Family and community practices that promote child survival, growth and development

A REVIEW OF THE EVIDENCE

WORLD HEALTH ORGANIZATION
GENEVA

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Executive summary

BACKGROUND

Every year, nearly 11 million children die before reaching their fifth birthday, and most of them during their first year of life. Most of these deaths (98% in 2002) are in developing countries; more than half are due to acute respiratory infections, diarrhoea, measles, malaria, and HIV/AIDS. In addition, malnutrition underlies 54% of all child deaths. Projections based on the 1996 analysis *The Global Burden of Disease* indicate that these conditions will continue to be major contributors to child deaths in 2020 unless significant efforts are made to control them (Murray & Lopez, 1996).

In response to this challenge, the United Nations Children's Fund (UNICEF) and the World Health Organization (WHO) developed the Integrated Management of Childhood Illness (IMCI) strategy, which focuses on these five conditions, and which includes three main components:

- Improvements in the case management skills of health workers through the provision of locally adapted guidelines on IMCI and through activities to promote their use.

- Improvements in the health system that are required for the effective management of childhood illness.

- Improvements in family and community practices.

This paper addresses *improvements in family and community practices*. More specifically, it presents the evidence for twelve key practices (see below), identified by UNICEF and WHO to be of key importance in providing good home-care for the child concerning the prevention or treatment of the IMCI conditions, in order to ensure survival, reduce morbidity, and promote healthy growth and development. It does not include the four additional practices added following a meeting of UNICEF, the WHO Regional Office for Africa and nongovernmental organizations (NGO) which took place in Durban, South Africa in June 2000, as these practices will need additional work to reach a specificity whose impact can be measured.

AIMS AND OBJECTIVES

This paper is a technical review document. It is targeted at an audience of health professionals, researchers and policy advisers, and aims to inform policy discussions concerning where investments in this area are best directed, for both programme action and research.

It has three specific objectives. The first is to summarize the evidence available on the potential impact on child survival, growth and development of interventions to improve each of the 12 key family and community practices, and the evidence concerning the feasibility of interventions to improve the key practices. The second is to identify gaps in knowledge that either hamper the assessment of impact, or need to be filled in order to develop effective interventions, and to make recommendations for future research. The third objective is to make recommendations concerning next steps and priority-setting for both programme action and research.

It is also hoped that the evidence presented will be used as a basis for advocacy to and by decision-makers in government ministries and partner agencies.

METHODOLOGY AND STRUCTURE

In compiling this evidence, it was fortunate that recent overviews and meta-analyses have been conducted for many of the key practices. Where appropriate these were used as the primary source of information. They were supplemented by published study papers, agency reports and interviews with experts.

The impact that can be achieved by intervening to improve a key practice depends on three factors:

— how widespread the current prevalence of inadequate conduct is;

— how strong the link is between inadequate conduct of the practice and child mortality, growth and development; and

— the success of interventions in increasing the proportion of the target population that successfully carries out the key practice.

This review therefore assesses the evidence concerning each of these. This is presented in the main body of the paper, with each key practice discussed in a separate chapter. All chapters are organized into the following sections, with an additional section entitled *Moderating factors* included where appropriate.

- The prevalence of the key practice
- The benefits of the key practice
- The impact of interventions to increase the key practice
- The feasibility of large-scale programmes
- Conclusions
- Questions to be answered.

Following the twelve chapters are tables that summarize the results of trials assessing the impact on mortality (or other health indicators) of interventions to improve the key practice, or in the event of no available controlled trials, the results of relevant observational studies.

A synthesis of the evidence from the individual key practices is then presented, highlighting general themes, summarizing conclusions and making recommendations for next steps. In particular, consideration is given to how this review might be used to assist the development of priority action for programmes and research in this arena.

CONCLUSIONS AND RECOMMENDATIONS
Potential impact

1. The review of the evidence confirms the importance of each of the 12 key practices. There are major gaps between current and desired behaviours for each practice. Interventions to close these gaps have the potential to make a substantial contribution to the reduction in mortality/morbidity, and/or improvement in child development.

2. There is considerable variation between the practices in the experience that exists in developing relevant effective interventions. On the one hand are the notable successes with strategies to improve immunization coverage (key practice 1) and to promote the use of oral rehydration salts (ORS) (part of key practice 8). At the other extreme, no substantive evidence was found concerning attempts to intervene to improve recognition of when sick children need treatment outside the home (key practice 9), and the evidence on improving adherence (key practice 10) is confined to small-scale interventions applied in a limited setting.

3. The impact that can be achieved by intervening to improve a key practice depends not only on how strong the link is between inadequate behaviour and child mortality, but also on how low the current prevalence of adequate behaviour is, and on the feasibility of available interventions to increase the proportion of the target population that successfully carries out the key practice. The potential impact will therefore vary considerably not only between countries, but also within countries.

TYPE OF INTERVENTIONS	KEY HEALTH IMPACT OF INTERVENTIONS TO INCREASE THE PREVALENCE OF THE BEHAVIOUR	COMMENTS

TAKE CHILDREN AS SCHEDULED TO COMPLETE A FULL COURSE OF IMMUNIZATIONS (BCG, DTP, OPV & MEASLES) BEFORE THEIR FIRST BIRTHDAY

Improve access through quality routine delivery

Improve access through quality mass campaigns such as National Immunization Days (NIDs)

Reduce missed opportunities at health facilities

Improve utilization through social mobilization/ communication campaign

- Immunizations already prevent an estimated three million child deaths each year.

- Despite the global immunization coverage of 80%, high coverage is not universal and there are as many deaths due to vaccine preventable diseases as there are deaths prevented by immunization. A different level of effort is needed to reach the last 20% of children unimmunized.

- Using results from efficacy studies it has been estimated that increasing coverage a further 10% would reduce measles deaths by 11%, diarrhoeal deaths by 4% and acute lower respiratory infections (ALRI) deaths by 2%.

- NIDs have been effective in the control and elimination of polio, and are being planned for measles. However, improving routine delivery services is important to ensure sustainable high coverage.

- Reducing missed opportunities for immunization during health visits could potentially reduce mortality as 41% (median) of children in developing countries have had a missed opportunity.

- Social mobilization can increase coverage and is an important principal in expanding coverage. It is estimated that nearly three million children in Africa do not receive measles immunizations even though they probably have access. No studies exploring the impact of social mobilization on mortality or morbidity were located.

- Improving immunization safety is important, as up to half of injections are currently unsafe.

- The private sector provides up to 40% of immunizations but their potential role in routine delivery has not been fully explored.

BREASTFEED INFANTS EXCLUSIVELY FOR SIX MONTHS

Changes in hospital policies/actions

Counselling/ education from peers or health workers

Mass media and community education

Mother-support groups

- Breastfeeding is associated with reduced child mortality/morbidity and improved development. Evidence includes a meta-analysis that found that breastfed infants under two months of age were six times less likely to die of infectious diseases than non-breastfed infants and a protective effect against diarrhoea has been observed in developed and developing countries.

- Interventions to improve exclusive breastfeeding (EBF) have focused around changing hospital practices (0–43% difference in EBF) and education/ counselling (4–64% difference in EBF).

- Counselling interventions were further explored in a meta-analysis; women who received lay support were less likely to stop exclusive breastfeeding (RR 0.66) than those who received no support, but there was no significant difference between those who received professional support and those who received no support.

- Data on the impact of support groups or mass media on exclusive breastfeeding are scarce and only peer counselling interventions reported morbidity impacts (children in the intervention groups were 1.9–2.9 times less likely to have diarrhoea).

- It is not known whether breastfeeding counselling/education is more effective with individuals or in a group setting.

- Breast milk provides all the nutrients needed for most infants up to six months of age (evidence for the optimal duration of EBF includes a trial demonstrating protection against gastrointestinal tract infection and studies suggesting that infants breastfed for six months do not show growth deficits).

- The prevalence of human immunodeficiency virus (HIV) in a country must be considered when breastfeeding promotion interventions are designed.

TYPE OF INTERVENTIONS	KEY HEALTH IMPACT OF INTERVENTIONS TO INCREASE THE PREVALENCE OF THE BEHAVIOUR	COMMENTS
STARTING AT SIX MONTHS OF AGE, FEED CHILDREN FRESHLY PREPARED ENERGY- AND NUTRIENT-RICH COMPLEMENTARY FOODS, WHILE CONTINUING TO BREASTFEED UP TO TWO YEARS OR LONGER		
Family counselling/ nutrition education **Provision of high energy and protein food supplements**	• Breast milk continues to be a source of key nutrients and to confer protection against infectious diseases throughout the second year of life, but after six months is not sufficient alone to meet nutritional requirements. However, complementary foods are often inadequate in energy and micronutrient concentration or quality, and are often prepared, stored, or fed to children in ways that increase their risk of illness. • Observational studies indicate that improving feeding practices could save 800 000 lives per year. • No complementary feeding interventions with mortality outcomes were located. Five efficacy trials to improve intake of complementary foods found net increases in energy intake of between 65 and 300 kcal/day and improvements in growth of between 0.25 and 0.46 SD units for weight-for-age, and 0.04 and 0.35 SD units for height-for-age. The growth improvements should translate into a reduction in deaths associated with malnutrition of between 2% and 13%. • Nutritional supplementation has a significant impact on long-term developmental outcomes in malnourished children in developing countries. • A recent pilot study in Brazil, implementing nutritional counselling through IMCI, has also been encouraging, reporting significant weight gains in children aged one year or more but not in younger children.	• Programmes demonstrate that it is possible to develop nutritionally improved complementary foods in diverse cultural settings, that poor mothers are willing to prepare new foods, and their children are willing to eat them, but that caregivers face considerable time and resource constraints.
ENSURE THAT CHILDREN RECEIVE ADEQUATE AMOUNTS OF MICRONUTRIENTS (VITAMIN A, IRON AND ZINC IN PARTICULAR), EITHER IN THEIR DIET OR THROUGH SUPPLEMENTATION		
Supplementation **Fortification** **Dietary modification**	• Improving intake of vitamin A, iron and zinc will have a substantial impact on mortality, morbidity and development in poor or micronutrient deficient populations. • Evidence comes from randomized controlled trials which show that vitamin A supplementation can reduce mortality by 23% (the morbidity and mortality impact varies across different diseases). No mortality studies were located for iron or zinc supplementation. However, iron supplementation improved development in children over two years of age and zinc supplementation reduced diarrhoea incidence by 18% and pneumonia incidence by 41%. None of the micronutrients had a consistent impact on growth except zinc. • Micronutrient deficiency will not be easily tackled through interventions to improve the micronutrient content of diets, although these may be a useful part of the solution, and may have wider benefits. Supplementation and/or fortification will be necessary. • Vitamin A supplementation programmes are being implemented in nearly 50% of countries where supplementation is advised and fortification in developed countries has been effective in helping reduce deficiencies. • Supplementation and fortification programmes need to be accompanied by promotion and communication activities but little information was located on this area.	• There is a strong case for tackling micronutrient deficiencies together, since diets deficient in zinc, are almost certainly iron deficient, and likely to be so in vitamin A. • Vitamin A supplementation is more easily delivered than iron and zinc, since megadoses can be given every 4–6 months. New technologies such as iron sprinkles may make supplementation more feasible.

TYPE OF INTERVENTIONS	KEY HEALTH IMPACT OF INTERVENTIONS TO INCREASE THE PREVALENCE OF THE BEHAVIOUR	COMMENTS
DISPOSE OF FAECES, INCLUDING CHILDREN'S FAECES SAFELY; AND WASH HANDS AFTER DEFECATION, BEFORE PREPARING MEALS, AND BEFORE FEEDING CHILDREN		
Hygiene education **Provision of services (soap/clean water/ sanitation facilities)**	• Handwashing interventions reduced diarrhoeal incidence by a median of 33% (range 11–89%). The impact was higher in studies that targeted handwashing alone rather than as part of a package of behaviours. • All types of handwashing are not equally effective. Using large quantities of water, vigorous rubbing, using cleansing agents such as soap, ash or clean mud, and drying with a clean cloth or in the air appear to be the most effective ways of removing pathogens. • Few faeces disposal interventions were located. However, six rigorous observational studies demonstrated a median reduction of 55% (range 20–82%) in all-cause child mortality associated with improved access to sanitation facilities. Little is known about the impact of disposing of faeces in the absence of latrines. • Improving faeces disposal is likely to have the greatest effect in high density areas.	• Large scale handwashing promotion programmes have been effective in initiating behaviour change. However, concerns still exist about feasibility because of the complexity of the behaviour and the resources required to carry out such a programme. • Latrines can be costly and difficult to maintain and keep clean and in some settings they are unfeasible; for example where housing density is extremely high or terrain unsuitable.
PROTECT CHILDREN IN MALARIA-ENDEMIC AREAS, BY ENSURING THEY SLEEP UNDER INSECTICIDE-TREATED BEDNETS		
Social marketing	• A meta-analysis of four African randomized controlled trials showed that insecticide-treated bednets (ITNs) are associated with a 17% reduction in child mortality compared to control populations with no or untreated nets. The majority of the benefits may be due to the insecticide treatment rather than the physical presence of the net. • The long-term effect of ITN use on mortality in high transmission areas is unclear. Lack of exposure to the malaria parasite at an early age may reduce long-term immunity. • Social marketing can increase ITN use by as much as 50% and child survival by as much as 25%. • Whether ITNs only protect those who sleep under them or whether they protect others in the community is still unclear, with studies on vector ecology providing conflicting evidence.	• Affordability is an important factor for both purchase and re-treatment of ITNs. Even at subsidized prices the poorest may still be excluded. Strategies are needed to ensure equity without undermining the commercial market. • Health, environmental impacts and resistance of insecticides need monitoring.
CONTINUE TO FEED AND OFFER MORE FLUIDS, INCLUDING BREAST MILK, TO CHILDREN WHEN THEY ARE SICK		
Group or individual counselling	• Randomized controlled trials have found that feeding nutritionally-complete diets to children with diarrhoea increases net energy and nutrient absorption without affecting stool output or the efficacy of ORS. Feeding locally-available foods does not increase duration of diarrhoea. • Anorexia to non-human milk and solids appears more severe than to breast milk during illness, highlighting the critical role of breastfeeding during illness. • No studies were located exploring the impact of interventions to improve feeding and giving fluids during illness on mortality or morbidity. There is evidence that counselling interventions can improve behaviour but there is little evidence about how best to scale up the interventions.	• Lessons can be learned from programmes aiming to improve the feeding of healthy children, which have shown the importance of involving many channels, behavioural aspects of feeding and peer counsellors.

TYPE OF INTERVENTIONS	KEY HEALTH IMPACT OF INTERVENTIONS TO INCREASE THE PREVALENCE OF THE BEHAVIOUR	COMMENTS
GIVE SICK CHILDREN APPROPRIATE HOME TREATMENT FOR INFECTIONS		
Training and counselling mothers **Training drugsellers** **Mass media campaigns** **Social marketing/ improving access** **Improving packaging and instructions**	• Uncomplicated diarrhoea, malaria and local infections can be managed at home with efficacious treatments. There are some concerns that encouraging home treatment of malaria will foster medication misuse. • Oral rehydration therapy (ORT) can prevent death from watery diarrhoea in all but the most severe cases. The national control of diarrhoeal disease programmes substantially increased the use of ORT, which is likely to have played a large role in the global reduction of diarrhoea deaths from 4.6 to 1.5 million. In Brazil ORT is estimated to have contributed to 79% of the decrease in diarrhoeal deaths. • Interventions to improve how ORT is used have focused on reconstitution and correct administration of ORS through health education, but evaluations have not been scientifically rigorous. • Interventions to improve home treatment of malaria-related fevers by training mothers and increasing access to treatment have had variable impacts on mortality and morbidity, but have the potential to have a large impact with one well-conducted study reporting a 41% mortality reduction. • Drugsellers' prescribing, which is often poor, and has been identified as influencing home treatment. Only one study was located that addressed shopkeeper behaviours (the percentage of childhood fevers treated adequately increased by 60%).	• Reduced osmolarity ORS was shown to decrease the need for unscheduled intravenous infusion and stool output compared to the standard formula and a new ORS formulation was released in 2002.
RECOGNIZE WHEN SICK CHILDREN NEED TREATMENT OUTSIDE THE HOME AND SEEK CARE FROM APPROPRIATE PROVIDERS		
Health education of mothers **Training of community health workers**	• Studies examining factors contributing to child deaths have found poor care-seeking implicated in 6–70% of deaths; a high number of deaths have also been attributed to delays in care-seeking. • Only two care-seeking intervention studies were located and their results were inconclusive (a non-significant impact found in one study, and no statistical analysis performed in the other). • Formative research conducted in Mexico and Ghana identified mother support groups and village volunteers as potential intervention channels but effectiveness was not explored. • Interventions are likely to be more successful if they focus on teaching caregivers to recognize symptoms that they can see but do not see as abnormal or dangerous, rather than symptoms they just do not know exist. • The impact of interventions to improve care-seeking relies on a high quality of care, and interventions must consider the type of providers utilized. Studies in Mexico have shown that private doctors are often preferred but that children had 4.2 times the risk of receiving poor quality care and 1.5 times the chance of dying if taken to a private doctor rather than a public doctor.	• Appropriate care-seeking is of particular importance in areas where access to health services is limited, because it is in these areas that caregivers would benefit most from being able to discern which episodes really need to be taken to the health centre.

TYPE OF INTERVENTIONS	KEY HEALTH IMPACT OF INTERVENTIONS TO INCREASE THE PREVALENCE OF THE BEHAVIOUR	COMMENTS

FOLLOW HEALTH WORKERS' ADVICE ABOUT TREATMENT, FOLLOW-UP AND REFERRAL

Counselling **Mass communication campaigns** **Medication appearance**	• Little is known about the impact of adherence on mortality or morbidity, but not adhering to treatment and referral instructions may lead to incomplete treatment, therapy failure, drug resistance and the later misuse of the leftover medicines. • Only small-scale adherence interventions were located, all reported a positive impact on adherence. Counselling interventions improved adherence by up to 66% and improving packaging by 27%. Only one trial had morbidity outcomes; in this study malaria parasite counts were lower where health workers used picture and verbal instruction to explain antimalarial dosing. The potential impact of mass communication interventions is unknown and should be investigated. • No interventions were located focusing on adherence to appointments and referral instructions. Whilst more research in this area is needed, reducing the need for referrals may also be an important intervention. In Uganda implementing IMCI was estimated to reduce referrals from 22% to 16%. • Interventions to improve appointment-keeping will have a minimal impact on mortality and morbidity where appointments are not kept because children have recovered.	• Accurate diagnosis and prescription are important for successful treatment; poor diagnosis and bad prescribing practices are common but can be improved. • No studies were located exploring adherence from the caregiver's point of view; this is essential to understand in order to develop effective interventions.

PROMOTE MENTAL AND SOCIAL DEVELOPMENT BY RESPONDING TO A CHILD'S NEEDS FOR CARE, AND THROUGH TALKING, PLAYING AND PROVIDING A STIMULATING ENVIRONMENT

Centre-based and child-focused that provide psychosocial stimulation directly to the child **Home-based and parent-focused that aim to improve parenting skills or the parent's ability to perform psycho-social stimulation**	• There is an extensive scientific basis for the benefits of home- and centre-based stimulation on early childhood development. Adults born in poverty who participated in a quality preschool programme have higher social responsibility, education performance, earnings and property wealth and greater commitment to marriage. • Randomized controlled trials have shown that centre- and home-based early childhood care and development interventions can improve parental verbal interaction, behaviour management and attitudes towards the child. • Centre-based interventions appear to be more effective than home-based approaches. However, interventions that utilize more than one delivery channel appear to have the greatest impact. Intensive interventions and time periods of 2–5 years are felt to be needed for long-lasting impact. • Home-based interventions appear to be effective in low-birth-weight and malnourished children but have inconsistent impacts on low-risk children. • In malnourished children, the combination of supplementation and stimulation interventions appears to have a greater effect on cognitive development than either one alone. Such combined programmes are likely to be more efficient at delivering services.	• New approaches are needed to improve participation rates and improve access to the most disadvantaged children. • There has been little research into socioeconomic factors that influence a child's ability to respond to a particular programme.

TYPE OF INTERVENTIONS	KEY HEALTH IMPACT OF INTERVENTIONS TO INCREASE THE PREVALENCE OF THE BEHAVIOUR	COMMENTS

**ENSURE THAT EVERY PREGNANT WOMAN HAS ADEQUATE ANTENATAL CARE.
THIS INCLUDES HER HAVING AT LEAST FOUR ANTENATAL VISITS WITH AN APPROPRIATE HEALTH CARE
PROVIDER, AND RECEIVING THE RECOMMENDED DOSES OF THE TETANUS TOXOID VACCINATION**

Improving access

Social mobilization

**Mass communica-
tion campaigns**

- The extent to which the antenatal care package can reduce infant and child mortality and morbidity is yet to be shown. Interventions have explored the health impact of individual elements of the visit or have compared the different antenatal protocols (i.e. different number of visits and focused versus 'standard' protocols).

- A meta-analysis of seven trials found that four antenatal visits were not associated with an increase in negative perinatal outcomes compared to more frequent visits (e.g. no statistically significant differences in low birth weight or perinatal mortality).

- A multi-site study found that fewer goal-oriented antenatal visits were not associated with increased risk for mothers or their infants compared to the standard model (e.g. no statistical difference in low birth weight or treated urinary tract infections between the models; rates of pre-eclampsia were slightly higher in the new model).

- No interventions were located which aimed to increase use of antenatal care through social mobilization or mass communication.

Interventions to change key practices

The review confirms much of what is already known from extensive experience in behaviour change and community-based programmes:

4. All the key practices are complex and involve several different behaviours. Some involve different behaviours at different times. Successful interventions need to acknowledge this and are likely to need a combination of different strategies, both to achieve coverage and to reinforce and support families in making the necessary changes.

5. Changing behaviours is complex and requires both perseverance and time. Various models have outlined the steps needed to accomplish this. Decision-making and behaviour-change involve not only the caregiver and the child, but the whole family and sometimes the whole community.

6. Different strategies will be appropriate in different settings and at different times. Cultural beliefs that inhibit the desired behaviour must be addressed, and those that enhance it utilized.

7. Interventions must tackle barriers, and not just proclaim benefits. They also need to reflect the realities of people's lives and their access to resources. Many households, even in conditions of poverty, will have the resources to perform the key practices, but will lack knowledge and skills about how to do this. Many others, however, are more severely constrained economically. In addition to knowledge and skills, they will require assistance, such as the provision of food or nutrient supplements for their children.

