with cognition) and explicit otherwise. KM is a multi-disciplinary management science and every organisation including healthcare has come to appreciate the importance of knowledge and its management (Blackler 1995). In simplistic terms, KM paradigm focuses on three core elements namely people, process and technology. Even though other facets of KM have been identified and justified (to mention a few, culture, IT, content, infrastructure, politics, etc). Each of these facets can be mapped to the core elements. portrays not only the core elements but also signifies the level with which they are weighted and displays them by their relative sizes corresponding to their importance from KM’s humanistic perspective (Lehane et al. 2003; Milton 2008).

Technologies as simple as email, web blogs, e-notice boards, fora etc. to much more sophisticated tools such as AI, knowledge discovery and data mining tools are part of the technology element in KM (Baskaran et al. [in press](#)). Technology plays the least significant role in KM but technology-based KM solutions are easy to procure and implement. They fail to contribute to their potential unless the other two core components are properly aligned with KM (Baskaran et al. [in press](#)). Process is related to internal mechanisms that the organisation has established collectively over years of existence. Process represents a summary of best practices which really work in that specific organisational environment (Baskaran et al. [in press](#)). It is common that the contexts for creating such processes are lost over time. Yet they preserve what is good and is practicable for the betterment of the organisation. Communities of Practices (COPs), social structure, cultural aspects, social capital and so forth play a vital role in the process element (Baskaran et al. [in press](#)).

People are the fundamental element in KM and it is the most significant factor in a knowledge-based strategy (Baskaran et al. [in press](#)). They in fact drive the other two elements. KM thrives only with proper individual’s acceptance of KM’s fundamental concepts. Unhindered exposition of KM procedures can assist in rapid KM deployment (Baskaran et al. [in press](#); Wickramasinghe et al. 2009).

The author's accentuation of the people element in KM does not necessarily mean to attenuate the importance of the other two elements. In fact a balanced approach with the right coalescence would provide the best of KM (Baskaran et al. [in press](#)).

13.5 Concluding Remarks: Knowledge, Disease and the Importance of “Sense”

“Knowledge is the enemy of disease” (National Knowledge Service 2006) and serves ultimately to protect the patient from harm. As skills and knowledge exist in both individuals and organizations, the essence of KM for urban health is how best to identify and capture knowledge and experience in order to disseminate it further throughout relevant organizations. Outside the urban health context, there have been several attempts to bring various forms of clinical information to the clinician at the point of care, which include:

1. to develop computer applications that stand alone, although which are often network accessible, and are available to the clinician upon his/her request
2. to incorporate the clinical knowledge directly into clinical information systems used by clinicians while giving care (once there, the computer-based system can automatically prompt the clinician or the clinician can request help) or
3. to request help from an outside source (Sittig 2005).

Elements of these approaches can be applied directly to the urban health context. At the time of writing, the prevalence and concern of the “Swine Flu” (H1N1) pandemic is of global concern. Little is currently known about the specific epidemiology of the virus. On 27 April 2009, the World Health Organisation (WHO) increased its influenza pandemic alert level from phase 3 to phase 4, indicating that they believe ‘sustained’ human-to-human transmission is occurring. It should be obvious that, once any applicable data and information can be collated, knowledge-based activities should be carried out to lower the spread of the infection and to increase international “know how”.

The somewhat outdated understanding of KM depicts a linear relationship between data, information, knowledge and wisdom. Several researchers have suggested other ideas, amongst them Snowden (2005) notion that the effective transition to knowledge should also include an element of sense-making (i.e. how can we make sense of the world so we can act in it?). Sensemaking has been an area of interest and research for some time; Dervin (1996) has concentrated on individual sensemaking (and the “cognitive gap” experienced when attempting to make sense of observed data) whilst Weick et al. (2005) has focussed on sensemaking at the organisational level.

In essence, once we have information, what can we do with it? All organisations now boast “information systems” and claim that they have revolutionised their internal

and external operations. On closer examination, what effective decision-making processes have resulted? Does this necessarily involve *context*? Was there any *sense* applied to the information in order to produce rich and pertinent knowledge? With the continuing threat of current and new (global) pandemics, the importance of sense-making and rich knowledge for urban health research and practice becomes of critical importance. By way of knowledge-based technologies, in conjunction with “field”-based urban health practitioners (for example, community health workers and associated and allied health professionals) can be used to enhance the use, access and viability of urban health operations. (Community) health workers in particular can be used to address communication, behavioral, and health knowledge gaps that exist between underserved populations and the healthcare system, to improve healthcare access and healthcare outcomes in public health settings and are an effective method of culturally tailoring public health and healthcare interventions (Gibbons and Tyus 2007).

We argue that true *sense* involves the knowledge and contextual experience of *people*. Judicious use of technology, people and processes (i.e. knowledge-based activities) can be used not only to bridge existing knowledge gaps but, by effective sharing and collaboration, ensure that this necessary bridging is sustainable and as strong as possible to cope with future urban health requirements.

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Epilogue

As the preceding pages have served to demonstrate Urban Healthcare settings are complex and challenging. Currently, with few exceptions, most patients in such settings receive inferior healthcare delivery due to multifarious issues as we have noted throughout this book. We believe that this situation is unacceptable in today's twenty-first century. Moreover we contend that superior healthcare delivery is not only possible but realisable through the incorporation of the numerous tools, techniques, tactics and technologies afforded by KM. We close by urging researchers and practitioners to embrace the principles of KM and apply them to Urban Health Contexts so that we can indeed evidence the possibilities of superior healthcare delivery.

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