8. Interventions to improve the key practices cannot be conducted in isolation from the provision of services. Most practices rely on accessibility to good quality health services. Many also rely on the availability of certain products or pharmaceuticals. These must be acceptable, accessible and affordable. Where the interventions rely on social marketing, with families purchasing a product creating demand, a favourable market and good quality responses are important. Interventions need, therefore, to interact with a variety of players, including the health sector and other relevant public sectors at the local, district and national levels, as well as manufacturers and private retailers.

9. In summary, success in reducing childhood mortality requires more than the availability of adequate health services with well-trained personnel. It also requires a range of associated key practices at family and community level, to tackle adequately the excess burden of child mortality, and to ensure that children reach their full physical and mental potential. To achieve success requires a partnership between health workers and families, with support from their communities.

Next steps and priority-setting for family and community practices that promote child survival, growth and development

10. Improving family and community practices is a critical intervention area that requires political commitment and resources to generate the necessary action in the field. The potential benefits are enormous. Governments and societies have a responsibility to enable families to provide the best possible care to their children.

11. Although all twelve key practices aim to improve child survival, growth and/or development through adequate prevention and treatment of the five IMCI conditions, it is important to recognize the diversity of their nature and of the level of development of interventions to promote them. Thus the practices differ with respect to:

    — the levels of impact achievable with improvement in the practice;

    — the complexity of the behaviour change involved, and whether any benefits are immediately apparent or cumulative over the long term;

    — the frequency of the required behaviour, and its likely sustainability;

    — the relative inputs required from the household, the health services and other actors including other relevant public sectors, manufacturers and retailers;

    — the different levels of development concerning intervention strategies;

    — the differing state of the strength of the evidence base concerning the impact of the practice and/or of the level of experience that exists in how to improve it;

    — the time-scale of possible implementation of different types of interventions.

It is crucial to take these factors into account when planning the implementation of the community component of the IMCI strategy, and in particular when deciding which practices to tackle and how to tackle them.

A. Introduction

BACKGROUND

Every year, nearly 11 million children die before reaching their fifth birthday, and most of them during their first year of life. Most of these deaths (98% in 2002) are in developing countries; more than half are due to acute respiratory infections, diarrhoea, measles, malaria, and HIV/AIDS. In addition, malnutrition underlies 54% of all child deaths. Projections based on the 1996 analysis *The Global Burden of Disease* indicate that these conditions will continue to be major contributors to child deaths in 2020 unless significant efforts are made to control them (Murray & Lopez, 1996).

Success in reducing childhood mortality requires more than the availability of adequate health services with well-trained personnel. As families have the major responsibility for caring for their children, success requires a partnership between health workers and families, with support from their communities. All families need to know how, and have adequate support to feed their children, to prevent and respond to common illnesses (including knowing when to seek care) and to follow treatment advice given by health workers.

In response to these challenges, UNICEF and WHO developed the Integrated Management of Childhood Illness (IMCI) strategy. At the core of this strategy is the integrated case management of the most common childhood problems seen in low- and middle-income countries, including important disease prevention and health promotion elements, such as immunizations and nutrition counselling. The strategy includes three main components:

- Improvements in the case management skills of health workers through the provision of locally adapted guidelines on IMCI and through activities to promote their use.

- Improvements in the health system that are required for the effective management of childhood illness.

- Improvements in family and community practices.

This paper addresses ***improvements in family and community practices***.

For the IMCI strategy to have an impact, improvements in health services must be complemented by well-targeted interventions, of proven efficacy, in the community. This is all the more critical because treatment of sick children often starts in the home using locally purchased medicines, and many severely ill children are not taken to a health facility. Improving family and community practices is a critical intervention area that requires political commitment and resources to generate the necessary action in the field. In order to direct investments to this area, the evidence of what can be gained at which cost must be available.

UNICEF and WHO originally identified ***twelve family and community practices considered to be of key importance to ensure survival, reduce morbidity, and promote healthy growth and development for young children***. These are:

1. Take children as scheduled to complete a full course of immunizations (BCG, diphtheria–tetanus–pertussis (DTP), oral polio vaccine (OPV) and measles) before their first birthday.

2. Breastfeed infants exclusively for six months.

3. Starting at six months of age, feed children freshly prepared energy- and nutrient-rich complementary foods, while continuing to breastfeed up to two years or longer.

4. Ensure that children receive adequate amounts of micronutrients (vitamin A, iron and zinc in particular), either in their diet or through supplementation.

5. Dispose of faeces, including children's faeces, safely; and wash hands after defecation, before preparing meals, and before feeding children.

6. Protect children in malaria-endemic areas, by ensuring that they sleep under insecticide-treated bednets.

7. Continue to feed and offer more fluids, including breast milk, to children when they are sick.

8. Give sick children appropriate home treatment for infections.

9. Recognize when sick children need treatment outside the home and seek care from appropriate providers.

10. Follow health workers' advice about treatment, follow-up and referral.

11. Promote mental and social development by responding to a child's needs for care, and through talking, playing, and providing a stimulating environment.

12. Ensure that every pregnant woman has adequate antenatal care. This includes her having at least four antenatal visits with an appropriate health care provider, and receiving the recommended doses of the tetanus toxoid vaccination.

Four additional groups of practices were adopted by UNICEF, the WHO Regional Office for Africa and nongovernmental organizations (NGO) after a meeting in Durban, South Africa, in June 2000. These are:

- Take action to prevent child abuse, recognize that it has occurred and take appropriate action.

- Provide appropriate care for HIV/AIDS affected people, especially orphans, and take action to prevent further HIV infections.

- Ensure that men actively participate in the provision of child care and are involved in reproductive health.

- Prevent and provide appropriate treatment for child injuries.

The specific practices under each of these areas are being defined further and are not discussed in this document.

AIMS AND OBJECTIVES

This paper is a technical review document. It is targeted at an audience of health professionals, researchers and policy advisers, and aims to inform policy discussions concerning where investments in this area are best directed, for both programme action and research.

It has three specific objectives. The first is to summarize the evidence available on the potential impact on child survival, growth and development of interventions to improve each of the 12 key family and community practices, and the evidence concerning the feasibility of interventions to improve the key practices. The second is to identify gaps in knowledge that either hamper the assessment of impact, or need to be filled in order to develop effective interventions, and to make recommendations for future research. The third objective is to make recommendations concerning next steps and priority-setting for both programme action and research.

It is also hoped that the evidence presented will be used as a basis for advocacy to and by decision-makers in government ministries and partner agencies.

METHODOLOGY AND STRUCTURE

The paper is arranged in four main sections:

A. Introduction

B. Evidence concerning key practices

C. Conclusions and recommendations

D. References

In Section B, each key practice is discussed in a separate chapter. The impact that can be achieved by intervening to improve a key practice depends on three factors:

— how widespread the current prevalence of inadequate conduct is;

— how strong the link is between inadequate conduct of the practice and child mortality, growth and development; and

— the success of interventions in increasing the proportion of the target population that successfully carries out the key practice.

This review, therefore, assesses the evidence concerning each of these. The chapters are organized into the following sections:

■ *The prevalence of the key practice*

■ *The benefits of the key practice* summarizes the evidence concerning the *efficacy* of interventions to increase the key practice, that is the scale of the impacts that have been achieved by interventions applied on a small scale in study settings with conditions optimized to achieve maximum coverage/uptake. Where possible the assessment of efficacy has been based on the results of randomized controlled trials but evidence from other experimental designs such as cohort and case control studies has also been included.

■ *The impact of interventions to increase the key practice* assesses the evidence concerning the *effectiveness* of interventions to increase the key practice, that is what impacts have been achieved when the intervention has been implemented under normal conditions. Where possible the assessment of effectiveness is based on the results of randomized controlled trials but evidence from other designs has also been included.

■ *The feasibility of large-scale programmes*, where *feasibility* is defined as the practicability of implementing a proposed health programme or large-scale intervention. This section includes evidence relating to the effectiveness of large-scale programmes, their logistics, sustainability and the coverage achieved.

■ *Conclusions*

■ *Questions to be answered*

Where appropriate, an additional section has been included entitled *Moderating factors*, which discusses factors that may influence the potential impact or coverage of the intervention, and which are therefore important to take into account when planning the intervention.

Following the 12 chapters concerning the key practices, a set of *tables* summarizes the impact of randomized controlled trials on child mortality, or in the event of no available controlled trials, the results of relevant observational studies. Disease incidence, growth, developmental or behaviour change outcomes were included in the tables if mortality outcomes were not available.

In compiling this evidence, publications up to August 2002 were reviewed and evidence presented from the most relevant publications. Fortunately, recent overviews and meta-analyses have been conducted for many of the key practices. Where appropriate these were

used as the primary source of information, and were supplemented by published study papers, agency reports and interviews with experts. These publications were located through:

- Electronic searches of BIDS, Health Star, Medline, Popline and Cochrane databases
- Electronic searches of the internet
- 'Hand' searches of the following internet sites: BASICS, LINKAGES, UNICEF, and WHO
- Informal consultation with international experts in the field of child health.

In Section C, the evidence from the individual key practices is synthesized. General themes are highlighted, conclusions are summarized, and recommendations are made for next steps. In particular, consideration is given to how this review might be used to assist the development of priority action for programmes and research in this arena.

References are collected together at the end in **Section D**.

B. Evidence concerning key practices

1. IMMUNIZATION

■ **Key practice.** Take children as scheduled to complete a full course of immunizations (BCG, diphtheria–tetanus–pertussis (DTP), oral polio vaccine (OPV) and measles) before their first birthday.

Vaccine-preventable diseases account for 10% of the burden of disease in children under five

Vaccine-preventable diseases account for approximately 10% of the global burden of mortality in children under five years of age, this corresponds to 1.1 million child deaths each year (WHO, 2002). To ensure children receive a full course of immunizations in a timely, safe and effective way services must be accessible, of high quality and utilized.

A complete course of immunizations involves five contacts with a health worker

The recommended immunization schedule is bacille Calmette-Guerin (BCG), oral polio vaccine (OPV) – in polio-endemic countries – and hepatitis B vaccine (HBV) – in countries with frequent perinatal transmission – at birth; OPV, diphtheria–tetanus–pertussis (DTP), HBV and *Haemophilius influenza* type B vaccine (Hib) at 6, 10 and 14 weeks; and measles and yellow fever vaccine (YF) – in YF endemic countries – at nine months (WHO, 2002). (Vaccines against hepatitis B, yellow fever and *Haemophilus influenza* have become more widely available in recent years; however, please note that they are not covered in this review.)

Since the 1960s, the recommendation for the timing and doses of the measles vaccine has varied and is still debated (de Quadros et al., 1996; de Francisco et al., 1994; Garly et al., 1999). This is because, before nine months of age, maternal antibodies can neutralize the vaccine (Caceres, Strebel & Sutter, 2000), but in some settings a significant proportion of children contract measles before this age. For example, in Bangladesh 13% of measles-related deaths and in the Democratic Republic of the Congo (formerly Zaire) 27% of measles cases occurred in children under nine months of age (Fauveau, 1991; Taylor et al., 1988). Even at nine months of age, seroresponse to the current measles vaccine is only 85% in developing countries, leaving an important proportion of children susceptible (Diaz-Ortega et al., 1994). Efforts to reduce the number of unprotected children have led to a search for vaccines that produce seroconversion in the presence of maternal antibodies (Osterhaus, van Amerongen & van Binnendijk, 1998) and to the *WHO/UNICEF Measles Strategic Plan 2001–2005* advocating a second opportunity for measles immunization for every child (WHO/UNICEF, 2001)

1.1 The prevalence of immunization

Immunization coverage increased dramatically in the 1980s but is now static with 20% of children unimmunized

DTP3 coverage is used to indicate the coverage of immunization services. Between 1980 and 1990 global coverage increased from 23% to 80%. Reaching the last 20% of unimmunized children has proven difficult, and coverage has remained static since 1990. Coverage varies dramatically by region (see Figure 1). In Africa, only 55% of children received DTP3 in 2000, compared to over 95% in South-East Asia (WHO, 2001). Coverage also varies within countries, with only 17% of developing countries achieving 80% coverage in every region (WHO/UNICEF, 2002a). Drop-out rates between the first and last vaccination of 10–59% are common (UNICEF, 2000).

FIGURE 1
Immunization coverage of target population by region, 2001

Source: WHO, 2001
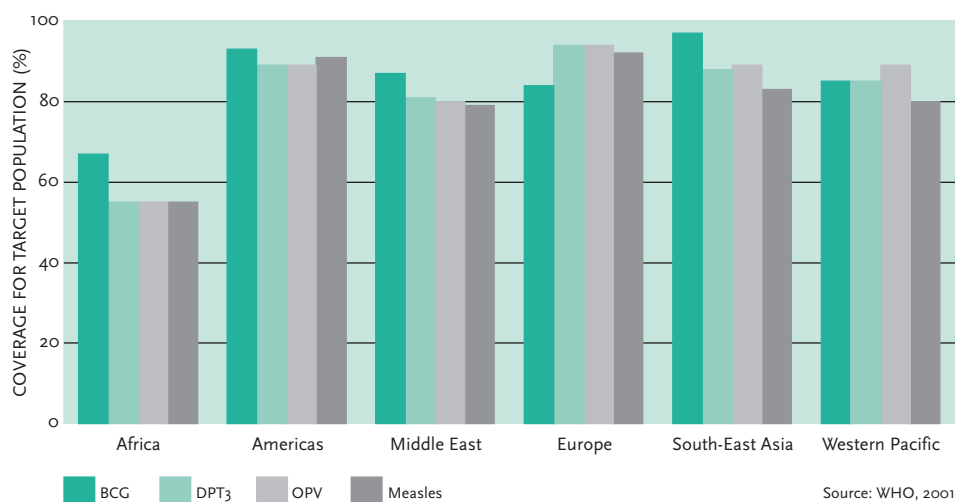
Observational studies have found that unimmunized children tend to be from families which:

— are comparatively large   — have low socioeconomic status
— have low maternal education   — have working mothers
— are recent migrants   — had bad experiences with services
— have little knowledge of vaccine preventable diseases.

and the following service characteristics have been found to be associated with service uptake:

— distance   — waiting times
— cost   — availability of curative care
— use by local opinion leaders

(Cutts et al., 1989; Cutts et al., 1991; Streatfield, Singarimbun & Diamond, 1990; Rees et al., 1991; Desgrees du Lou & Pison, 1994; Brugha & Kevany, 1995; Rahman, Islam & Mahalanabis, 1995; Jamil et al., 1999; Nuwaha et al., 2000; Browne et al., 2002).

The characteristics of households and of immunization services are associated with uptake

1.2   The benefits of immunization

Measles accounts for the majority of vaccine-preventable deaths among children. A review of 12 studies (see Table B.1.1) (Aaby et al., 1995) found that measles immunization was associated with reductions in total mortality that ranged from 30% to 86%. It is estimated that if coverage in developing countries increased to 85% from 74% (1998 levels), measles deaths would be reduced by an additional 11%. Immunizing a child later than scheduled puts infants at risk of unprotected exposure to early-life pathogens and decreases the efficacy of the vaccine. Immunizing late is better than not immunizing at all. A study in Bangladesh found a significant mortality reduction in children vaccinated in their first year of life, and also a 3–10/1000 difference in the number of deaths between children vaccinated in their second and third year of life and non-vaccinated children (figures read from graph). No significant reduction in mortality was observed among those vaccinated above three years of age (Koenig et al., 1990).

Data indicate that the association between measles immunization and total mortality is greater than would be predicted by the elimination of measles alone (Foster, McFarland & Meredith John, 1993), and measles vaccine may reduce overall mortality by general stimulation of the immune system (Aaby et al., 1995). Suggestions that the mortality reduction is caused by a postponement rather than prevention of death (replacement mortality) is not supported by the evidence (Koenig, 1991).

Increasing measles immunization coverage in developing countries from 74% to 85% would reduce measles deaths by an additional 11%

Diarrhoea and acute lower respiratory infections (ALRI), mostly pneumonia, are common complications of measles that often lead to death (Ruutu & Lucero, 1994). About 15% of ALRI deaths are measles-associated, and it is estimated that increasing vaccination coverage in developing countries from 74% to 85% would reduce ALRI deaths by an additional 1.7%. Feachem & Koblinsky (1983) estimated that immunizing 45–90% of all children aged 9–11 months with a vaccine of 85% efficacy would prevent 6–26% of diarrhoeal deaths and 0.6–3.8% of diarrhoeal episodes. Subsequent studies, such as a case control study in Bangladesh, found reductions in diarrhoeal mortality of up to 59% (Clemens et al., 1988). It is estimated that if vaccination coverage increased in developing countries from 74% to 85%, diarrhoeal deaths would be reduced by an additional 3.3%.

Measles is a well-known risk factor for severe malnutrition. However, it appears that other factors, such as a poor diet and the frequency of other infections, override the benefits of immunization on a child's nutritional status (Huffman & Steel, 1995). Observational studies in the Democratic Republic of the Congo (formerly Zaire) (Kasongo Project Team, 1981) and Haiti (Holt, 1987) found no difference in anthropometric status of those immunized and those not immunized.

The efficacy of BCG vaccination ranges from 0% to 80% for pulmonary tuberculosis (Fine & Rodrigues, 1990), 75–86% for tuberculous meningitis and miliary tuberculosis (Rodrigues, Diwan & Wheeler, 1993) and 20–80% for leprosy (Fine, 1989). The efficacy of three doses of OPV in preventing paralytic polio in developing countries ranges from 72% to 98% when the cold chain is properly maintained (EPI, 1993). Outbreak investigations have demonstrated efficacy of 87% for the current diphtheria vaccine (Jones, Kim-Farley & Algunaid, 1985) and pertussis rates have declined with well-established immunization programmes (Galazka & Robertson, 1995).

1.3 The impact of interventions to increase immunization

Interventions to increase the number of children immunized can either improve the delivery system (access, cost, waiting times, safety, missed opportunities) or improve utilization (through social mobilization and communication campaigns). The focus of the interventions can be to increase:

— the uptake of immunizations
— the timing of immunizations
— the completion of the course of immunizations.

Improving immunization coverage has contributed to a reduction in the global burden of disease due to vaccine-preventable diseases from 23% in 1974 to 10% in 2000, and immunizations prevent an estimated three million child deaths a year (World Bank, 2001). The current disparities in coverage between and within countries must be addressed to further reduce the mortality from, and to control, eliminate and eradicate, vaccine-preventable diseases.

Immunizations can be delivered as routine services (at fixed locations such as clinics or by outreach services) or during specific immunization campaigns. Few data were located quantifying the effect of different delivery strategies on coverage, mortality or morbidity, but several observational studies have found a link between vaccination status and access to fixed or outreach services (Desgrees du Lou & Pison, 1994 Bosu et al., 1997; Vaahtera et al., 2000). An evaluation of a mass immunization campaign in Egypt found that house-to-house vaccination of OPV resulted in coverage of 100% compared with 86% for fixed-site delivery (Linkins et al., 1995) and in a controlled trial in Ghana the house-to-house group had 20% higher immunization coverage than the control group (Brugha & Kevany, 1996).

Routine services are essential delivery strategies to maintain and improve immunization coverage, but mass campaigns can play an important role in control and eradication efforts. Polio has been almost eradicated through National Immunization Days (NIDs) (Technical Consultative Group, 2002), and results from mass measles immunization campaigns have been encouraging in some settings. In urban Burkina Faso, measles vaccina-

tion coverage was increased by 32% and in South Africa by 26% after mass campaigns (Zuber et al., 2001; Dammann et al., 1990). In the Philippines, after measles vaccination and vitamin A were added to NIDs the number of reported measles cases declined by 50% (Green et al., 1995). Similar results were found in South Africa, but measles cases rose to above pre-campaign levels two years later (Abdool Karim et al., 1993). Initial data from other mass measles immunization activities in Africa suggest that targeted urban campaigns have little impact on measles transmission either in the cities or the surrounding rural areas (WHO, 2000a).

Interventions reducing the number of missed immunization opportunities for eligible children at health facilities have the potential to reduce significantly mortality and morbidity. A review of 79 studies of missed opportunities (18 population-based, 52 health-service-based, and 9 intervention trials) (Hutchins et al., 1993) found that a median of 41% (range 0–99%) of children surveyed in developing-country studies had missed opportunities for immunization during visits to the health services. The reasons for the missed opportunities are shown in Table 1. A subsequent study in Ghana showed that eliminating missed opportunities would have increased immunization coverage from 61% to 67% (Brugha, 1995) and in the Central African Republic from 34% to 59% for all antigens, and from 54% to 70% for measles (Kahn et al., 1995).

TABLE 1
Reasons for missed immunization opportunities for eligible children at health facilities
(Hutchins et al., 1993)

REASON FOR MISSED IMMUNIZATION OPPORTUNITY	MEDIAN (%)	RANGE (%)
Failure to administer immunizations simultaneously	22	2–38
False contraindications	19	6–65
Negative health worker attitude, e.g. fear of wasting vaccine	16	1–26
Logistical problems	10	1–24
Parental refusal	3	2–11

Social mobilization and communication interventions are important for improving immunization coverage. It is estimated that three million children in Africa alone do not receive measles vaccinations even though they probably have access to services (Edmunds et al., 2001). Mobilization and communication interventions focus on educating mothers about how, when and where they can receive vaccinations for their children and motivating them to attend.

Social mobilization has been shown to increase coverage, but no studies exploring the impact on mortality or morbidity were located. In urban Cambodia, social mobilization efforts increased coverage in the second round of a mass campaign by 12% (Bilous et al., 1997), and in Indonesia, coverage increased by 55% after schoolchildren were targeted to take messages about immunization back to their parents (WHO, 1997). In Mexico, 40% of mothers reported that they were prompted by immunization promotion activities to seek immunization for their children (Perez-Cuevas et al., 1999). In the Philippines, a mass communication campaign providing information about details of the time, place and age of routine measles vaccination was successfully implemented. The number of fully vaccinated children increased from 54% before the campaign to 65% after the campaign. There is substantial evidence that the campaign increased knowledge and that knowledge was related to uptake (Zimicki et al., 1994).

Moderating factors
Immunization procedures. Cost can be reduced and efficacy increased if vaccines are handled properly and waste limited through good stock-management, cold chain maintenance,

Mass immunization can increase coverage by up to 32%, but the impact on measles cases may not be sustained

41% of children missed opportunities for immunization during visits to health services

Social mobilization has the potential to improve coverage by between 11 and 55%

proper reconstitution of vaccines and good injection techniques. It is estimated that half the supplied vaccines are wasted (Cutts & Olive, 1999). A 1998 study involving 19 developing countries found that in 14 of the countries at least 50% of the injections were unsafe (cited in WHO, 2002). Technologies such as auto-disposable syringes, pre-filled single dose syringes and vaccine vial monitors should help to reduce procedural problems (WHO, 2000b).

Dosing recommendations can also affect mortality and morbidity. A strategy for two opportunities for measles immunization has been adopted in more than 16 African countries and is projected to reduce child deaths by 150 000 a year in those countries (WHO/UNICEF, 2002b).

1.4 The feasibility of large-scale programmes

No single delivery or promotional strategy is appropriate for all settings and achieving high coverage may require a combination of several strategies. The most appropriate strategies depend on the nature of the coverage problem (See Box 1) and the context. The context includes:

— epidemiology of the disease
— characteristics of the vaccine
— accessibility of the population
— adequacy of the current delivery system and infrastructure
— ability to identify unvaccinated children
— available communication channels
— parental/community attitudes and knowledge.

BOX 1

WHO classes those unreached by immunization services into three groups

■ Populations living in areas with good physical access who shun contact with government services.

■ Rural populations who are mobile, or live so far from the national infrastructure that they have no contact with services.

■ Populations with good access who succeed in partly immunizing their children but drop out before the schedule is completed.

Source: WHO, 2000b

While we know that routine delivery systems and mass campaigns can successfully increase coverage, a different level of effort is needed to immunize the last 20% of children unimmunized, who are often the poorest and most needy (WHO, 2002). Groups that have been identified as hard to reach include those in urban areas, ethnic minorities and remote populations. Strategies for reaching the unreached have been outlined by WHO (2000b) (see Box 2).

BOX 2

Strategies for reaching the unreached with sustainable outreach services

Plans to reach the unreached should be comprehensive, addressing all unreached segments of the population. The goal at the outset should be to define these segments according to the best strategies for reaching the whole population equitably.

The overall principle of this approach, whether it involves improvement of the existing infrastructure or entails new strategies, is that the community is involved to express the specific needs of the region, provide support infrastructure for visiting teams, maintain activities between visits and keep up political pressure.

Source: WHO, 2000b

For routine delivery systems to achieve high coverage, efforts must be well coordinated, planned and managed. Services must be designed to reach caregivers at appropriate times and places, and health education must inform caregivers when to return, and motivate them to do so through social mobilization efforts that establish demand and ensure community ownership (WHO, 2002). Barriers to immunization must be explored and communities must be involved in planning and implementing new and innovative strategies to improve coverage (Omer, 1999). Cost of vaccines and providing accessible and viable delivery systems remain major constraints for many developing countries (WHO, 2002). The private sector provides up to 40% of vaccinations in some settings (Cutts & Olive, 1999) but their potential role in routine delivery has not been fully explored.

NIDs (see Box 3) have shown that nationwide coverage of mass campaigns is feasible, and polio has almost been eradicated (Technical Consultative Group WHO, 2002). Global measles eradication is now planned (Claeson & Waldman, 2000).

BOX 3

National Immunization Days (NIDs)

NIDs involve immunizing all children under five (regardless of immunization status) with two doses of OPV at 4–6 week intervals. Fixed locations and mobile teams are utilized and are followed by door-to-door canvassing in focal areas of disease transmission (Green et al., 1995; Cutts & Olive, 1999). They achieved very high coverage compared to routine services (see Table 2)

TABLE 2
Comparison of polio 3 routine coverage and polio NID coverage
(Source: WHO, 2000b)

COUNTRY	1998 COVERAGE WITH THIRD POLIO DOSE IN ROUTINE SERVICES	HIGHEST COVERAGE ACHIEVED DURING POLIO NIDS
Angola	36	90
Cameroon	48	103
Chad	24	108
Kenya	64	82
Niger	25	103
Togo	35	104

The organization and logistics of NIDs have been facilitated by their short duration, which increases the willingness of partner agencies and government ministries to lend vehicles, personnel and equipment and allows the use of volunteers (Green et al., 1995). Experiences from other types of NID-like mass campaigns are mixed. Measles campaigns were largely successful in the 1980s in the Americas where funding was predominantly local and the campaigns were used as part of national disease eradication programmes. They have been less successful in settings where they were used to raise coverage quickly (as they only did so in the short term), were felt to be imposed by donors, to interrupt other health services and to use low-quality vaccines (Cutts, 1998). Mass campaigns that include injections and multi-dose vaccines such as DTP, have greater training, time, supervision and logistical implications than NIDs (Green et al., 1995) and should only be considered where it is epidemiologically appropriate.

1.5 Conclusions

- Increased immunization coverage in recent decades has led to substantial reduction in mortality and the near eradication of polio. Global immunization coverage is 80%, but high coverage is not universal and three million children still die of vaccine-preventable diseases each year.

- Using results from efficacy trials, it has been estimated that increasing immunization coverage from 74% to 85% would reduce measles deaths by 11%, diarrhoea deaths by 4% and ALRI deaths by 2%.

- Cost of vaccines and access to viable delivery systems remain major constraints for many developing countries but large-scale immunization programmes are effective and feasible in most settings.

- National immunization days have been effective for the control and elimination of polio, and are being planned for the control of measles. However, improving routine delivery services is important to ensure sustainable high coverage and to sustain measles control.

- Reducing missed opportunities for immunization during health visits could potentially reduce mortality, as 41% (median) of children in developing countries have had a missed opportunity.

- A different level of effort is needed to reach the last 20% of children unimmunized and no single delivery or promotional strategy is appropriate for all settings. Achieving high coverage may require a combination of several strategies which ensure services are both accessible and utilized, with the most appropriate strategies depending on the nature of the coverage problem and the context.

- Social mobilization can increase coverage and is an important principle in reaching the unreached. It is estimated that three million children in Africa do not receive measles vaccination, even though they probably have access.

- Efforts must be made to reduce wastage of vaccines and improve safety.

1.6 Questions still to be answered

- Methods of training health staff in immunization procedures, immunization timeliness and reducing missed opportunities.

- New and creative methods for sustainable delivery that reach poorly covered populations/groups, for example those in urban areas and countries in conflict.

- Methods of improving family and community involvement in immunization programmes.

- The potential of increasing coverage using the private sector.

- How to successfully integrate new technologies into routine services that ensure vaccine safety and efficacy.

2. BREASTFEEDING

■ **Key practice.** Breastfeed infants exclusively for six months.

Breast milk provides all the nutrients needed for most infants up to six months of age. It is more easily digested than substitutes, and provides antibacterial and antiviral agents which protect the infant against disease. It also aids the development of the immune system (Hanson, 2000). Exclusive breastfeeding minimizes exposure to water-borne and food-borne pathogens and reduces the risk of infants being fed nutritionally-inferior foods. Exclusive breastfeeding is defined as no other food or drink, not even water, except breast milk, but allows the infant to receive drops and syrups (vitamins, minerals and medicines) (WHO, 2001a).

A recent WHO expert group reviewed the evidence for the optimal duration of exclusive breastfeeding (WHO, 2001a) and concluded that infants should be exclusively breastfed for six months. Evidence includes a trial by Kramer et al. (2001) which demonstrated protection against gastrointestinal tract infection in infants when exclusive breastfeeding to six months was promoted, and studies which suggest that infants who continue to be breastfed for six months do not show growth deficits (Adair et al., 1993; Cohen et al., 1994; Simondon & Simondon, 1997; Dewey et al., 1999; Kramer et al., 2001). Although a reduction in iron status has been demonstrated in low-birth-weight infants exclusively breastfed for six months versus four months (Dewey et al., 1998), this should not be interpreted as an adverse effect of exclusive breastfeeding for six months on infant health and growth on a population basis. The iron stores at birth adequately provide for the iron needs of the breastfed infant in the first six months of life. In the second half of infancy, breastfed infants who do not receive additional iron from supplements or complementary foods are at risk of becoming iron-deficient (Butte, Lopez-Alarcon & Garza, 2002).

Exclusive breastfeeding is a complex behaviour. Mothers must:

— decide to breastfeed
— learn the correct techniques
— persevere when difficulties arise
— sometimes counter cultural norms (Green, 1999).

2.1 The prevalence of exclusive breastfeeding

The prevalence of exclusive breastfeeding is difficult to determine. Measures often look at current status rather than status since birth and include all children 0–4 months, which overestimates the prevalence (Aarts et al., 2000). Exclusive breastfeeding for six months is rare; using data from 94 countries and the 'current status' measure, WHO estimates that 35% of infants aged 0–4 months are exclusively breastfed. They have also shown that while exclusive breastfeeding rates are increasing in some countries, levels are as low as 2% in some African countries (WHO, 2001b).

2.2 The benefits of breastfeeding

There is a vast literature on the benefits of breastfeeding, and a recent annotated bibliography (Leon-Cava et al., 2002) identified 188 studies (mostly observational) exploring the association between breastfeeding and childhood mortality, morbidity, development and chronic diseases. Evidence for the benefits of exclusive breastfeeding compared to, for example, predominant breastfeeding is less common.

A meta-analysis of three observational studies in less-developed countries (see Figure 2) found that breastfed infants under two months of age were six times less likely to die of infectious diseases than non-breastfed infants (see Table B.2.1). Those 2–3 months old were 4.1 times less likely, and those 4–5 months old were 2.5 times less likely to die (WHO, 2000a). The analysis found that breastfeeding was more strongly associated with reductions in diarrhoeal mortality than acute lower respiratory infections (ALRI); breastfed children under six months of age were 6.1 (CI 4.1–9.0) times less likely to die of diarrhoea and

Breast milk is an uncontaminated source of nutrients and antibacterial/ antiviral agents. It also aids the development of the immune system.

It is now recommended that infants should be exclusively breastfed for six months

Exclusive breastfeeding is a complex behaviour which is sometimes contrary to cultural norms

35% of children 0–4 months of age are estimated to be currently exclusively breastfed

Breastfed infants under two months of age are six times less likely to die of an infectious disease than non-breastfed infants

FIGURE 2

Infant mortality due to infectious diseases associated with not breastfeeding, by country and age group

Source: WHO, Collaborative Study Team, 2000
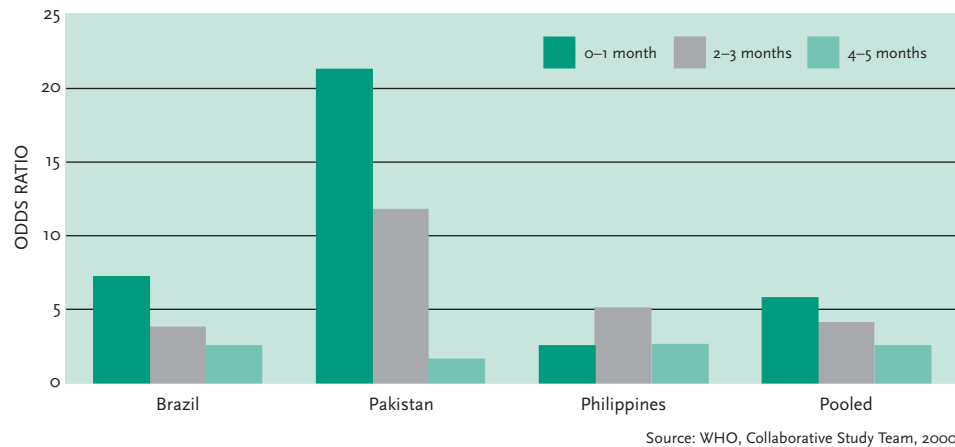
2.4 (CI 1.6–3.1) times less likely to die of ALRI than non-breastfed infants. The risk of death with no breastfeeding was substantially higher for lower maternal education levels.

Feachem & Koblinsky (1984) reviewed 21 breastfeeding studies (almost all from developed countries) and calculated that breastfeeding could reduce diarrhoeal mortality by 24–27% among infants aged 0–5 months. More recently, Victora et al. (1999) reviewed the association between breastfeeding and ALRI mortality (three observational studies) and calculated that decreasing the proportion of infants who are not breastfed by 40% could potentially avert 3% of all pneumonia deaths (range 0.5–7% due to differences in regional breastfeeding prevalence).

There is also evidence for associations between breastfeeding and morbidity outcomes. In their review, Leon-Cava et al. (2002) found studies which demonstrated a protective effect of breastfeeding on diarrhoea in both developed (Howie et al., 1990; Dewey, Heinig & Nommsen-Rivers, 1995; Scariati, Grummer-Strawn & Fein, 1997) and developing countries (Mondal et al., 1996; VanDerslice, Popkin & Briscoe, 1994; Ahmed et al., 1992; Ketsela, Asfaw & Kebede, 1990; Popkin et al., 1990) (see Table B.2.2). Case-control studies (in Bangladesh, Brazil, Bangladesh and Egypt) found that breastfed infants were 2–3 times less likely to suffer from diarrhoea-related dehydration (Kirkwood & Morris, unpublished data, 1992). The protective effect of breastfeeding is stronger in highly contaminated and crowded environments (Van Derslice, Popkin & Briscoe, 1994). Feachem & Koblinsky (1984) estimated that breastfeeding could reduce diarrhoeal morbidity by 8–20% among infants aged 0–5 months and a dose-response from exclusive to partial to non-breastfeeding has been reported (Victora et al., 1987; Shamebo et al., 1994; Briend, Wojtyniak & Rowland, 1988).

Breastfed children typically grow more quickly than non-breastfed children in the first 2–3 months of life, and less rapidly from 3–12 months. There are unlikely to be adverse consequences associated with this slower growth, which has been attributed to the ability of breastfed infants to self-regulate their milk intake according to their needs (WHO, 2002; Eckhardt et al., 2001; Dewey, 1998; Adair et al., 1993). Not breastfeeding is unlikely to lead to a growth advantage where there is a high risk of diarrhoeal morbidity in non-breastfed children (Brown et al., 1989; Adair et al., 1993). Breastfeeding may also be cardio-protective and protective against obesity (Wilson et al., 1998; Von Kries et al., 1999; Gillman et al., 2001).

Fatty acids in breast milk assist in infant brain and visual development (Uauy & De Andraca, 1995) and breastfeeding is thought to enhance cognitive outcome in children (Lanting et al., 1994; Lucas et al., 1992; Horwood & Fergusson, 1998). A meta-analysis of 20 observational studies found that breastfed infants scored three points higher for cognitive development compared to formula-fed infants. The effect was first seen at six months

Breastfeeding could reduce diarrhoea mortality by 24–27% and morbidity by 8–20% in infants aged 0–5 months and could avert 3% of pneumonia deaths

Breastfeeding protects against diarrhoea and diarrhoea-related dehydration

Breastfeeding has been shown to have a long-term impact on cognitive development

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and persisted until 15 years of age (Anderson, Johnston & Remley, 1999), but there may be problems with confounding factors.

2.3 The impact of interventions to increase exclusive breastfeeding

Interventions to increase exclusive breastfeeding include:

— changes in hospital policies/actions
— counselling/education from peers or health workers
— mass media and community education
— mother support groups.

Impact on behaviour change. Green (1999) reviewed 35 studies exploring the impact of interventions that promoted exclusive breastfeeding. Table 3 shows the difference in exclusive breastfeeding between the intervention and control group, or pre- and post-intervention level for the studies located that reported exclusive breastfeeding at 4–6 months. Most of the interventions focused around changing hospital practices (mixed results) and education or counselling (encouraging results); data on the impact of support groups or mass media are scarce.

TABLE 3
Differences in exclusive breastfeeding between the intervention and control groups or pre- and post-intervention levels at 4–6 months of age

INTERVENTION TYPE	DIFFERENCES IN EXCLUSIVE BREASTFEEDING (%)
Changes in hospital practices	
India (Wellstart International, 1998)	43
Belarus (Kramer et al., 2001)	7
Nicaragua (Strachan-Lindenberg et al., 1990)	0
Pre- or postpartum education	
Chile (Valdes, 1996)	48
Iran (Froozani et al., 1999)	48
Brazil (Barros et al., 1995)	9
Turkey (Neyzi et al., 1991)	4
Peer counselling	
Mexico (Rodriguez-Garcia et al., 1990)	6
Bangladesh (Haider et al., 2000)	64
Mass media/community education	
Honduras (Hernandez et al., 1995)	5
Mother support group	
Honduras (Green, 1998)	12 (at 3 months of age)
Combined interventions	
Brazil (Rea & Berquo, 1990)	26
Chile (Valdes et al., 1993)	33

A recent meta-analysis (Sikorski et al., 2002) of six developed-country and five developing-country randomized or quasi-randomized controlled trials exploring the impact of counselling interventions on exclusive breastfeeding, found a relative risk of 0.78 (CI 0.69–0.89) for stopping exclusive breastfeeding before six months among women who received any type of support, a relative risk of 0.66 (CI 0.49–0.89) for support received from lay people, but no significant difference between those who received professional support and those who received no support (CI 0.81–1.01). It is not known whether breastfeeding counselling/education is more effective with individuals or in a group setting.

As illustrated in Box 4, studies have found that counselling interventions are most likely to result in sustained behaviour change if the intervention is early, longer, more intensive and if there is ongoing contact and training (Morrow et al., 1999; Green, 1999; Rea et al., 1999; Prasad & Costello, 1995; Lutter et al., 1994; Ashworth, 1998; Neyzi et al., 1991).

Peer counselling also appears to have greater impact on exclusive breastfeeding rates than support from professionals

Sustained behaviour change is more likely if interventions are earlier, longer, more intensive and contact is ongoing

**The effect of the number and timing of home visits by peer counsellors
on exclusive breastfeeding in Mexico**

The controlled trial by Morrow et al. (1999) in Mexico exploring the impact of home visits by peer counsellors on exclusive breastfeeding found that at three month postpartum exclusive breastfeeding was practised by:

■ 12% of the control mothers

■ 50% of the mothers who received three home visits by peer counsellors, and

■ 67% of mothers who received six home visits by peer counsellors.

The difference between the six- and three-visit group seems to have been established in the first two weeks (see Figure 3) illustrating the importance of early contact.

FIGURE 3
Effect of home visits on rates of exclusive breastfeeding

Source: Morrow et al., 1999

Impact on mortality and morbidity. The impact of interventions that promote exclusive breastfeeding on diarrhoeal morbidity was demonstrated in randomized control trials using peer counsellors in Mexico, Brazil and Bangladesh, Brazil and Mexico (Haider et al., 1996; Barros et al., 1995; Morrow et al., 1999). In Mexico, infants whose mothers received postpartum counselling were 2.1 times less likely to have diarrhoea than the control group (Morrow et al., 1999). In Brazil, infants in the intervention group were 1.9 times less likely to have diarrhoea than the controls and had improved weight-for-age (Barros et al., 1995). In Bangladesh, mothers who were counselled after their infants had been admitted to hospital with diarrhoea were 2.9 times less likely to suffer a subsequent episode of diarrhoea than those who were not counselled (Haider et al., 1996). A separate trial in Bangladesh exploring the impact of peer counselling on exclusive breastfeeding found a significantly improvement in weight-for-length (Z scores of +0.1 compared to −0.9) and weight-for-age (weight of 6.58 kg compared to 6.39 kg) among the intervention group at five months of age, but no significant improvement on length-for-age (Ashworth et al., 2001). No studies were located that examined the impact of breastfeeding promotion on mortality or child development.

Peer counselling on exclusive breastfeeding has been shown to reduce diarrhoea and improve weight-for-length and weight-for-age

Moderating factors

HIV/AIDS. The issue of HIV/AIDS must be considered when breastfeeding counselling interventions are designed. A WHO Technical Consultation (WHO, 2000b) reviewed the evidence relating to feeding infants of HIV-positive mothers. The risks of transmitting HIV to an infant through breast milk are estimated at 20%, but vary with duration of breastfeeding and other risk factors, such as the mother's health, viral load, the condition of her breasts and the infant's oral and intestinal mucosal integrity (Savage & Lhotska, 2000; Nicoll et al., 2000). It is currently recommended that women should be counselled on the basis of

HIV/AIDS must be considered when designing breastfeeding counselling interventions

current recommendations on infant feeding options. If feasible, acceptable, affordable, sustainable and safe, then appropriate replacement feeding should be practised by HIV-positive women. If replacement feeding is not felt to be appropriate, then recommendations are: to express and heat-treat breast milk; to use an HIV-negative wet nurse; to use uncontaminated donor milk; or to exclusively breastfeed but discontinue at six months (WHO, 2000b).

There is concern that replacement feeding will also be practised by women who are uninfected or whose HIV-status is unknown (Savage & Lhotska, 2000). For women whose status is unknown but who live in high prevalence communities, exclusive breastfeeding for six months followed by rapid weaning may be the appropriate strategy. Exclusive breastfeeding carried a significantly lower risk of HIV-1 transmission at three months (hazard ratio 0.52) than mixed feeding, and a similar risk to no breastfeeding in a cohort study in South Africa (Coutsoudis et al., 1999).

2.4 The feasibility of large-scale programmes

Current programmes that promote exclusive breastfeeding include the Baby-friendly Hospital Initiative (BFHI), counselling, mother-support groups and mass media campaigns. While these programmes appear logistically feasible, rigorous evaluation of their performance is limited. Effective hospital and community intervention strategies appear to have several key elements in common – providing support to the mother that is accessible, timely and salient to her need. Legislation and institutional policies (e.g. the International Code of Marketing of Breast-milk Substitutes, maternity leave, breastfeeding breaks) promote general breastfeeding, but may also improve levels of exclusive breastfeeding (Ashworth, 1998).

Evaluations of BFHI show that an emphasis on institutional policies and retraining of health staff is important (Westphal et al., 1995), and the impact of BFHI will be limited where most births occur at home. Community-based interventions, such as mother-support groups, have been shown to be sustainable but are biased towards women already motivated to breastfeed and have low coverage (Green, 1998). Mass media can be an effective channel for health promotion where coverage is high and channels and production skills are adequate, and campaigns have been implemented in several countries (Green, 1989). In order to be effective, mass media campaigns must tackle barriers to breastfeeding rather than just proclaim the benefits. They also must be placed within a larger framework involving policy-makers, administrators and employers. No large-scale peer counselling programmes exist and the feasibility is unknown.

2.5 Conclusions

- Breastfeeding is associated with reduced child mortality, morbidity and improved development. Evidence includes a meta-analysis that found breastfed infants under two months of age were six times less likely to die of infectious diseases than non-breastfed infants, and a protective effect against diarrhoea has been observed in developed and developing countries.

- Breast milk provides all the nutrients needed for most infants up to six months of age. Evidence for the optimal duration of exclusive breastfeeding includes a trial demonstrating protection against gastrointestinal tract infection and studies suggesting that infants breastfed for six months do not show growth deficits.

- Interventions to promote exclusive breastfeeding (EBF) have focused around changing hospital practices (0–43% difference in EBF) and education/counselling (4–64% difference in EBF). In terms of counselling, a meta-analysis found that women who received lay support were less likely to stop exclusive breastfeeding (RR 0.66) than those who received no support, but there was no significant difference between those who received professional support and those who received no support.

■ Data on the impact of support groups or mass media on exclusive breastfeeding are scarce and only peer counselling interventions reported morbidity impacts (children in the intervention groups were 1.9–2.9 times less likely to have diarrhoea).

■ The prevalence of HIV in a country must be considered when breastfeeding promotion interventions are designed.

■ Successful Baby-friendly Hospitals and community-based intervention strategies appear to have several key elements in common – providing support to the mother that is accessible, timely and salient to her need

2.6 Questions to be answered

■ Whether mass media campaigns or mother-support groups are effective in improving exclusive breastfeeding rates.

■ Comparative approaches to integrating breastfeeding recommendations in areas of high HIV transmission.

■ The number and timing of contacts with a counsellor needed for exclusive breastfeeding behaviour change.

■ Whether group counselling is as effective as one-on-one counselling in improving exclusive breastfeeding rates.

■ The feasibility and effectiveness of peer counselling when implemented on a large scale.

3. COMPLEMENTARY FEEDING

■ **Key practice.** Starting at six months of age, feed children freshly prepared energy- and nutrient-rich complementary foods, while continuing to breastfeed up to two years or longer.

Childhood malnutrition remains a common problem in the developing world. Recent estimates suggest that more than one-third of young children are stunted, with height-for-age below –2 standard deviations (SD) with respect to international growth references (UNICEF, 2001a), and that malnutrition is a direct or indirect cause of 54% of all childhood deaths (Pelletier, Frongillo & Habicht, 1993; WHO, 2002). In addition to this mortality risk, early growth retardation is also associated with delayed motor development (Pollitt, 1994), and impaired cognitive function and school performance (Lasky et al., 1981; Sigman et al., 1989; Martorell et al., 1992).

The importance of caregiving behaviours was recognized by UNICEF (1990) in its conceptual model of factors that determine children's risks of malnutrition, death and disability. More specifically, successful complementary feeding requires not only that foods of adequate energy and nutrient quality be available, but also a range of appropriate behaviours by the caregiver, which are described in Box 5.

Malnutrition is widespread, and associated with more than half of all child deaths

Successful complementary feeding requires not only that foods of adequate energy and nutrient quality be available, but also a range of appropriate behaviours by the caregiver

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BOX 5

Appropriate feeding behaviours

■ Adaptation of the feeding method to the psychomotor abilities of the child:
  — spoon handling ability
  — ability to munch or chew
  — use of finger foods

■ The activity of the feeder, including:
  — encouragement to eat
  — offering additional foods
  — providing second helpings

■ Responsiveness of the feeder, including:
  — the affective relationship between the child and feeder
  — timing of feeding
  — positive or aversive style of interacting

■ The feeding situation, including:
  — the organization, frequency, and regularity of the feeding situation
  — whether the child is supervised and protected while eating
  — distraction during eating events

Source: Brown, Dewey & Allen, 1998

The caregiver must also have adequate time, knowledge, and skills and an absence of other constraints, such as traditional rules for food distribution within the family or cultural taboos concerning certain foods for young children. In addition, the caregiver needs to process and handle foods in ways that ensure their safety (see below). More generally, at the household and community levels, the major factors that are likely to influence the caregiver's ability to provide care include:

— education, knowledge and beliefs
— workload and time constraints
— health and nutritional status
— mental health, stress and self-confidence
— autonomy, control of resources and intra-household allocation
— social support from family members and community
   (Brown, Dewey & Allen, 1998).

3.1 The prevalence of complementary feeding from six months and breastfeeding up to two years

The 'timely complementary feeding rate' is defined by WHO as the percentage of infants aged 6–9 months who are fed solid or semi-solid complementary foods in addition to breast milk. Data collected between 1995 and 2000 show a range of rates from 10% to 97% (see Figure 4 for rates in selected countries) (UNICEF, 2001b). In general, it is more common for other foods or fluids to be added too early rather than too late. However, in south Asia, delayed introduction of complementary food is common (Brown, Dewey & Allen, 1998). There is also considerable variation in the duration of breastfeeding both across and within regions (see Figure 4); in Africa, median duration ranged from 15.2 to 24.4 months in 1986–1990 (Perez-Escamilla, 1993). WHO data (1996a) indicate an average duration of 14 months in the Western Pacific Region and 25 months in the South-East Asia Region.

FIGURE 4
Complementary feeding and continued breastfeeding

Timely complementary feeding (6–9 months)

Continued breastfeeding (12–15 months)

Source: UNICEF, 2001b
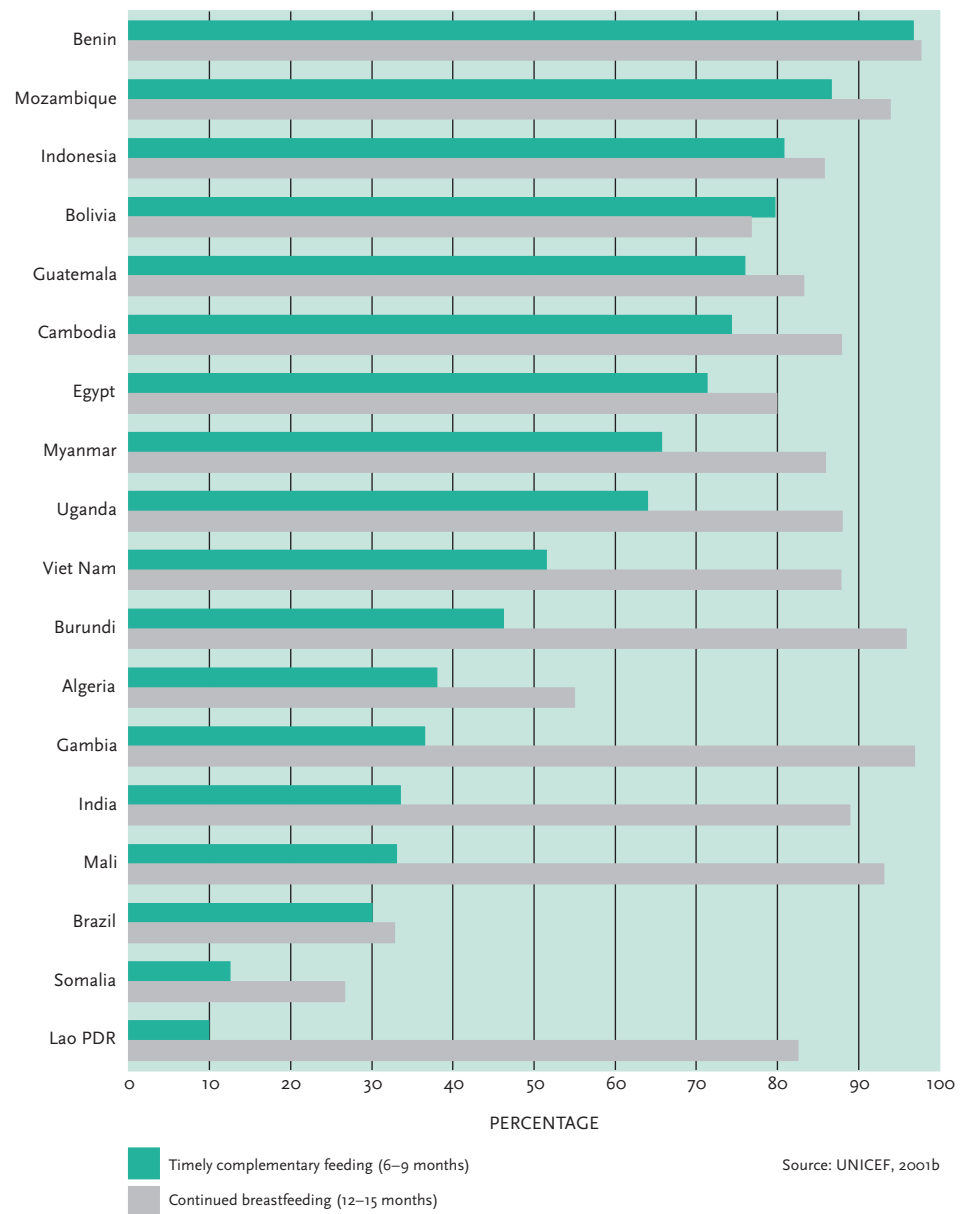
3.2 The benefits of complementary feeding from six months and breastfeeding up to two years

It is now recommended that an infant should be exclusively breastfed until six months (see Chapter 2, Breastfeeding). In addition, breastfeeding should continue up to two years of age or longer. The weight of evidence suggests that breast milk continues to be a source of key nutrients, such as vitamin A (West et al., 1986; Mahalanabis, 1991), calcium and protein (Brown, Allen & Dewey, 1995) and to confer some protection against infectious diseases throughout the second year of life (Molbak et al., 1994; Brown, Dewey & Allen, 1998).

There is also a strong association between complementary feeding and reduced mortality in children aged 6–11 months. Observational studies indicate that improved feeding practices to prevent or treat malnutrition could save 800 000 lives per year (WHO, 1998). As a baby grows and becomes more active, breast milk alone is not sufficient to meet full nutritional requirements. From six months, suitably prepared mixtures of semi-solid foods are needed to complement the breast milk intake to meet essential nutrient and energy requirements (Brown, Dewey & Allen, 1998). From about one year of age, children no longer require specially prepared foods and are able to share the normal 'family' foods (Brown, Dewey & Allen, 1998). Ingestion of sufficient quantities of these complementary foods will generally result in appropriate growth of the child (Brown, Dewey & Allen, 1998). However, complementary foods are often inadequate in energy density and micronutrient concentration or quality, and are often prepared, stored, or fed to children in ways that increase their risk of illness (Caulfield, Huffman & Piwoz, 1999) (see Chapter 5, Hygiene).

3.3 The impact of interventions to improve complementary feeding

Interventions to improve the use of freshly prepared energy- and nutrient-rich complementary foods include:

— family counselling
— nutrition education
— provision of high energy and protein food supplements
— provision of snack foods developed using local foods
— specific feeding advice and cooking demonstrations.

Impact on behaviour change. Interventions that modify parental behaviour through counselling and increasing family support have met with only modest success in developed countries. Studies in developing countries have found associations between maternal education and specific feeding behaviours such as location of feeding, organization of the feeding event, feeding encouragement and the use of a spoon (Guldan et al., 1993). In situations in which feeding encouragement is relatively low, increased encouragement of eating has been observed when children are ill (Bentley et al., 1991) (see Chapter 7, Food and fluids) or refuse food (Engle & Zeitlin, 1996). It is felt that active feeding behaviours can have an important impact on the amount of food ingested and should be included in investigations of complementary feeding (Brown, Dewey & Allen, 1998).

Impact on mortality and morbidity. Caulfield, Huffman & Piwoz (1999) identified five efficacy trials in their review of interventions to improve intake of complementary foods by infants 6–12 months of age (see Table B.3.1). Four of the trials, conducted in Colombia, Guatemala, Indonesia and Jamaica, gave food as supplements to the usual diet of the infants, but they differed with respect to the foods offered and the delivery mechanism. In Guatemala, a high-energy, moderate-protein, micronutrient-fortified drink was provided daily at feeding centres. In Colombia, whole powdered milk and commercial high-protein vegetable mix, and in Jamaica milk-based formula, skim milk powder and cornmeal were distributed to families weekly. Indonesia, in contrast, was the only trial that used a combination of solids and semi-solids, offering 20 distinct snack foods – which were developed using local foods – daily to children attending day-care centres. The other trial, which was

Breastfeeding should continue up to two years of age or longer

As a baby grows and becomes more active, solid and semi-solid foods are needed as well as breast milk to meet essential nutrient and energy requirements

Interventions can improve complementary feeding behaviours

conducted in Bangladesh, provided specific feeding advice and cooking demonstrations to caregivers, in their home, on how to enrich meals with energy and protein.

All five studies were successful in identifying foods that were liked and accepted by infants, and by their caregivers, and that improved the energy intake in intervention compared to control groups. Study infants were offered at least 400 kcal/day in addition to their usual energy intake from breast milk and non-breast-milk foods. The net increase in total energy intake due to the intervention ranged from 65 to 300 kcal/day. The intake was less than the 400 kcal/day offered because infants did not consume all the food they were offered (self-regulation of their energy intake) and in some sites additional intake of non-breast-milk foods replaced some of the energy previously provided by breast milk.

All five studies also reported statistically significant improvements in growth. The interventions, which lasted between five and nine months, achieved average improvements of between 0.25 and 0.46 SD units for weight-for-age, and between 0.04 and 0.35 SD units for height-for-age. Impacts on growth in these ranges were also achieved by a more recent nutrition education trial in China (Guldan et al., 2000). One carefully executed experimental trial showed significant effects on cognitive development, although not growth, among children when the intervention began prior to 12 months of age (Black et al., 1995).

Similar impacts on growth have also been achieved in a programme setting. Four of five programmes (in the Dominican Republic, Mali and two in Indonesia) for which data are available, found improvements between 0.25 and 0.50 SD units for weight-for-age (Caulfield, Huffman & Piwoz, 1999). Data from the two Indonesian programmes showed that this was a result of energy increases in the range of 70 to 165 kcal/day, similar to the lower half of the range achieved in the efficacy trials. The exception was Peru, which achieved only a modest increase of 9 kcal/day, with no impact on growth.

These improvements in growth translate into absolute reductions in the prevalence of malnutrition of up to 20% at one year of age, depending on the underlying prevalence rate, and an estimated absolute reduction in the percentage of deaths associated with malnutrition of between 2% and 13% (Caulfield, Huffman & Piwoz, 1999). Note that an absolute reduction in the percentage of deaths associated with malnutrition is equivalent to the proportional reduction in the total number of deaths, and these estimates imply that complementary feeding programmes could save 2–13% of childhood deaths occurring from six months of age.

Ashworth & Feachem (1985) previously estimated a proportional reduction in diarrhoea mortality of 2–12% associated with improved nutritional quality. In the United Republic of Tanzania, children fed fermented gruel were found to have a 40% lower frequency of diarrhoea than children consuming non-fermented gruels (Lorri & Svanberg, 1994). An effect on ALRI would also be expected, since observational studies have shown an increased risk of ALRI mortality that ranges from 3.1–21.5 in underweight children and an increased morbidity risk of 1.9–4.8 (Victora et al., 1999). Inputting the estimates of Caulfield, Hoffman & Piwoz (1999) for the absolute reductions in malnutrition into the model given in Victora et al. (1999) to estimate the potential impact on ALRI deaths suggests a proportional reduction in ALRI deaths of 6%.

Nutritional supplementation is also known to have a significant impact on long-term developmental outcomes in malnourished children in developing countries (WHO, 1999; Grantham-McGregor et al., 1997; Grantham-McGregor et al., 1991; Pollitt, Watkins & Husaini, 1997; Haas et al., 1995).

Moderating factors

Food safety. The importance of food hygiene in preventing child deaths was reviewed by Esrey & Feachem (1989). They estimated that more than half of the 1.5 billion episodes of childhood diarrhoea that occur each year may be the result of contaminated food. Good food hygiene is therefore essential to break the malnutrition–infection cycle, and to promote good growth. Raw foods may themselves harbour pathogens, for example meat from an infected animal, or these may be introduced during processing, preparation, feeding or

<div class="margin-notes">

Complementary feeding interventions can improve energy intake in infants

Complementary feeding interventions can have significant impacts on child growth and childhood diarrhoea

Complementary feeding interventions can reduce childhood deaths

</div>

storage after cooking. Sources of contamination include polluted water, dirty pots and cooking utensils, contaminated hands, polluted environment (soil, dust, irrigation and wastewater, human and animal excreta, night soil), domestic animals, flies and pests (Brown, Dewey & Allen, 1998). Barriers to contamination include simple processing and handling techniques, such as washing hands before food preparation (see Chapter 5, Hygiene), consuming food shortly after cooking, and avoiding the use of feeding bottles and teats. However, in low-income settings, adequate food handling faces many resource constraints, such as lack of soap, clean water, or adequate fuel for boiling water and thoroughly cooking food, absence of facilities for safe storage of food, and insufficient time and knowledge (WHO, 1996b).

3.4 The feasibility of large-scale programmes

Challenges relate to feeding practices, as well as availability of appropriate foods. In the *Designing by dialogue* manual describing how to work with families to find ways to improve child feeding practices, Dickin, Griffiths & Piwoz (1997) outline the key challenges that need to be addressed at different ages (see Box 6).

Good food hygiene is essential to break the malnutrition–infection cycle, and to promote child growth

BOX 6

The key challenges in complementary feeding

■ For the young weanling, when the first complementary foods are introduced, the key concern is energy and nutrient density. These foods are often too dilute liquids with a lot of water and little food.

■ At the next stage, from 9 to 11 months of age, when the child has become accustomed to new foods, frequency of feeding becomes an additional important concern, as does variety in the diet.

■ In order to consume adequate amounts of bulky staple foods, children need to eat more frequently than the standard two to three times a day of adults and older children. These concerns persist into the second year of life.

■ In the second year of life, the greatest challenge is increasing the total food intake. The child is now old enough to consume the family diet, and needs the variety that this offers. However, special attention is still required to ensure that children eat enough food at each meal, and as they still require more frequent feeds, family meals need to be supplemented with additional feeds between meals.

■ Lack of supervision of meals, and lack of persistence in encouraging children to eat are additional common problems observed throughout the first two years of life.

■ Finally, Brown, Dewey & Allen (1998) conclude that it is practically impossible to meet the essential micronutrient requirements from unfortified complementary foods (see Chapter 4, Micronutrients).

Source: Dickin, Griffiths & Piwoz, 1997; Brown, Dewey & Allen, 1998

It is practically impossible to meet some micronutrient requirements from unfortified complementary foods

Caulfield, Hoffman & Piwoz (1999) summarized the experiences of 16 nutrition programmes in 14 countries, with a complementary feeding component, many of which were conducted under a 'growth monitoring' umbrella. Most were large in scale, with 1000 or more potential beneficiaries. The majority of the programmes took a comprehensive approach, and encompassed the full range of child feeding practices from initiation of breastfeeding through complete integration of the child into the dietary routine of the remainder of the family. They also carried out qualitative and quantitative formative research on a subsample in order to identify current practices and beliefs and develop improved and acceptable practices. Most involved some form of monitoring and evaluation. All programmes used a variety of communication approaches, including both mass media and one-on-one counselling.

Many of the programmes attempted to build new recipes, focusing largely on what mothers were 'already doing right'. Eleven programmes developed new or improved complementary foods, based on local staples or grain-based porridges to which protein-, energy- or micronutrient-rich local ingredients were added. For example, in sub-Saharan Africa, added ingredients included peanuts, peanut butter, fish powder, milk, eggs, cowpea flour and red palm oil. Additionally, some of the African programmes added fermented

Complementary feeding programmes should encompass the full range of child-feeding practices from initiation of breastfeeding through complete integration of the child into the dietary routine of the remainder of the family

flour to reduce the viscosity of the porridge, thus enabling the energy density to be increased and enhancing its acceptability to the children. In Indonesia and the Philippines, fish flakes, vegetables and oil were added to rice, and in Peru brown sugar, oil and carrots were added.

These programmes demonstrated that it is possible to develop nutritionally improved complementary foods in diverse cultural settings, that poor mothers are willing to prepare new foods, and their children are willing to eat them, but that caregivers face considerable time and resource constraints in feeding the foods regularly, and that foods were often discontinued during episodes of illness (see Chapter 7, Food and fluids). As discussed above in section 3.3, such programmes can achieve improved energy intakes, resulting in improvements in growth. A recent pilot study in Brazil implementing nutritional counselling through IMCI, has also been encouraging. This achieved significant weight gains in children aged one year or more but not in younger children (Santos et al., 2001).

3.5   Conclusions

- Breast milk continues to be a source of key nutrients and to confer protection against infectious diseases throughout the second year of life, but from six months is not sufficient to meet nutritional requirements alone. However, complementary foods are often inadequate in energy, and micronutrient concentration or quality, and are often prepared, stored, or fed to children in ways that increase their risk of illness.

- Observational studies indicate that improving feeding practices could save 800 000 lives per year.

- No complementary feeding interventions with mortality outcomes were located. Five efficacy trials to improve intake of complementary foods found net increases in energy intake of between 65 and 300 kcal/day and improvements in growth of between 0.25–0.46 SD units for weight-for-age, and 0.04–0.35 SD units for height-for-age. The growth improvements should translate into a reduction in deaths associated with malnutrition of between 2% and 13%.

- Nutritional supplementation has a significant impact on long-term developmental outcomes in malnourished children in developing countries.

- A pilot study in Brazil implementing nutritional counselling through IMCI, has also been encouraging, reporting significant weight gains in children aged one year or more but not in younger children.

- Programmes demonstrate that it is possible to develop nutritionally improved complementary foods in diverse cultural settings, that poor mothers are willing to prepare new foods, and their children are willing to eat them, but that caregivers face considerable time and resource constraints and it may be impossible to meet essential micronutrient requirements from unfortified complementary foods in some settings.

- Whether to improve feeding practices and or improve the availability of appropriate foods depends on the context.

3.6   Questions still to be answered

- Methods of increasing the feasibility of implementing programmes to improve complementary feeding on a wide scale.

- Methods of developing appropriately fortified high-quality, low-cost, complementary foods and ensuring access to them.

- Effectiveness of implementing nutrition counselling through IMCI.

- How to improve food availability/food security.

4. MICRONUTRIENTS

■ **Key practice.** Ensure that children receive adequate amounts of micronutrients (vitamin A, iron and zinc in particular), either in their diet or through supplementation.

Chapter 3 focused on the large burden of malnutrition, and on the importance of giving complementary foods of adequate energy and nutrient quality. This chapter focuses on the need to ensure that children receive adequate amounts of micronutrients, either in their diet or through supplementation. In particular, the evidence is reviewed concerning three of the four micronutrients essential for child health and development:

— vitamin A
— iron
— zinc.

Deficiencies in each are widespread, and the potential impact of improving intakes is substantial.

The fourth, iodine deficiency, responsible for the world's leading cause of mental retardation, is not reviewed here. The virtual elimination of iodine deficiency disorders (IDD) was one of the goals adopted at the 1990 World Summit for Children, and universal salt iodization was the obvious (and only) strategy. Enormous progress has been made. Prior to 1990, it was estimated that less than 20% of salt was iodized; by 1998, all but seven countries with recognized IDD problems had passed legislation to ensure universal iodization; and 70% of households in the developing world now consume adequately iodized salt (UNICEF, 2001a).

4.1 Improving vitamin A intake

4.1.1 The prevalence of vitamin A deficiency
Vitamin A deficiency (VAD) is widespread. Over 100 million preschool-age children are thought to be affected (UNICEF, 1998).

4.1.2 The benefits of improving vitamin A intake
Vitamin A is crucial for effective immune-system functioning. Severe VAD causes eye damage, manifested as night blindness and xerophthalmia which, if untreated, can lead to permanent blindness. It is well established that even moderate deficiency increases a child's risk of mortality and severe infection. Observational and intervention studies have shown that repletion of vitamin A status is strongly associated with reversal of cellular changes, improved immune function and reduced risk of infection and death (Beaton et al., 1993).

4.1.3 The impact of interventions to improve vitamin A intake
Interventions to improve vitamin A intake include:

— dietary modification/home gardens
— supplementation
— fortification
— plant breeding.

The potential impact of dietary modifications, home gardens, fortification and plant breeding are discussed below in the section on Feasibility.

Mortality and morbidity. Details of randomized controlled trials that examined the impact of vitamin A supplementation on childhood health are found in Table B.4.1. A meta-analysis of eight randomized controlled trials of vitamin A supplementation (Beaton et al., 1993) showed an average mortality reduction of 23% among children aged six months to five years (corresponding to a relative risk of 0.77, with a 95% confidence interval of 0.71–0.84). This relative effect was consistent over this age range, and similar for boys and girls.

Vitamin A, iron and zinc are essential for child health and development

Iodine, a fourth essential micronutrient is being tackled through a policy of universal iodization of salt. It is not reviewed here

Vitamin A deficiency (VAD) affects over 100 million preschool-age-children

Vitamin A supplementation (VAS) has reduced mortality by 23% among children aged six months to five years. It also reduces severe morbidity.

Additionally, vitamin A supplements as part of measles case management can reduce the case fatality rate by more than 50% (Hussey & Klein, 1990). The two companion morbidity and mortality trials in Ghana found an impact on severe diarrhoea, clinic attendances and hospitalizations, as well as a 19% reduction in mortality (Ghana VAST, 1993). The impact on mortality varies across different diseases; it is pronounced for diarrhoea and measles, but absent for pneumonia (Vitamin A and Pneumonia Working Group, 1995). Studies of the impact of vitamin A supplementation on malaria are sparse and the results are inconsistent. In Ghana, Binka et al. (1995) found no impact on malaria mortality.

In contrast to the findings for children aged six months to five years, the evidence suggests that vitamin A supplementation has no impact on mortality for infants aged 0–5 months. Analysis of data concerning the first year of life from the large-scale field trials of periodic vitamin A supplementation, suggests that dosing the infant during the first four months of life, even with 100 000 IU of vitamin A, has no impact on subsequent mortality. This impact only starts to become apparent when dosing takes place at five months of age (Vitamin A and Pneumonia Working Group, 1995). In addition, the immunization-linked multi-centre trial in Ghana, India and Peru found almost identical mortality in the vitamin A and control groups for infants during the first nine months of life (WHO/CHD Immunization-Linked Vitamin A Supplementation Study Group, 1998). This trial assessed the safety and effectiveness of delivering 25 000 IU of vitamin A alongside the first three EPI vaccines at 6, 10 and 14 weeks of age; mothers were also given 200 000 IU in the postpartum period.

<div style="text-align: right">In contrast to its impact in older children, VAS during the first six months of life appears to have no impact on mortality</div>

In marked contrast, the trial conducted by Humphrey et al. (1996) in Indonesia in which 2067 infants were given 50 000 IU on the first day of life, found a dramatic 64% reduction in infant deaths (95% CI, 13–84%), most of which occurred in the first five months of life. This should be interpreted with caution as there were only 26 deaths reported when vital status was checked at one year (loss to follow-up was 11%), many less than would be expected. Further studies currently being conducted in India and Zimbabwe and India may help to clarify this issue.

<div style="text-align: right">There was also no impact of vitamin A supplementation on symptoms or signs of malaria</div>

There was also no impact of vitamin A supplementation on reported symptoms of fever, malaria parasitic rates, and parasite densities in children with a positive blood smear in Ghana (Binka et al., 1995). In contrast, in Papua New Guinea where there are no clinical manifestations of vitamin A deficiency, there was a 20–40% decrease in malaria-attributable health centre attendance, with protective effects persisting even at high parasite densities (IVACG Meeting, Cairo, September, 1997).

<div style="text-align: right">Results concerning the effect of VAS on growth are conflicting</div>

Results concerning the effect of supplementation on growth are conflicting. Of two trials in Indonesia, one found an effect on weight gain in male children over three years of age, but no effect on linear growth; whereas in the other, linear growth increased but not weight (West et al., 1988; Muhilal, Idjradinata & Muherdiyantiningsih, 1988). In India (Rahmathulla et al., 1991), there was no effect on either weight, linear growth, or weight-for-height. The two companion trials in Ghana found a similar annual mean weight gain (36 g) among children aged >36 months who were supplemented, but this is unlikely to be functionally significant (Kirkwood et al., 1996). At best, it appears there may be a small but inconsistent effect of vitamin A intake on child growth, even in populations with a high prevalence of vitamin A deficiency.

<div style="text-align: right">The evidence suggests that any population with substantial biochemical vitamin A deficiency, even in the absence of clinical vitamin A deficiency, would benefit from VAS</div>

All the mortality trials were conducted in poor populations with clinical manifestations of deficiency. There was no direct relationship between rates of xerophthalmia and levels of biochemical deficiency. None of the mortality trials were conducted in populations that showed biochemical evidence of vitamin A depletion but no associated evidence of clinical manifestations. The study populations in Ghana came closest. Rates of xerophthalmia were 0.7% in the mortality trial population and 1.5% in the morbidity trial population. In contrast, 14.4% of the mortality trial children were biochemically severely deficient (<0.35 μmol/l) and 15.8% of the morbidity trial children.

The morbidity trial in north-eastern Brazil (Barreto et al., 1994) was the only trial conducted in an area with no xerophthalmia but with substantial biochemical deficiency. Vita-

min A supplementation was found to have an impact on the severity of diarrhoea, as it did in the Ghana health study trial, which suggests that supplementation probably would also have an impact on mortality in this population, as it did in Ghana. Thus it would appear that it is not necessary for vitamin A eye signs to be present for a population to benefit from vitamin A supplementation in reducing child mortality. In fact, it is likely that any population with substantial biochemical vitamin A deficiency would benefit.

4.1.4 The feasibility of large-scale programmes

Home gardens and dietary improvement. Vitamin A is found as retinol in breast milk, liver, eggs, butter and whole cow's milk, and as beta-carotene (a precursor of vitamin A) in dark-green leafy vegetables, orange and yellow fruits (such as mangoes) and red palm oil. Although it may be possible in some settings to increase the consumption of vitamin A through animal foods, in many developing country settings the majority of vitamin A consumption will need to be from plant sources. The promotion of vegetable gardens and of preservation techniques, such as drying mangoes to extend the access of this source of vitamin A throughout the year, can increase the intake of vitamin A in the diet, and improve dietary diversification. However, evidence suggests that this approach alone will not be sufficient to tackle VAD. First, the diet may not contain sufficient fat to enable the carotenoids to be converted into vitamin A (de Pee et al., 1995). Second, there are gaps in our knowledge concerning the bioavailability of carotenoids in various plant foods, and of the effect on these of different methods of processing, such as duration and temperature of cooking. Third, in some settings, it may simply not be feasible to meet the vitamin A requirements in early childhood through complementary foods plus breast milk (Brown, Dewey & Allen, 1998; Hudelson et al., 1999).

Tackling VAD requires supplementation and/or fortification. Interventions to improve vitamin A intake in the diet will not be sufficient.

Supplementation. Vitamin A is stored in the liver and supplies last several months. Unlike zinc and iron, which need to be consumed on a regular basis, a child's vitamin A status can be maintained with high potency capsules every 4–6 months, as well as with more regular lower doses. The relative impact on mortality for children above six months of age did not differ with method of dosing (high potency capsules every 4–6 months, weekly low potency capsules, or food fortification), baseline mortality rate, or prevalence of xerophthalmia. In the Ghana trial, there was no evidence that an interval between doses of less than four months would have had a greater impact on severe morbidity or mortality, and the effectiveness of supplementation did not vary by time of year (Ross et al., 1995). The absolute effect, however, will increase with baseline mortality and vary by strategy used, as different strategies differ in their feasibility of achieving broad population coverage at sustainable costs. By mid-1997, the policy of periodic high dose supplements had been adopted in all but 3 of the 38 countries where clinical VAD existed, and in all but 13 of the additional 40 countries with documented subclinical deficiency. Currently, at least 35 of the 100 countries where supplementation is advised are routinely providing vitamin A supplements with immunization during National Immunization Days (UNICEF, 1998) (see Figure 5).

Unlike zinc and iron, a child's vitamin A status can be maintained with high potency capsules every 4–6 months

Linking vitamin A supplementation to early immunizations. As immunization programmes have established a delivery system that reaches a large proportion of young children, linking vitamin A supplementation to these could be one mechanism to achieve extensive coverage in vitamin A-deficient populations. In 1992, an informal consultation was convened by WHO's Nutrition Unit and the Expanded Programme on Immunization (EPI) to assess the role of using immunization contacts to combat vitamin A deficiency. It was recommended, in association with the International Vitamin A Consultative Group (IVACG), delivery of 25 000 IU of vitamin A with each of the first DTP immunizations (scheduled around 6, 10 and 14 weeks) and with measles immunization around nine months. Among populations in which breastfeeding is common and prolonged, the group also recommended one large 200 000 IU dose to the mother during the safe period of postpartum infertility (about 60 days).

FIGURE 5
Improvements in vitamin A supplementation
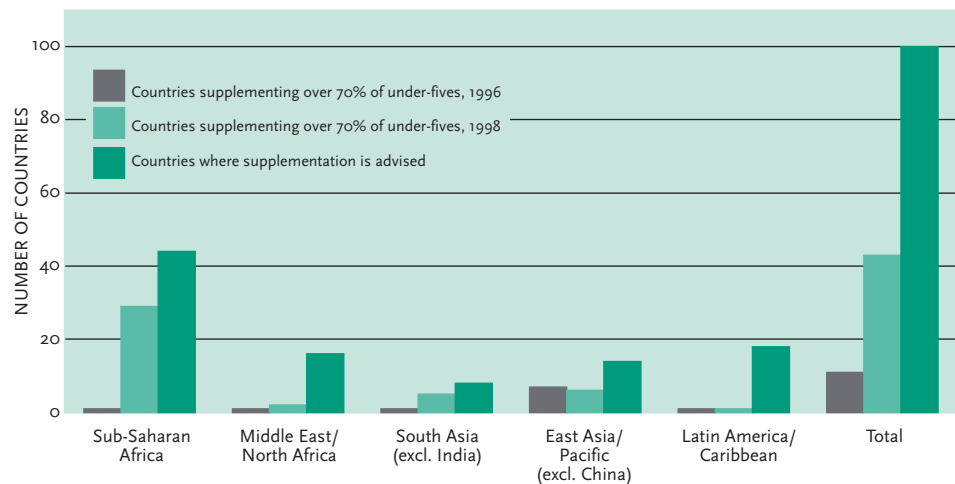
Source: UNICEF, 2001b

Clear benefits of linking VAS to immunization were not confirmed in recent multicentre trials. Results of further trials are awaited.

This particular schedule formed the basis of the multi-centre, immunization-linked supplementation trial, in which a total of 8439 infants and their mothers in Ghana, India and Peru were randomized to vitamin A or control groups. This combined maternal and immunization-linked supplementation schedule achieved a modest impact on the infants' vitamin A status at six months compared to infants in the control group who received a single 100 000 IU at nine months at the time of their measles immunization. However, this effect was no longer apparent at age nine months. No significant between-group differences in mortality were observed. The rate ratio to compare all deaths up to age nine months was close to 1 (RR=0.96; 95% CI=0.73, 1.27) (WHO/CHD Immunization-Linked Vitamin A Supplementation Study Group, 1998). Current trials are planned to see if higher doses of 50 000 IU will achieve a more substantial impact on vitamin A status.

Early concerns that vitamin A, if given at the same time as measles vaccination, may interfere with the immune response to the vaccine (Semba et al., 1995) have not been confirmed by later studies (Semba et al., 1997; Benn et al., 1997).

Several countries are tackling VAD through fortifying the sugar supply

Fortification. Several countries are tackling VAD through fortifying the sugar supply. Guatemala has led the way. Sugar fortification began in the mid-1970s, and although there was a lapse in fortification during the early 1980s, an evaluation of 82 villages in 1990 concluded that VAD had been successfully brought under control (UNICEF, 1998). By 1998, sugar was also being fortified in parts of Bolivia, El Salvador, Honduras and the Philippines, with Zambia planning to start (UNICEF, 1998).

Plant breeding. New developments in plant breeding currently under research may also play an important role in the future. This includes rice that has been genetically altered to make beta-carotene, called 'golden rice' (Potrykus, 2001).

4.2 Improving iron intake
4.2.1 *The prevalence of iron deficiency*

Iron deficiency anaemia affects about half of all preschool children in developing countries

Iron deficiency is the most prevalent of the micronutrient deficiencies (OMNI, 1998). About one half of all preschool children are thought to have iron deficiency anaemia (IDA) (Allen et al., 2000), and in most developing countries the majority of non-anaemic children also have biochemical evidence of iron deficiency (Yip, 1997). Iron deficiency is usually caused by inadequate dietary intake of bioavailable iron and/or excessive loss due to parasitic infections (Grantham-McGregor & Ani, 1999).

4.2.2 The benefits of improving iron intake

Observational studies indicate that iron deficiency is associated with reduced work capacity in children and reduced work productivity in adults (Grantham-McGregor & Ani, 1999). Impaired growth, lethargy, anorexia, reduced cell-mediated immunity and reduced neutrophil activity can also result (Michaelsen et al., 2000). Severe IDA is also associated with increased mortality (Tomkins, 2000) and may result in increased susceptibility to infection (Bhaskaram & Reddy, 1975).

Observational and intervention studies have shown that repletion of iron stores is associated with reductions in attention deficits, lethargy, and anorexia. However, growth and psychomotor outcomes may not improve (Grantham-McGregor & Ani 2001; Michaelsen et al., 2000). The risks of permanent developmental deficits are related to the severity of iron deficiency, the child's age at the time of the deficiency, the duration of the iron deficiency and other socioeconomic factors (Michaelsen et al., 2000).

There have also been concerns about whether improving the iron intake of young children is advisable in populations where infections are endemic. The basis of these concerns is summarized by Tomkins (2000), see Box 7.

> **BOX 7**
>
> **Basis for concerns regarding improving iron intake in populations where infections are endemic**
>
> ■ First, experimental laboratory studies showed that adding iron to a cultured medium increased bacterial growth (Andrews, 1998; Brochu, Greinier & Marand, 1998).
>
> ■ Second, there was observational evidence of increased intestinal parasitic infection during re-feeding of refugees (Murray et al., 1978).
>
> ■ Third, intramuscular iron injections to anaemic infants in Papua New Guinea resulted in increased respiratory morbidity and mortality (Oppenheimer et al., 1986).
>
> ■ Fourth, there have been some reports of increased susceptibility of young children to malaria following iron supplementation, although several others not indicating such a hazardous interaction (Oppenheimer, 1998).
>
> ■ However, improving iron intake can have an important impact on immune strength and a number of studies have shown no increase in infectious disease incidence or severity (Tomkins, 2000; Menendez et al., 1997; Bates et al., 1987; Beck et al., 1999; Berger et al., 2000; Mitra et al., 1997).
>
> Source: Tomkins, 2000

4.2.3 The impact of interventions to improve iron intake

Published studies have examined the prevention of iron deficiency, the treatment of established iron deficiency and the treatment of established IDA. Interventions to improve iron intake include dietary modification, supplementation, and fortification. Dietary modifications and fortification are discussed in the section on Feasibility.

Mortality and morbidity. Daily iron supplementation has been shown to restore iron stores and improve haemoglobin levels. These trials are not discussed in this paper. No evidence of impact of iron supplementation on childhood mortality was located.

Impact of iron supplementation on growth is variable. Improvement in anthropometric indices, in anaemic and non-anaemic children, was found in only two out of six studies. No impact was found in Benin, with daily supplements given for three months to preschool children (Dossa et al., 2001), nor in Bangladesh, with daily supplements given for 12 months to preschool children (Rahman et al., 1999), nor in South Africa, with daily supplements given for 10 weeks to schoolchildren (Taylor et al., 2001). However, in India weight gain of 0.83 kg was seen in adolescent girls aged 10–14 years given iron and folic acid supplements for two months (Kanani & Poojara, 2000) and significant improvements in both weight-for-height and weight were seen in schoolchildren in Kenya after iron supplementation was given for seven months (Latham et al., 1990).

Evidence of the impact of iron supplementation on child development is also inconsistent. Details of randomized controlled trials that examined the impact of iron supplementa-

Severe IDA can be associated with increased mortality

Benefits of improving iron intake include improved attention span and appetite

Impact of iron supplementation on growth is variable

tion on childhood development are found in Table B.4.2. Treatment trials in anaemic infants (aged 0–24 months) are difficult to interpret as many used non-anaemic control groups or developmental screening tests to measure outcomes (Grantham-McGregor & Ani, 1999). However, one placebo-controlled trial from Indonesia investigated the impact of iron supplementation in anaemic infants (aged 12–18 months) on formal developmental outcomes, and found no benefit (Idjradinata & Pollitt, 1993). In their recent review of the role of micronutrients in psychomotor and cognitive development (see table B.4.2 for details of the individual studies), Grantham-McGregor & Ani (2001) reported that only two of six prophylactic trials in children under two years of age without IDA showed clear benefits. In contrast, eight of nine trials in older children with IDA showed improvements in cognition or school achievement, from iron treatment (Allen et al., 2000; Grantham-McGregor & Ani, 2001).

Evidence of the impact of iron supplementation on child development is inconsistent

4.2.4 The feasibility of large-scale programmes

Dietary improvement. Infancy, adolescence and pregnancy are three periods of high iron requirement, since iron is required for tissue growth and blood volume expansion. The average infant triples birth weight during the first year of life. The iron requirement during this rapid tissue growth is 0.8 mg/day, almost as high as that required by adult men (Yip, 1997). It is practically impossible to meet this demand from unfortified foods (Brown, Dewey & Allen, 1998). This conclusion applies everywhere, since an infant would need to consume far greater amounts of iron-rich food, such as liver, than is seen anywhere in the world. In the United States of America, for example, iron fortification of infant foods results in the diet having seven times the amount of iron that could be achieved from unfortified foods in Peru (Brown, Dewey & Allen, 1998). Iron is therefore a 'problem micronutrient'; there is a large discrepancy between the content in unfortified complementary foods and the amount required by the infant. This implies that reducing the prevalence of IDA can only be achieved through supplementation or fortification.

It is practically impossible to meet the infant's iron demand from unfortified foods

Reducing the prevalence of IDA is likely to be achieved only through supplementation or fortification

Supplementation. There is limited experience in implementing universal prophylactic iron supplementation in infants (Yip, 1997), and results have not been encouraging. Problems include lack of compliance with the recommended daily schedule on a long-term basis (Stoltzfus & Dreyfuss, 1998; Galloway & McGuire, 1994), and the coexistence of other micronutrient deficiencies which may limit the haematological response to iron (Allen et al., 2000). For example, a UNICEF pilot project in Romania was only able to achieve a reduction in IDA prevalence among infants aged 6–9 months, from 60% to 45% (Ciomarten et al., 1996). In Mexico, although trial conditions ensured good compliance, 12 months of supplementation failed to have any impact on the levels of low haemoglobin, which were 30% in both iron-supplemented and unsupplemented groups (Allen et al., 2000).

Weekly iron supplementation is likely to be more feasible than daily supplementation (Michaelsen et al., 2000). Studies from Bolivia, China and Indonesia, Bolivia, and China indicate that weekly iron supplementation in children with iron deficiency and IDA is as effective as daily iron supplementation in improving haemoglobin levels (Michaelsen et al., 2000). There is little evidence about the effectiveness or feasibility of prophylactic weekly iron supplementation in infants.

Weekly iron supplementation is likely to be more feasible than daily supplementation

Alternative formulations are also being developed. Zlotkin and colleagues (Zlotkin, 2001) have recently developed and tested a new form of iron, powdered micro-encapsulated ferrous fumarate, and a new delivery system, a single dose sachet. The powdered iron can be sprinkled directly on any semi-liquid food. Other micronutrients, like ascorbic acid, zinc and vitamin A, can be included in the sachet. Advantages of the coated 'sprinkles' are many. They can be added directly to food without changing its taste or consistency, since encapsulation prevents the micronutrients from oxidizing it. They are easy to use; no literacy is needed. The sachets are lightweight and easy to store and transport; inexpensive and low-tech to manufacture. Inadvertent poisoning is unlikely. Last but not least, virtually any micronutrient can be added. Zlotkin (2001) and colleagues have already demonstrated,

Iron 'sprinkles' are as efficacious as iron drops, for the treatment of anaemia in young children

in randomized controlled trials in Ghana and a pilot study in India, that the iron 'sprinkles' are as efficacious as the gold standard, iron drops, for the treatment of anaemia in young children. The next stage of development includes a series of effectiveness studies for prevention in Ghana, India, Laos and Mongolia, India, Laos and Ghana (Zlotkin, personal communication).

Fortification. In the developed world, there is good evidence that targeted iron fortification of complementary foods for infants and young children is effective in helping to reduce iron deficiency (Michaelsen et al., 2000). Targeted fortification of milk powder distributed to lower income families has also been successful in Chile (Stekel et al., 1986). However, targeted fortification is less likely to be a good approach in most less-developed countries, where the diet for infants and young children is based almost exclusively on locally produced food items (Yip, 1997). IDA can be tackled through general rather than targeted fortification, provided this will not lead to excess iron intake in any sector of the population. Vehicles that have been used for general fortification with iron include wheat flour in several countries in Latin America (OMNI, 1998), sugar in Guatemala (Yip, 1997) and salt (Michaelsen et al., 2000).

4.3 Improving zinc intake
4.3.1 The prevalence of zinc deficiency
Zinc deficiency is estimated at 31% globally, and is widespread among children in developing countries, particularly where diets are low in animal products and based on high-phytate cereals and legumes (Sandstead, 1991). It is a particular problem during the period of complementary feeding (Allen, 1998).

4.3.2 The benefits of improving zinc intake
Zinc deficiency is associated with impaired immunity and increased risk of infectious diseases (Black, 1998). Severe zinc deficiency causes growth retardation, diarrhoea, skin lesions, loss of appetite, hair loss and, in boys, slow sexual development (UNICEF, 1998). Zinc promotes normal growth and development. It forms part of the molecular structure of enzymes, promotes development and function of immune cells and is essential for cellular activation and proliferation (Shankar & Prasad, 1998; UNICEF, 1998). Observational and intervention studies have shown that repletion of zinc stores is associated with improved immune function, reduced diarrhoea, improved growth and psychomotor function (Black, 1998; Prasad, 1991).

4.3.3 The impact of interventions to improve zinc intake
Interventions to improve zinc intake include dietary modifications, supplementation and plant breeding. Dietary modifications and plant breeding are discussed in the section on Feasibility.

Mortality and morbidity. Impact of zinc supplementation on childhood mortality is currently under investigation in a large multi-centre trial in India, Nepal and the United Republic of Tanzania (WHO, 2002). No other evidence of impact on childhood survival is currently available.

A series of randomized controlled trials has confirmed the importance of zinc supplementation in preventing growth faltering, and its therapeutic and preventive effects on serious childhood diseases. In their recent review, Bhutta et al. (1999) concluded that zinc supplementation of young children in developing countries can substantially reduce their rates of diarrhoea and pneumonia. This was based on a pooled analysis of 10 randomized controlled trials (see Table B.4.3). Seven of the trials provided 'continuous' supplementation of 1–2 RDA of elemental zinc 5–7 times per week, while three provided a 'short course' of 2–4 RDA daily for two weeks, followed by 2–3 months' morbidity surveillance. Similar results were obtained with the two types of regimens. The pooled odds ratio (95% CIs)

obtained from the 'continuous' trials were 0.82 (0.72–0.93) for diarrhoea incidence, 0.75 (0.63–0.88) for diarrhoea prevalence, and 0.59 (0.41–0.83) for pneumonia incidence. The corresponding odds ratios for the 'short course' trials suggested similar reductions. They were 0.89 (diarrhoea incidence), 0.66 (diarrhoea prevalence) and 0.74 (pneumonia incidence), but the CIs were considerably wider than for the 'continuous' trials, due to the smaller total number of children involved, and all included '1'. The effect on severity and duration of diarrhoea is less consistent, with a reduction in some settings (Gatheru et al., 1988; Sachdev et al., 1988; Sazawal et al., 1995) but not others (Bates et al., 1993; Ruel et al., 1997).

In addition, therapeutic trials have demonstrated that children in developing countries benefit from zinc supplementation during acute diarrhoea, with a reduction in both episode duration and severity (Bahl, 2001). There is some evidence of a similar benefit for children suffering from persistent diarrhoea. A recent trial in Peru reported a 28% reduction in duration when children with persistent diarrhoea received a daily zinc supplement of 20 mg for two weeks, but no impact on severity (Penny et al., 1999).

Trials in the Gambia and Papua New Guinea suggest that zinc supplementation also reduces the incidence of malaria. In Papua New Guinea, children given 10 mg elemental zinc per day, six days a week for 46 weeks, experienced 38% lower incidence (95% CI: 3–60%) of *Plasmodium falciparum* health centre based episodes, compared to children receiving placebo (Anuraj et al., 2000). The impact was even greater, 69% (25–87%) reduction, for episodes with high levels of parasitaemia ($\geq 100\ 000/\mu l$). The earlier trial in the Gambia evaluated a twice-weekly regime and found that zinc-supplemented children had 32% fewer clinic visits for malaria; this result was of borderline statistical significance (Bates et al., 1993). No difference was found between the zinc and placebo groups in the incidence of falciparum malaria (relative risk 0.98, 95% confidence interval 0.86–1.11) in a recent randomized controlled trial in Burkina Faso (Muller et al., 2001). No studies were located of the impact of zinc supplementation on measles.

A meta-analysis of 25 placebo-controlled zinc-supplementation trials in children (Brown, Peerson & Allen, 1998) found a small but significant increase in height-for-age (0.22 SD) and weight-for-age (0.26 SD). In studies in which the average child was stunted (i.e. mean height-for-age z score was below −2SD), the effect was substantial (0.49 SD). Several studies have also demonstrated that zinc supplementation increases rates of growth during recovery from severe malnutrition (Brown, Dewey & Allen, 1998).

Further investigation into the impact of zinc supplementation on developmental outcomes is needed. Short-term impacts of zinc supplementation on activity levels in Indian and Guatemalan and Indian infants (Sazawal et al., 1996; (Bentley et al., 1997; Sazawal et al., 1996), responsiveness in low-birth-weight infants in Brazil (Ashworth el al., 1998), motor development in very low-birth-weight infants (Friel et al., 1993), and tracking and recognition in Chinese children aged 6–9 years (Liu et al., 1995) have been described. However, no improvements in developmental outcomes in children in Canada and Guatemala were demonstrated (Gibson et al., 1989; Cavan et al., 1993).

4.3.4 The feasibility of large-scale programmes

Dietary improvement. Gibson et al. (1998) reviewed household dietary strategies that could be used to improve the content and bioavailability of zinc in predominantly plant-based diets of older children. They implemented these strategies in rural Malawi using a participatory research process that focused on building relationships with the community and involving them in the design, implementation, and monitoring and evaluation. The strategies implemented at the household level included:

— increasing the intake of foods with high zinc content and high bioavailability
— increasing the intake of foods known to enhance zinc absorption
— various treatments, such as soaking, germination, fermentation, thermal processing and milling.

They successfully improved the zinc content of the diets of children aged 4–6 years. However, in their review of complementary feeding, Brown, Dewey & Allen (1998) suggest that in many developing-country settings it may be difficult to meet the zinc requirements of infants and young children from food during the period of transition from breast milk to solid foods.

Supplementation. As Allen (1998) says in her review, it may be difficult to meet the zinc requirements of infants and young children from food. This implies that zinc supplementation may be especially useful during this period (Allen, 1998). She highlights significant gaps in current knowledge concerning the best method to provide zinc supplements, the appropriate frequency and dosing, and the bioavailability of different supplements in the presence of dietary inhibitors. She also strongly advocates the case for combining zinc with other micronutrients in supplements, since diets that are deficient in zinc are almost certainly also deficient in iron, and likely to be deficient in vitamin A. Tackling zinc through supplementation poses challenges, however, as zinc must be consumed in small amounts on a regular basis.

No large-scale zinc supplementation programmes were located. A multi-centre trial in India, Nepal and the United Republic of Tanzania (WHO, 2002) will recruit a total of 150 000 children to investigate the impact of zinc supplementation on childhood mortality. In India and Nepal, 65 000 children between 2 and 24 months will receive zinc plus iron or iron alone. In the United Republic of Tanzania, a multifactorial design will be used to assess the effects of iron and the possible interaction of zinc and iron in 85 000 children aged 2–35 months receiving either zinc, iron, zinc plus iron or placebo. Rapidly dissolving tablets of zinc, iron, and zinc plus iron have been developed by a pharmaceutical company. Study results should be available in 2004.

Plant breeding. New developments in plant breeding currently under research – including three different plant-breeding strategies – are methods that could increase the bioavailability of zinc from food staple crops (Ruel & Bouis, 1998).

4.4 Conclusions

- Improving intake of vitamin A, iron and zinc will have a substantial impact on mortality, morbidity and development in poor or micronutrient-deficient populations.

- Evidence comes from randomized control trials which show that vitamin A supplementation can reduce mortality by 23% (the morbidity and mortality impact varies across different diseases). No mortality studies were located for iron or zinc supplementation. However, iron supplementation improved development in children over two years of age and zinc supplementation reduced diarrhoea incidence by 18% and pneumonia incidence by 41%. None of the micronutrients had a consistent impact on growth except zinc.

- Additional information about the effects of vitamin A supplementation in children aged 0–5 months and the effects of zinc supplementation on child mortality is soon to be available.

- Reducing micronutrient deficiencies is likely to require a variety of approaches. They will not be adequately tackled through interventions to improve the micronutrient content of diets, although these may be a useful part of the solution, and may have wider benefits. Supplementation and/or fortification will be necessary.

- Vitamin A supplementation programmes are being implemented in nearly 50% of the countries where supplementation is advised.

- Vitamin A supplementation is more feasible than iron and zinc, since mega-doses every 4–6 months are both efficacious and safe for young children. New technologies, such as iron sprinkles and combining micronutrients, will make iron and zinc supplementation more feasible.

It may be difficult to meet the zinc requirements from food during the period of complementary feeding. Supplementation and/or fortification may be especially useful during this period.

- Since the daily requirement of iron is relatively large, it is unlikely to be possible to meet it with a single fortified product.

- New developments in plant breeding currently under research may also play an important role in the future.

- Community demand for and acceptance of supplements or fortified products cannot be taken for granted.

- Supplementation and fortification programmes need to be accompanied by promotion and communication activities to promote behaviour change.

4.5 Questions still to be answered

- Effectiveness of iron and zinc supplementation on developmental outcomes in young children.

- Methods of providing an integrated approach to tackling micronutrient deficiencies (such as large-scale programmes that combine micronutrients and fortification using a variety of food products).

- Effectiveness and feasibility of new technologies (such as sachets of micro-encapsulated micronutrients and plant breeding).

5. HYGIENE

■ **Key practice.** Dispose of faeces, including children's faeces, safely; and wash hands after defecation, before preparing meals, and before feeding children.

Poor sanitation, lack of clean water and inadequate personal hygiene are associated with diarrhoeal disease, worm infestations, skin and eye infections and other vector borne diseases (Boot & Cairncross, 1993). Diarrhoea is the second most serious cause of mortality in children under five, accounting for 13% of child deaths in developing countries (WHO, 2002). It is also an important contributor to childhood morbidity and poor growth and development. Excreta are the primary source of diarrhoeal pathogens and it is estimated that 90% of child diarrhoea is the result of poor sanitation, lack of access to clean water supplies and inadequate personal hygiene (WHO, 1997). Box 8 shows the faecal oral transmission route and how adequate excreta disposal and washing hands block pathogen transmission.

90% of child diarrhoea is the result of poor sanitation and inadequate personal hygiene

BOX 8

Faecal–oral disease transmission

Source: Wagner & Lanois, 1958; EHP/USAID, 1999
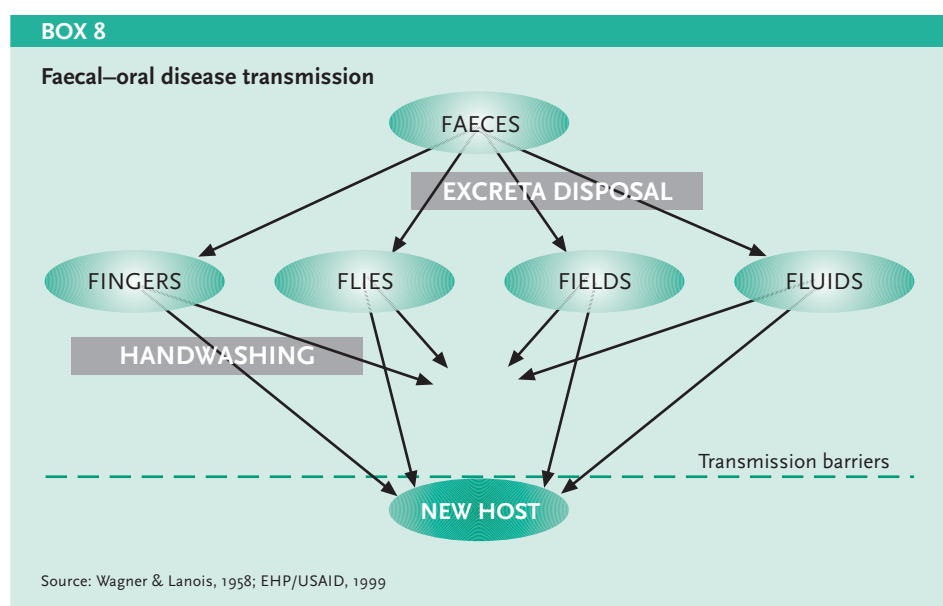
5.1 Handwashing

Hands are an important vector in the transfer of infection from faeces. Hands become contaminated:

— during defecation
— through handling children's faeces
— through touching other contaminated hands and surfaces.

Contamination is also associated with high humidity and outdoor agricultural activity (Murphey, Stanton & Gilbraith, 1997; Aziz et al., 1990; Han, Khin & Hlaing, 1986).

5.1.1 The prevalence of handwashing

Measuring handwashing behaviour is problematic, as good behaviours are likely to be increased under observation and overreported in surveys (Manun'Ebo et al., 1997; Curtis et al., 1993). In many settings, the prevalence of handwashing appears low. In rural India, only 2% of mothers washed their hands after defecation and 4% before preparing food (Singh et al., 1992). In Nigeria, 29% of mothers washed their hands after disposing of children's faeces; in rural areas, the frequency was only 17% (Omotade et al., 1995). In Thailand, qualitative research revealed that mothers tend to wash their hands after defecation but not after disposing of their child's faeces (Rauyajin et al., 1994).

Current handwashing behaviours are poor, with as few as 2% of mothers washing their hands after defecation in some settings

5.1.2 The benefits of handwashing

Case-control studies exploring the association between handwashing and mortality and morbidity have had mixed results and must be interpreted with caution because of problems with confounders. Only one study was located with mortality as an outcome, which found no significant association between handwashing and diarrhoeal deaths (Hoque et al., 1999). In Sumatra, no association between handwashing and the incidence of diarrhoea was found (Aulia et al., 1994); while in Myanmar, the risk of persistent diarrhoea was higher if the mother did not wash her hands after defecation (RR 1.7), did not use soap (RR 1.3) or used dirty rags/linen to dry them (RR 2.6) (Khin-Maung et al., 1994a). In Bangladesh, a hospital-based case-control study found that neonates, whose mothers reported washing their hands during the care of the neonate, had five times less rotavirus infection than those who reported not washing their hands (Kilgore et al., 1996). Data collected as part of the *Central American Handwashing Initiative* found diarrhoeal episodes decreased with increasing handwashes, the incidence being 23% among women with no handwashes in a day, and 10% for eight handwashes (Favin, Yacoob & Bendahmane, 1999). In a Malawi refugee camp, 27% fewer diarrhoeal episodes were reported in houses with soap (Peterson et al., 1998)

5.1.3 The impact of interventions to increase handwashing

Interventions to increase handwashing include:

— hygiene education
— provision of soap and clean water
— changing the design of the community taps.

Behaviour change. Few intervention studies reported behaviour change data. In Indonesia, only 3% of the control group reported washing their hands after defecation compared to 92% of the intervention group. By the end of the intervention, people's attitudes about soap had changed and the number who reported soap to be unaffordable decreased from 32% to 12% (Wilson et al., 1991). Two years later, women were still enthusiastic and were purchasing soap themselves, and 79% had soap in their house and reported regular handwashing (Wilson & Chandler, 1993).

Mortality and morbidity reduction. No intervention studies measuring the impact of handwashing promotion on childhood mortality, growth or development were located. Intervention studies measuring the impact of handwashing promotion on diarrhoea morbidity were reviewed by Huttly, Morris & Pisani (1997) (Table B.5.1). Studies differed in setting, content, intensity, and duration and in whether handwashing was encouraged alone or as part of a larger intervention package. Ten studies showed a positive impact on diarrhoeal incidence, the median reduction was 33% (range 11–89%). The reduction was 35% (range 30–89%) in studies that just focused on handwashing, and 26% (range 11–40%) in studies where it was part of a package (Black et al., 1981; Han & Hlaing, 1989; Khan, 1982; Sircar et al., 1987; Wilson et al., 1991; Alam et al., 1989; Pinfold & Horan, 1996; Haggerty et al., 1994; Ahmed et al., 1993; Torun, 1982). This difference suggests that targeting single behaviours may be most effective. Two subsequent intervention studies were located. A 33% reduction in diarrhoea incidence was observed after a handwashing intervention in a Dhaka slum (Shahid et al., 1996), while health education in the Gambia that included handwashing did not result in a difference in diarrhoea incidence in the control and intervention group, but did reduce skin infections (Hoare et al., 1999). A new tap design (Tippy Taps) implemented in rural areas in Guatemala also reduced diarrhoeal incidence (Watt, 1988).

Moderating factors

The community. Handwashing interventions even had an impact when they were in communities where general conditions were unsanitary, such as in an urban slum in Bangla-

desh (Shahid et al., 1996; Khan, 1982). They were most effective where there was a strong sense of community (Pinfold & Horan, 1996), community participation and high health educator efficacy (Haggerty et al., 1994).

Type of handwashing. All types of handwashing are not equally effective in removing pathogens (see Table 4). In Bangladesh, for example, the traditional method of washing hands after defecation did not significantly reduce contamination (Hoque et al., 1995). Using large quantities of water, vigorous rubbing, using cleansing agents such as soap, ash or clean mud and drying with a clean cloth or in the air are the most effective ways of removing pathogens (Anuradha et al., 1999; Hoque & Briend, 1991; Hoque et al., 1995; Kaltenthaler, Watermann & Cross, 1991).

TABLE 4
Effectiveness of handwashing in Bangladesh under different conditions
(Source: Hoque et al., 1995)

	MEAN FAECAL COLIFORM COUNT	
TYPE OF HANDWASHING	**LEFT HAND**	**RIGHT HAND**
No washing[1]	8511	977
Usual handwashing practice[1]	1995	1318
Dried on worn cloth[1]	812	437
Dried on clean cloth[1]	191	89
Air dried[1]	112	55
Used pond water	288	263
Used 0.5 litres water	269	234
Used soil (wet)	240	159
Used soap	195	112
Used soil (near latrine)	132	110
Used 1 litre water	128	79
Used ash	98	54

1 These results were obtained by observing women washing their hands and then measuring the faecal coliform count. The other results were obtained experimentally by varying each washing technique, while keeping the other components of handwashing constant.

Diarrhoeal agent. Intervention studies that have examined the impact of handwashing by diarrhoeal agents, mostly found an impact for all agents. In Bangladesh, a similar reduction for dysenteric and non-dysenteric diarrhoea was found (Khan, 1982), while another study in Bangladesh found a reduction for all agents studied, except rotavirus (attributed to the low incidence of rotavirus) (Shahid et al., 1996). A study in Myanmar found no reduction in dysenteric diarrhoea (Han & Hlaing, 1989).

5.1.4 The feasibility of large-scale programmes
Cultural beliefs and practices that either inhibit (perceiving children's faeces as harmless) or enhance (perceptions of religious purity) good handwashing must be addressed when designing programmes (Boot & Cairncross, 1993). Locally appropriate channels of communication should be utilized (Curtis et al., 2001). The intervention studies in Table B.5.1 focused on face-to-face channels and were often intensive, which may not be feasible for larger-scale programmes.

Handwashing promotion programmes have been effective in initiating behaviour change and have used a variety of innovative methods. The *Sanitation and Family Education (SAFE)* project in Bangladesh utilized many channels including discussions, demonstrations, action learning exercises, folk songs, role playing and games. This project targeted caregivers,

children, and key community members, and handwashing increased from 1% to 82% (Bateman et al., 1995). The *Central American Handwashing Initiative* is another example of a large-scale project. It worked with soap-producers who stressed health impacts in their marketing and targeted schoolteachers, students, health workers and mothers (Favin, Yacoob & Bendahmane, 1999).

These programmes illustrate that improving handwashing is possible on a large scale; however, concerns still exist about feasibility because of the complexity of the behaviour and the resources required to carry it out. Most handwashing education promotes washing hands at specific times – after defecation or handling children's faeces and before handling food. A study in Guatemala found that this involves 32 handwashes a day and 20 litres of water (Graeff, Elder & Booth, 1993). Family resources must be considered in intervention design. If cost is an inhibitor to soap use, ash or mud can be promoted. If access to water is an inhibitor, the building, management and maintenance of a water supply should be considered (Favin, Yacoob & Bendahmane, 1999).

5.2 Faeces disposal

Faeces can be safely removed by:

— using a sanitary facility (toilet, latrine or potty)
— disposing of faeces away from homes, water and where people walk
(Favin, Yacoob & Bendahmane, 1999).

5.2.1 *The prevalence of adequate faeces disposal*

As with handwashing, faeces disposal behaviours are difficult to measure, but data suggest that behaviours are poor. In Peru, 42% of households had faeces accessible to children (Huttly et al., 1994), and in Nigeria, 17% of houses had human faeces in or around the house – prevalence was 25% in rural areas (Omotade et al., 1995). Safe faeces disposal is facilitated by access to adequate sanitation facilities, but in 2000 only 60% of people in the developing world had access to excreta disposal facilities (UNICEF, 2001).

5.2.2 *The benefits of adequate faeces disposal*

In their reviews of the impact of access to sanitation facilities Esrey et al. (1985, 1991) (see Table B.5.2) located six rigorous observational studies investigating all cause-child mortality; the median reduction was 55% (range 20–82%). Three observational studies examined diarrhoeal mortality and found a median reduction of 65% (range 43–79%); median reduction in diarrhoeal disease in 19 rigorous studies was 26% (range 0–68%). Subsequent case-control studies have also found a positive association between sanitation facilities. In Bangladesh, there was a higher incidence of diarrhoea where children's faeces were disposed of in an open space compared to in a latrine (odds ratio 10.5) (Aulia et al., 1994). In Burkina Faso, there was a 50% increased risk of hospitalization for children in families with unsafe stool disposal compared to those who disposed of faeces in a latrine; however, diarrhoea was not associated with where children defecated, only with where the faeces were disposed (Traore et al., 1994). Studies in Sri Lanka and the Philippines found that families who did not dispose of faeces in the latrine had a 54% and 64% higher incidence of diarrhoea (Mertens et al., 1992; Baltazar & Solon, 1989). Using the Sri Lanka data, it was estimated that if inadequate disposal was reduced from 91% to 50%, 12% of all diarrhoeal episodes could be prevented.

In Lesotho, the impact of latrine ownership on diarrhoea appears to be higher in children of literate mothers and children whose mothers washed their hands (Daniels et al., 1990). In Malaysia, reduction in diarrhoeal incidence was higher among children of literate women (Esrey & Habicht, 1988).

Observational studies related to general faeces disposal (i.e. not necessarily linked with sanitation facilities) have also found an association between inadequate disposal and diarrhoea. A cohort study in Papua New Guinea found that children living in houses without

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Large-scale programmes have successfully improved handwashing behaviour

Cost of soap, access to water and cultural beliefs must be considered when designing handwashing interventions

Current faeces disposal behaviours are poor with as many as 42% of houses in some settings having faeces accessible to children

Inadequate faeces disposal is associated with a 48–64% higher incidence of diarrhoea

Sanitation could reduce diarrhoea morbidity by 26% and overall mortality by 55%

faeces in the yard had 48% fewer diarrhoeal episodes than those children living in houses with faeces in the yard (Bukenya & Nwokolo, 1991). In Myanmar, persistent diarrhoea was higher where children defecated on the floor rather than in a potty or latrine (odds ratio 3.8) and where faeces were disposed around the house (odds ratio 1.8), compared to safe disposal (Khin-Maung et al., 1994b). In a multi-site cross-sections survey in East Africa, burial of children's faeces in the soil was positively and significantly associated with reduced incidence of diarrhoea, with an odds ratio of 3.36 (Tumwine et al., 2002).

5.2.3 The impact of interventions to increase adequate faeces disposal
Interventions to increase faeces disposal include:

— providing sanitation facilities
— promoting their use
— promoting defecation in designated sites
— promoting the burial of faeces or the clearing of faeces out of homes and compounds.

Behaviour change. Interventions encouraging faeces disposal have had mixed results. In Burkina Faso, hygiene education had little impact on the use of latrines, potties or on stool disposal post intervention (Curtis et al., 2001). In contrast, a project in Bangladesh found higher latrine use in the group that received hygiene education (94% compared to 57% for children over five) and less faeces in the yard (82% compared to 99%) (Bateman et al., 1995).

Interventions encouraging the use of latrines have had mixed results

Mortality and morbidity. Few faeces disposal interventions with mortality or morbidity were located. A hygiene education intervention in rural Bangladesh found that children in the intervention area were experiencing 25% fewer episodes of diarrhoea than those in the control area (Aziz et al., 1990).

Moderating factors
Type of sanitation facility. Type of latrine was associated with the impact of sanitation facilities on diarrhoea mortality in some observational studies. From the review by Esrey et al. (1991), reductions appear to be greatest for flush toilets. Subsequent studies have had mixed results. In Bangladesh, a family hanging latrine (faeces fall directly onto land or water from a platform) was associated with an increased risk of diarrhoea compared to no latrine (odds Ratio 1.4), while a pit latrine or latrine with a septic tank had no effect (Ahmed et al., 1994). Other studies found no difference in diarrhoea mortality by latrine type (Hoque et al., 1999; Tumwine et al., 2002). A separate case-control study in Bangladesh found higher mortality in houses where the latrine was dirty (odds ratio 1.9) (Hoque et al., 1999).

Type of latrine affects the impact on diarrhoea

Density and coverage. Improving faeces disposal is likely to have the greatest effect in high-density areas and where disposal is adopted by the whole community rather than single households (VanDerslice & Briscoe, 1995).

5.3 The feasibility of large-scale programmes
Little is known about the feasibility of improving and sustaining adequate faeces disposal through education or in the absence of latrines. More is known about the feasibility of improving access to sanitation facilities. Box 9 outlines the lessons learned from sanitation programmes in developing countries.

Evidence is needed on the impact and sustainability of faeces disposal education

Latrines can be costly and difficult to maintain and keep clean, and in some settings they are unfeasible – pit latrines cannot be built where housing density is extremely high or terrain unsuitable. In an urban township in Malawi, for example, rocky terrain with inadequate soil consolidation, and environmental conditions, such as heavy rains and floods, caused problems for the use of pit latrines (Grimason et al., 2000).

Latrine interventions must fit the local setting and needs and include education

Latrines alone will not remove faeces. In Lima, half of the houses had pit latrines but only 4% of children aged 2–3 years used them (Huttly et al., 1994), and in Sri Lanka, 46% of houses had latrines and only 10% of children under five used them (Mertens et al., 1992). In Malawi, most pit latrines were fouled with faecal matter, their structure (cardboard, paper, cloth, brick) made the hygienic upkeep of the latrine difficult and the cloth doors were often used for hand drying; more than half of the respondents had not received any information regarding health education (Grimason et al., 2000).

5.4 Conclusions

■ Handwashing interventions reduced diarrhoeal incidence by a median of 33% (range 11–89%). The impact was higher in studies that targeted handwashing alone rather than as part of a package of behaviours.

■ All types of handwashing are not equally effective. Using large quantities of water, vigorous rubbing, using cleansing agents such as soap, ash or clean mud, and drying with a clean cloth or in the air appear to be the most effective ways of removing pathogens.

■ Large-scale handwashing promotion programmes have been effective in initiating behaviour change. However, concerns still exist about feasibility because of the complexity of the behaviour and the resources required to carry it out.

■ Few faeces disposal interventions were located. However, six rigorous observational studies demonstrated a median reduction of 55% (range 20–82%) in all-cause child mortality associated with improved access to sanitation facilities. Little is known about the impact of disposing of faeces in the absence of latrines.

■ Improving faeces disposal is likely to have the greatest effect in high density areas.

■ Latrines can be costly and difficult to maintain and keep clean, and in some settings they are unfeasible – for example, where housing density is extremely high or terrain unsuitable.

5.5 Questions to be answered

■ Effectiveness of large-scale programmes that involve community development approaches in improving handwashing behaviours.

■ New approaches to interventions that improve faeces disposal behaviour in families and communities.

■ More information about the most effective methods of hygiene education.

6. TREATED BEDNETS

■ **Key practice.** Protect children in malaria-endemic areas, by ensuring that they sleep under insecticide-treated bednets.

Malaria is a significant health and development problem causing almost one million deaths a year among children under five years of age (WHO, 2002), about 90% of them African children. This corresponds to 9% of all childhood mortality and 20% of deaths in Africa (WHO, 2002; WHO, 1994). Deteriorating health services, climate change, population movement and the spread of drug resistance has lead to an increase in the number of malaria deaths per thousand population in sub-Saharan Africa and a spread to areas previously free from the disease (Malaria Consortium, 1999).

Insecticide treated bednets (ITNs) prevent malaria because they kill any mosquitoes that land on them and create a barrier between people and mosquitoes during the night. To correctly use an ITN, families must adopt a number of behaviours. They must:

— acquire the ITN
— erect it correctly (ensure the borders are secure and that it hangs and protects but does not touch the skin)
— use it regularly (at peak biting times and throughout the year)
— re-treat the net at six-monthly intervals or whenever it is washed (Favin, Yacoob & Bendahmane, 1999).

6.1 The prevalence of ITN use

Current use of bednets in sub-Saharan Africa is limited, with several countries reporting household ownership of less than 10% (see Figure 6), but there are pockets of high coverage. Generally, use appears to be more common in towns (Lines, 1996) – in the United Republic of Tanzania, up to 70% of urban households use ITNs (Malaria Consortium, 1999). There is little data on how well nets are used once acquired. A study in Iquitos, Peru found that 59% of nets had inadequately secured borders, and families washed their nets every 2–4 weeks with little re-treatment (Kelley & Black, 2001).

6.2 The benefits of ITN use[1]

A meta-analysis of four African randomized controlled trials (see Table B.6.1) showed that ITNs are associated with a 17% reduction in child mortality compared to control populations with no or untreated nets (Lengeler, 2001). One of the trials (D'Alessandro et al., 1995) investigated the impact of treated versus untreated nets on childhood mortality, reporting a reduction in child mortality of 23% (95% confidence interval 1–41%). This suggests that the majority of the benefits of ITNs on childhood mortality may be due to the insecticide treatment rather than the physical presence of the net. Two of the trials, in the Gambia (D'Alessandro et al., 1995) and Ghana (Binka et al., 1996), showed equivalent reductions in non-malaria and malaria deaths, but these results could be attributed to problems identifying malaria deaths with verbal autopsies (Snow et al., 1992). Whether ITNs only protect those who sleep under them or whether they protect others in the community by reducing the number of mosquitoes is still unclear, with studies on vector ecology providing conflicting evidence (Magesa et al., 1991; Lindsay et al., 1993; Magbity et al., 1997; Bogh et al., 1998; Quinones et al., 1998; Mathenge et al., 2001).

An association between ITN use and reduced morbidity has also been documented. In Kenya, a 45% (95% confidence interval 20–63%) reduction in the frequency of severe malaria episodes was observed following the introduction of ITNs (Nevill et al., 1996). In the meta-analysis, Lengeler (2001) found that in areas with stable malaria ITNs reduced inci-

> **Malaria accounts for 8% of all childhood mortality and is a growing problem**

> **Correct use of bednets involves adopting many behaviours**

> **Several countries in sub-Saharan Africa report household ownership of bednets of less than 10%**

> **Bednets are associated with a 17% reduction in child mortality**

> **The majority of the benefits of ITNs appears to be due to the insecticide treatment rather than the physical presence of the net**

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[1] In the intervening time between the completion of this review and its publication, additional information on the efficacy, impact and factors surrounding the use of insecticide-treated bednets has been published in a supplement to the *American Journal of Tropical Medicine and Hygiene*, 2003 (68) No.4, The Western Kenya insecticide-treated bednet trial.

FIGURE 6
Percentage of children who slept under blankets

Source: UNICEF, 2001

dence of mild malaria by 48% (95% confidence interval 41–54%) compared to no nets, and treated nets reduced incidence of mild malaria by 39% (95% confidence interval 27–48%) compared to untreated nets. As with mortality, this suggests that the majority of the benefits of ITNs may be due to the insecticide treatment rather than the physical presence of the net.

Three studies (D'Alessandro et al., 1995; Nevill et al., 1996; Shiff et al., 1996a) reported small improvements in anthropometric status. Improvements in anaemia rates and microscopically determined *Plasmodium falciparum* prevalence have also been reported (Fraser-Hurt et al., 1999; Premji et al., 1995).

6.3 The impact of interventions to increase the use of ITNs

Interventions to increase the use of ITNs, include:

— social marketing
— health education.

Behaviour change. Experiences from social marketing programmes have been encouraging. In the United Republic of Tanzania, a social marketing campaign that started in 1997 had increased ownership of ITNs from 10% to 61% by 2000, and coverage for infants increased from 10% to 50% (Schellenberg et al., 2001; Abdulla et al., 2001). In Zambia, where there was no use of treated nets before the programme, coverage increased to 33% (with 80% re-treating their nets at least once) after a programme of selling subsidized nets through community agents. Use of nets was prioritized for pregnant women and the under fives (Malaria Consortium, 1999).

FAMILY AND COMMUNITY PRACTICES THAT PROMOTE CHILD SURVIVAL, GROWTH AND DEVELOPMENT

Mortality and morbidity. In the Tanzanian social marketing programme child survival increased by 16% three years after an ITN programme was introduced; malaria incidence and rates of anaemia also decreased (by 25% and 23% respectively); and small impacts on child growth were found (Schellenberg et al., 2001; Abdulla et al., 2001). In the Gambia, the national ITN programme reduced mortality by 25% with the effect varying from 0–40% depending on usage of nets (D'Alessandro et al., 1995).

Moderating factors

Vector ecology. The impact of ITN interventions will be small if the intense biting times do not correspond to ITN use. ITNs are not likely to be effective if vectors bite early in the evening or if people go to sleep later (such as in urban areas) (Favin, Yacoob & Bendahmane, 1999). In Iquitos, Peru, a recent study found that although 98% of families used ITNs, exposure to mosquitoes was still high as the peak biting time of the vector, Anopheles darlingi, was between 6.00 and 7.00p.m. when people were still performing evening activities outside the home (Kelley & Black, 2001).

Seasonality. To date, studies in Africa have been conducted in areas with moderate or exclusively seasonal malaria. In these settings, the impact of ITNs by season does not appear consistent, although the confidence intervals around the points of estimate overlap. In Ghana, the mortality effect was greatest in the wet season, when rates of transmission and ITN usage were higher – rate ratio =0.79 (CI 0.63–1.00) compared to 0.92 (CI 0.58–1.08) (Binka et al., 1996); and in Burkina Faso, the effects of insecticide-treated curtains were greatest in the dry season when rates of transmission were low – rate ratio 0.82 (CI 0.66–1.01) compared to 0.94 (CI 0.68–1.29) (Habluetzel et al., 1997). Some controversy persists over whether ITNs will have similar mortality impacts in areas with perennial rather than seasonal malaria. A study under way in Kenya should address this issue (Kachur et al., 1999).

Reduced/delaying acquisition of immunity. The long-term effect of ITN use on mortality in high transmission areas is contentious. Lack of exposure to the malaria parasite at an early age may reduce long-term immunity, thus postponing severe malaria until children are older when they experience worse symptoms. Data from five sites show the highest rates of hospital admissions and cases of cerebral malaria in areas with moderate transmission rates, supporting the argument that too little exposure may be problematic (Snow et al., 1997). Differences in parasite strains, or in the seasonality of transmission, have also been suggested as reasons for the observed differences (Brown, 1997). The study in Burkina Faso found that the mortality reduction associated with ITN use was confined to the first year post-intervention (26% reduction in the first year, and no reduction in the second year). This could be due to chance, or to a reduction in the use of the ITNs, rather than waning immunity (Habluetzel et al., 1997). Lengeler (2001) reports that the general consensus among researchers is that problems of delayed immunity would be confined to high-transmission areas; that any form of transmission control may cause such a shift; and that direct evidence for an effect does not exist. A study with long-term follow-up is being carried out in Burkina Faso and should help clarify this issue.

6.4 The feasibility of large-scale programmes

UNICEF and WHO have set a goal of providing 32 million nets and 320 million re-treatments a year for the next 10 years to protect 80% of African households against malaria (Malaria Consortium, 1999). Achieving this relies on households providing most of the purchasing funds and on utilizing the public and private sectors and commercial markets (Shiff et al., 1996b).

Supply and demand barriers (see Box 10) associated with ITNs affect the feasibility of large-scale programmes.

In some settings vectors mostly bite in the early evening, reducing the impact of ITNs

Controversy exists as to whether ITNs will have a similar mortality impact in areas with perennial rather than seasonal malaria

Using bednets may reduce long-term immunity. A study in Burkina Faso is exploring this, which should help clarify the issue

32 million nets a year need to be produced for Africa. Private sector and the commercial market must be involved

Affordability has been identified as the most important factor in both purchase and re-treatment of ITNs (Lines, 1996), and even at subsidized prices the poorest may still be excluded. Innovative strategies are needed to ensure equity without undermining the development of a sustainable commercial market (Malaria Consortium, 1999).

Households appear to be willing to pay more for nets than re-treatment. In the Gambia, re-treatment decreased from 77% to 14% when insecticide stopped being free of cost (Muller et al., 1997) and a reduction in re-treatment has been seen in other countries after the introduction of charges (Rowland et al., 1997; Kroeger et al., 1997). A lack of knowledge about the importance of re-treatment, the lack of an obvious function, concerns about safety, the inconvenience and a lack of availability (especially in rural areas) have been identified as barriers to re-treatment (Shiff et al., 1996b; Kelley & Black, 2001).

Cost is important for both purchase and re-treatment. Perceptions and knowledge of their benefits affect willingness to pay

Little is known about the most effective ways of increasing demand, awareness and appropriate use, and re-treatment. In Nigeria, Senegal, Uganda and Zambia, demand is affected by the fact that ITNs are seen as luxury items and by misperceptions about malaria transmission (Kelley & Black, 2001). Other studies found that ITNs are seen more as a mosquito-control, rather than a malaria-control measure (Aikins, Pickering & Greenwood, 1994; Stephens et al., 1995).

Supply of ITNs can also be problematic. In Zimbabwe, programmes encountered a range of constraints. Sales tax on the ITNs was not removed and the programme encountered unfavourable markets, inadequate distribution channels, low motivation among retailers because of perceptions about limited profitability, and a lack of government commitment (Malaria Consortium, 1999).

Other factors identified that prevent correct use of ITNs include:

— sleeping patterns
— use by adults over children
— frequent washing
— a decrease in use during low transmission seasons.

Sleeping patterns, use by adults over children, frequent washing and a decrease in use during low transmission seasons could reduce the impact of ITNs

In Kenya, three years after an ITN intervention, children under 10 years of age were 33% less likely to sleep under the ITNs than adults (Kachur et al., 1999). In northern Ghana, use in the dry season was 20% compared to 99% in the wet season and washing was frequent due to children soiling the ITNs (Binka & Adongo, 1997). Overcoming these barriers requires appropriate education, promotion, marketing and net design. In Ghana, sleeping patterns were accommodated by providing ITNs large enough for whole families, and dark ITNs were proposed to reduce the need for washing (Binka & Adongo, 1997).

ITN interventions face operational and technical challenges. Careful insecticide selection and the development of new insecticides are needed to counter insecticide resistance, which has been reported in several settings (Curtis et al., 1998). Health and environmental impacts of the insecticides also need to be monitored. An insecticide registration system and clear instructions on the safe handling, storage, application and disposal of the insecticide will aid appropriate use. Technology could be improved to facilitate use by developing permanently treated nets or insecticide that changes colour as it runs out.

Insecticide resistance may become a problem

6.5 Conclusions

■ A meta-analysis of four African randomized controlled trials showed that ITNs are associated with a 17% reduction in child mortality compared to control populations with no or untreated nets. The majority of the benefits may be due to the insecticide treatment rather than the physical presence of the net.

■ The long-term effect of ITN use on mortality in high-transmission areas is unclear. Lack of exposure to the malaria parasite at an early age may reduce long-term immunity.

■ Social marketing can increase ITN use by as much as 50% and child survival by as much as 25%. The transition from efficacy to effectiveness cannot be taken for granted, as access to viable delivery systems and cost of ITNs remain major constraints for many developing countries and re-treatment rates are often low.

■ Demand is likely to be highest where use is already common, where families have some disposable income and where local preferences and practices are taken into account in design and distribution strategies.

■ Vector ecology, seasonality and population coverage should be considered when implementing ITN programmes.

■ Health, environmental impact and resistance of insecticides need monitoring.

6.6 Questions to be answered

■ Whether ITNs only protect those who sleep under them, or whether they protect others in the community.

■ The impact of ITN programmes in areas with perennial malaria.

■ Development of permanently treated ITNs and new insecticides to counter resistance.

■ Strategies to provide and distribute an adequate and sustainable supply of ITNs produced in developing countries, to ensure equity without undermining the commercial market.

7. FOOD AND FLUIDS

■ **Key practice.** Continue to feed and offer more fluids, including breast milk, to children when they are sick

Children require increased food and fluids during illness to prevent malnutrition and dehydration

Children require food and fluids during illness to prevent malnutrition and dehydration. This is because energy requirements are increased during illness (a rise in body temperature of 1 °C increases energy requirements by 10–15%) but energy and nutrient intakes are often decreased through:

— anorexia
— caregivers withholding food and breast milk
— loss of nutrients through vomiting
— mucosal injury, increased gastrointestinal transit times and impaired absorption during diarrhoeal episodes.
(Martorell et al., 1980; Laney & Cohen, 1993; Piwoz, 1994; Kukuruzovic et al., 1999).

Children take in 5–19% less energy when they are sick

Studies in Guatemala, Nigeria and Peru, have found a total reduction in energy intake of 5–19% in sick children (Martorell et al., 1980; Dickin et al., 1990; Brown et al., 1990; Brown et al., 1995), with anorexia reported to affect children on 31–75% of days they are sick and increasing with severity of illness (Brown et al., 1995). Anorexia to non-human milk and solids appears to be more severe than to breast milk; in fact, unlike for other foods, the frequency, duration and energy intake from breastfeeding does not decrease during illness unless it is withheld (Hoyle, Yunus & Chen, 1980; Brown et al., 1990; Dickin et al., 1990). For example, in Peru 72% of children with diarrhoea refused non-human milk, 27% refused food but only 6% refused breast milk (cited in Huffman & Combest, 1990). This highlights the critical role of breastfeeding during illness. 'Active feeding', which can be defined as the frequent encouragement of a child to eat or drink, can increase the food intake of anorexic sick children, but requires time and patience. It includes offering frequent feeds and using finger feeding, a cup, bottle or spoon to encourage frequent feeds.

Unlike for other foods, frequency, duration and energy intake from breastfeeding does not decrease during illness unless it is withheld

Anorexic children must be actively fed to ensure adequate energy intake

7.1 The prevalence of continuing to feed and giving fluids during illness

Not withholding food and active feeding are important during illness. Figure 7 shows the rates of continued feeding and giving fluids in developing countries during diarrhoeal episodes by region.

FIGURE 7
Rates of continuing to feed and offering more fluids to children with diarrhoea
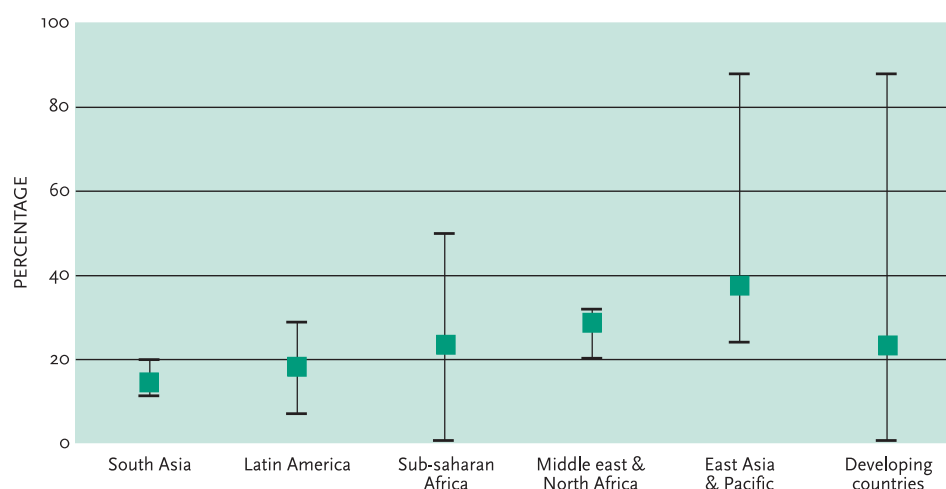
Source: UNICEF, 2001

As can be seen in Figure 7, levels of inappropriate feeding and giving fluids are variable. In Bangladesh, India, Mexico, Nigeria, and Sudan, 16–65% of mothers reduced breast-feeding, 32–45% reduced food, and 48–60% reduced fluids when children were sick (Jinadu, Odebiyi & Fayewonyom, 1996; Edet, 1996; Bhuiya & Streatfield, 1995; Black, Brown & Becker, 1984; Piechulek et al., 1999; Mota-Hernandez et al., 1993; Ahmed et al., 1994).

Piwoz (1994) reviewed studies of feeding practices in several African countries; feeding was predominantly passive, and young children were observed deciding when, what and how much they ate and drank (CARE et al., 1989; Samba & Gittelsohn, 1991; Ministry of Health of Ghana, 1989; Keith, 1991; Toure, 1991; Dettwyler, 1989). There is evidence that in some settings active feeding increases during illness. In Peru, for example, mothers made more of an effort to feed on days with diarrhoea than days without (odds ratio 2.0) (Bentley et al., 1991). In Mali, 80% of mothers reported they would encourage a child they felt was sick to feed, but only 45% would encourage a healthy child (Toure, 1991).

7.2   The benefits of continuing to feed and give fluids during illness

Studies exploring the benefits of feeding and giving fluids during illness have focused on diarrhoea, and have found that feeding nutritionally complete diets to children increases net energy and nutrient absorption, without affecting stool output or affecting the efficacy of oral rehydration salts (ORS) (Alam et al., 1992). A study in Peru reported that children fed a nutritionally complete diet were 140 g heavier two weeks after hospital admission for diarrhoea than those fed a less complete diet (Brown et al., 1988). Research has also found that there is no need to dilute milk feeds or give lactose-free formula during most cases of diarrhoea. Results from meta-analyses show that undiluted animal milk is a safe component of the diet, unless the diarrhoea is severe or the child is dehydrated (Brown, Peerson & Fontaine, 1994).

Torun & Chew (1991) reviewed 11 studies using staples in the dietary management of acute diarrhoea (see Table B.7.1), and found that feeding locally available foods was associated with reduced duration or no difference in duration of diarrhoea (Garcia & Harum, 1975; Ibanez et al., 1979; Ibanez et al., 1986; Molla et al., 1983a; Molla et al., 1983b; Brown et al., 1982; Brown et al., 1988; Alarcon et al., 1991; Torun & Fuentes, 1990; Dardano, Chew & Gamero, 1990). In Guatemala, children with diarrhoea fed a diet including local staples had episodes an average of 3–5 days shorter than those fed on full-strength liquid formula and a non-staple based porridge (Torun & Chew, 1991). Two studies in Peru found similar results – in one, children with diarrhoea fed local foods had a median of seven days less diarrhoea than those fed a soy milk formula (Alarcon et al., 1991); in the other, children fed a diet including local cereals had episodes on average one day shorter than those who did not receive local cereals (Lanata et al., 1992).

A randomized control trial in Myanmar, exploring the impact of breastfeeding during diarrhoeal episodes, found that infants who were breastfed during the diarrhoeal episode needed 550 ml less ORS, had five fewer motions and produced 250 ml less stools than non-breastfed children (Khin-Maung et al., 1985). Case control studies (in Bangladesh, Brazil, Bangladesh and Egypt) found that breastfed infants were 2–3 times less likely to suffer from diarrhoea-related dehydration (BR Kirkwood, SS & Morris unpublished data, 1992). For information about Oral Rehydration Therapy see Chapter 8, Home treatment.

7.3   The impact of interventions to continue feeding and giving fluids during illness

Interventions to continue feeding of infants when they are sick include:

— group and individual counselling of mothers.

Several simple community-based interventions have effectively improved feeding of healthy infants (see Chapter 3, Complementary feeding). The lessons learned from these interventions are relevant for interventions to increase feeding and giving fluids during illness, and should be referred to.

The prevalence of withholding food, breast milk or fluids ranges from 16–65%

Active feeding is uncommon in healthy children but evidence suggests it is acceptable and practised during illness

Feeding nutritionally complete diets to children with diarrhoea increases net energy and nutrient absorption without affecting stool output

Children with diarrhoea can safely be fed nutritionally complete diets containing local staples

Breastfeeding protects children from dehydration and reduces the need for ORS

Behaviour change. In Cameroon, group and individual counselling increased knowledge of the need to continue feeding during diarrhoea from 86% to 93% (CARE et al., 1989); and in the Gambia, continuing to feed solid food during diarrhoea increased from 14% to 55% shortly after a health education campaign (Rasmuson, Seidel & Gabbidon, 1990). Mothers were eager to try new feeding practices for children with diarrhoea or malnutrition, and to continue these if their children ate well or liked them (Samba, 1993). In Senegal, 87% of mothers who were asked to feed their sick children a mixture of milk, oil and sugar tried the preparation, and 62% of those felt they would continue the practice (Diene, 1993).

Mortality and morbidity. No studies were located exploring the impact of interventions to increase giving foods and fluids to sick children on mortality or morbidity.

Moderating factors

Health worker communication skills. Health workers are an important channel for educating caregivers about feeding during illness. In Uganda, 80% of health workers believed that solid foods should not be given to children with diarrhoea (Konde-Lule, Elasu & Musonge, 1992), and studies have found that advice is usually vague and non-specific (Coulibaly, 1989; Sene, 1993; Gamatie, 1992; Roisin, Zerbo & Corbin, 1990).

7.4 The feasibility of large-scale programmes

Counselling mothers to continue to feed and offer more fluids to sick children is an important part of IMCI. However, there have been no large-scale evaluations of this IMCI strategy to date. Programmes aiming to improve feeding of healthy children, have illustrated the importance of:

— involving many channels
— frequent contacts and continuous promotion
— using peer groups
— focusing on behavioural aspects of feeding as well as on what to feed.

Box 11 lists the conclusions Piwoz (1994) drew about how to successfully design interventions to improve child feeding during illness, from her review of small-scale studies.

> **BOX 11**
>
> **Interventions are more likely to be successful if they:**
> ■ stress the benefits to the mother and child of adopting the feeding practice
> ■ provide mothers with methods for overcoming their children's resistance to new practices
> ■ build on existing practices
> ■ are individualized and include decision-making and negotiation elements
> ■ do not have major time and resource constraints
> ■ are based on formative research exploring beliefs and practices
>
> Source: Piwoz, 1994.

Effective programmes must also take into account resource and time constraints, local knowledge, beliefs and practices that may motivate or make caregivers resistant to behaviour change. Ethnographic studies have reported varied and complicated food regimens tied to local illness classification systems. It is essential to understand these practices in order to design effective interventions. Practices include adding, eliminating, increasing or withholding foods, fluids or breast milk (Saini et al., 1992; Jinadu, Odebiyi & Fayewonyom, 1996; Edet, 1996; Almroth, Mohale & Latham, 1997; Piechulek et al., 1999; Bhatia et al., 1999; Guerrero et al., 1999; Konde-Lule, Elasu & Musonge, 1992; Odebiyi, 1989; Sserunjogi & Tomkins, 1990; Ashworth & Draper, 1992).

7.5 Conclusions

■ Randomized control trials have found that feeding nutritionally complete diets to children with diarrhoea increases net energy and nutrient absorption without affecting stool output or the efficacy of ORS. Feeding locally available foods does not increase duration of diarrhoea.

■ Anorexia to non-human milk and solids appears more severe than to breast milk during illness, highlighting the critical role of breastfeeding during illness.

■ No studies were located exploring the impact of interventions to improve feeding and giving fluids during illness on mortality or morbidity. There is evidence that counselling interventions can improve behaviour but there is little evidence about how best to scale up the interventions.

■ Lessons can be learned from programmes aiming to improve the feeding of healthy children, which have shown the importance of involving many channels, behavioural aspects of feeding and peer counsellors.

7.6 Questions to be answered

■ Effectiveness of IMCI-related activities that promote continuing to feed and give fluids and breast milk to sick children.

■ Effectiveness of counselling and health promotion interventions.

8. HOME TREATMENT

■ **Key practice.** Give sick children appropriate home treatment for infections.

<div style="margin-left:auto">Uncomplicated malaria, diarrhoea and mild local infections can be managed at home</div>

Not all infections need to be treated by health professionals. Uncomplicated diarrhoea can be successfully managed at home by continuing to feed and administering oral rehydration therapy (ORT) correctly. In malarious areas, all fevers should be treated at home with antimalarial medications; paracetamol should be given, and the body sponged with tepid water if paracetamol is unavailable (WHO, 1993; TDR, 2000). Local measles infections (conjunctivitis and mouth ulcers) can also be treated at home. Treating illness at home is a common practice; a review of 24 studies exploring treatments for malaria (McCombie, 1994) reported that levels of self-treatment ranged from 1–84%, with 44% of the studies reporting home treatment for more than 50% of episodes. Home treatment is common and it is important to ensure that the behaviours are also appropriate.

Appropriate home treatment involves:

<div style="margin-left:auto">Appropriate home treatment involves recognition, prompt and correct use of treatments and the avoidance of ineffective or harmful treatments</div>

— early recognition of the illness
— prompt and correct procurement and use of relevant treatments
— the avoidance of ineffective or harmful treatments
— the continuation of feeding (see Chapter 7)
— taking the child to a health facility if (s)he does not improve.

Interventions to improve home treatment should result in a reduction in severe illness episodes, health service and caregiver burden and pharmaceutical misuse. Many of the issues involved in the home treatment process are covered in other chapters (Chapter 7, Foods and fluids; Chapter 9, Care-seeking; and Chapter 10, Adherence).

Moderating factors

Drugsellers. Appropriate home treatment relies on caregivers knowing the correct treatment and dosage. Caregivers can be targeted directly, but drugsellers can also play an important role in ensuring appropriate treatment through giving clear instructions when selling treatments. Drugseller training is often minimal and studies have shown poor knowledge of correct treatments and correct dosing (Haak, 1988; Dua, Kunin & White, 1994; Goel et al., 1996). In Zambia, 81% of drug vendors could not report the correct dose of chloroquine for children (Makubalo, 1991). Another potential barrier to using drugsellers to improve home treatment is that they are economically driven and respond to client demands, which may be inappropriate (Homedes & Ugalde, 2001). In Kenya, drugsellers' knowledge of correct treatment was high but this was not reflected in selling patterns; 62% of drugsellers knew correct doses of antimalarials, but only 3% reported that their clients bought the correct dose. The drugsellers did not feel it was in their interest to give advice if not asked, or to question the customer about why they bought incorrect doses (Mwenesi, 1993).

<div style="margin-left:auto">Drugsellers often have poor knowledge of correct treatments and doses and are economically driven, responding to client demand</div>

An intervention in Kenya to train shopkeepers, reported that before the intervention, information or instructions were rarely given to clients. Instruction-giving improved after the intervention and the percentage of childhood fevers where an adequate dose of chloroquine was consumed, rose from 3.7% before training to 65% afterwards (Marsh et al., 1999). Shopkeeper interventions are under way in Ghana, Nigeria and Uganda (TDR, 2000). The Kenyan intervention shows that sustainable improvements in shopkeepers' 'prescribing' practices can be achieved if their advisory role does not diminish income. An important requirement from the community was that shopkeepers should be trained by a trusted agent (Marsh et al., 1999). Programmes involving shopkeepers or druggists must have realistic aims; shopkeepers are unlikely to change practices if it makes them unpopular with the population or decreases their income.

<div style="margin-left:auto">Training shopkeepers increased the number of fevers correctly treated with chloroquine by 60%</div>

<div style="margin-left:auto">Sustainable improvements in shopkeepers 'prescribing' can be achieved if practices don't diminish income</div>

Adherence. Once caregivers have purchased the correct drugs in the correct dose, the full course should be given. Adherence is important for successful treatment and to reduce

the spread of resistant strains (see Chapter 10, Adherence). Interventions to improve adherence to antimalarials are described in Table B.10.2.

Drug policy. In most developing countries there continues to be widespread use of drugs that are not essential to recovery from illness, are not acceptably safe and are not affordable. While drugsellers and caregivers have an important role to play, new drugs are frequently introduced into the market and into programmes with insufficient information and without consideration for their proper/maximal use at the community and home level (Homedes & Ugalde, 2001). A study evaluating clinical information given by United States' pharmaceutical companies in four developing countries, found that information about the drugs supplied was insufficient, lacking in detail, and varied from the clinical standard for 68% of the 241 drugs evaluated (Goel et al., 1996). Clinical information and dosing advice provided with medications have been shown to improve use at the community level, so drug policies that ensure that dosing information is universally available have the potential to improve home treatment. (Homedes & Ugalde, 2001).

8.1 Home treatment of uncomplicated diarrhoea

Recommendations for oral rehydration therapy (ORT) have changed over time (see Box 12). When interpreting trends in ORT use over time the successive changes in the recommended fluids must be taken into consideration.

BOX 12

Changes in ORT recommendations

■ In the early 1980s, it was recommended that all diarrhoea episodes should be treated with a solution of **oral rehydration salts** (ORS) a specific formulation of sodium, chloride, potassium, glucose and citrate/bicarbonate salts designed to maximize the absorption of water across the gastrointestinal tract wall.

■ Later in the 1980s, **ORS** was still recommended but it was recognized that access was limited and that not all cases of diarrhoea were accompanied by dehydration. The emphasis shifted to preventing dehydration through **recommended home fluids** (fluids made up at home that contain specific quantities of salt and sugar or carbohydrates).

■ From 1993, the emphasis was on preventing dehydration through **increased fluids plus continued feeding** which is expected to supply salt, carbohydrates and water.

Source: Victora et al., 2000

Problems identified in the preparation and use of ORS/RHT at home include:

— measuring the correct amount of water
— adjusting the amount of ORS/RHT for the child's age
— having time to encourage the child to drink the fluids (especially if the child is vomiting).
  (Touchette et al., 1994; Guiscafre et al., 1988; Bronfman et al., 1991; Homedes & Ugalde, 2001).

Incorrect reconstitution of ORS/RHT (e.g. with insufficient water or with other fluids such as milk or cordial) can result in a dangerous solution if the concentration of the ORS or the osmolarity of the prepared fluid is too high.

8.1.1 *The prevalence of ORT use*

Although changes in definition make ORT use difficult to measure, it is estimated that in 2000, 69% of diarrhoea cases were treated with ORT (ORS and/or recommended home fluids) (UNICEF, 2001a), and data show positive trends in most parts of the world (see Figure 8).

FIGURE 8
Trends in the use of ORT for diarrhoea, 1990–2000
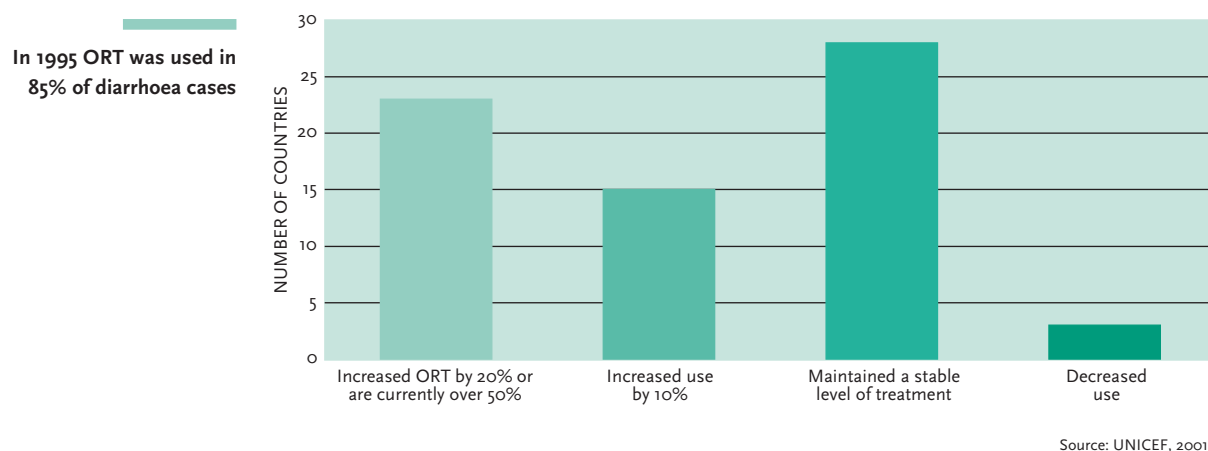
Source: UNICEF, 2001a

8.1.2 The benefits of ORT

ORT can prevent death from watery diarrhoea in all but the most severe cases (WHO, 1997a). Many studies have demonstrated strong associations between using glucose and cereal-based ORS solutions, and reducing mortality and hospital admissions for treatment of dehydration (Santosham et al., 1982; Pizzaro, Porada & Mata, 1983; Ryder, Reeves & Sack, 1985; Bhan et al., 1986; Gore, Fontaine & Pierce, 1992). The benefits of using other home-based fluids for ORT have also been demonstrated (Kassaye, Larson & Carlson, 1994; Grange, 1994).

There has been much research on the formulation of ORS to improve stability, enhance absorption and reduce osmolarity (WHO, 1999) and a new low sodium, low glucose ORS formulation was released in 2002 (WHO, 2002a). The new formula is supported by the finding of trials exploring the impact of reduced osmolarity ORS, a meta-analysis (eight trials) found an odds ratio of 0.59 (CI 0.45–0.79) for unscheduled intravenous infusion for the low osmolarity formula compared to the standard WHO formula, and a mean difference in a log scale of −0.23 (CI −0.33– −0.14) for stool output (11 trials) (Hahn, Kim & Garner, 2002).

8.1.3 The impact of interventions to increase the use of ORT

Interventions to improve the home management of uncomplicated diarrhoea by families and communities include:

— individual counselling of mothers
— mass media campaigns
— social marketing.

Behaviour change. Despite problems of measurement due to the changing definitions of ORT, it is generally accepted that the national control of diarrhoeal disease programmes (CDD) that were operational in 80 countries by 1990, substantially increased the use of ORT (Victora et al., 2000). These programmes involved increasing the production and supply of ORS, training health workers to counsel mothers about ORS and ORT, and mass communication strategies (WHO, 1999). The total number of diarrhoea cases treated with ORS or RHT increased by as much as 20% between 1990 and 2000 (see Figure 8), and ORS supply increased from 51 million packets in 1979–1980 to 800 million in 1991–1992 (Victora et al., 2000).

Interventions to improve the use of ORT have focused on strategies to improve reconstitution and correct administration of ORS through health education, but evaluations have not been scientifically rigorous (i.e. used pre-post or post-only evaluation designs with no comparison group). In Lesotho and Mexico, quantity and timeliness of ORS use increased

when health education was given in health facilities (Touchette et al., 1994; Bronfman et al., 1991). In Bangladesh, no differences were found in use, knowledge or composition of ORS between women taught individually or in groups (Chowdhury, Karim & Ahmed, 1988). In Mexico, women who received education answered correctly 35% more questions about ORT than controls, and those taught by nurses had better knowledge than those educated through pamphlets but the difference was not significant (Guiscafre et al., 1988). In Kenya, the effectiveness of written instructions increased when they were tailored to the local culture and language (only 40% of mothers given the standard text recalled the instructions, compared to 95% of those given the revised instructions) (Eisemon, Patel & Sena, 1987). Similar results have been found for verbal instructions (Kumar, Kumar & Raina, 1989; Jinadu et al., 1988).

Mortality and morbidity. It is difficult to determine the magnitude of the effect of ORT because of data limitations (Pierce, 2001). Victora et al. (2000) recently reviewed the impact of large-scale ORT programmes on diarrhoeal mortality in Brazil, the Philippines, Egypt, and Mexico and the Philippines (see Table B.8.1) and concluded that promotional activities and the increased use of ORT are likely to have played a large role in the global reduction of diarrhoea deaths from 4.6 to 1.5 million between 1980 and 1999. In Brazil, ORT has been estimated to have contributed to 79% of the decrease in diarrhoeal deaths (Victora et al., 2000).

Community-based randomized controlled trials involving health education and provision of ORS have demonstrated significant impacts of using ORS on childhood mortality, the number of cases presenting at health centres and hospital admissions (Rahman et al., 1979; Kielmann et al., 1985). In Bangladesh, Rahman demonstrated reductions of diarrhoeal deaths from 2.9 to 0.6 per 1000, and reductions in case fatality rates from 2.4% to 0.5% (Rahman et al., 1979).

8.1.4 The feasibility of large-scale programmes

A large number of countries have tried different community-based programmes including supplying ORS, training mothers in ORS preparation and community oral rehydration units (CORU). A study of CORU in Colombia reported in a WHO review of CDD achievements (WHO, 1999) found that, while volunteers had good knowledge of ORT procedures and knew when to refer, the service was utilized for only 2% of diarrhoea cases. 70% of mothers said they did not know the service existed. Of those who used it, however, 89% said they would use the service again, suggesting that CORUs can provide a useful service if actively promoted. Along with promoting programmes, it is also important that programmes are appropriate to the setting, for example cereal-based RHT fluids should only be promoted in areas where they are traditionally used (WHO, 1999).

Without continued commitment and resources, progress already achieved may come to a halt or even be reversed. The challenge now is to extend coverage to hard-to-reach groups and settings where coverage continues to be poor. In Swaziland, for example, social marketing increased the proportion of women who used the correct ORS formula from 16% to 32%, but despite the increase, overall levels of correct use were still low (Smith & Mills Booth, 1985).

8.2 Home treatment of fever in malarious areas

Malaria is a major cause of morbidity in the tropics, and causes between 700 000 and 2.7 million deaths a year (Breman, 2001). Fever is the most common symptom of malaria. Malaria is also associated with malaise, vomiting and febrile convulsions.

8.2.1 The prevalence of home treatment for malaria

Few studies have quantified the appropriate use of antimalarials, paracetamol or tepid sponging for fever in communities. In the United Republic of Tanzania, only 11% of caregivers treated fever with chloroquine, while 90% treated with aspirin or paracetamol (Tarimo et

Interventions have found that health education can improve the reconstitution and increase the use of ORS, but evaluations have not been rigorous

ORT is likely to have played a large role in the reduction of diarrhoea deaths from 4.6 to 1.5 million between 1980 and 1999

The challenge is to extend coverage of ORT to hard-to-reach groups and new approaches to improving coverage are needed

al., 2000). Other African studies have reported home treatment of fever with antimalarials in less than 30% of cases (Deming et al., 1989; Glik et al., 1989; Igun, 1987; Mwenesi, Harpharn & Snow, 1995; Diallo et al., 2001). When children are given antimalarials in the home, dosing is not always correct; in the Congo, 33% of children were underdosed and 20% overdosed; in Guatemala, 87% of adults took the wrong dose of antimalarials (Carme et al., 1992; Ruebush, Weller & Klein, 1992); and in Kenya, only 4% of children treated at home with chloroquine received an adequate total dose (Marsh et al., 1999).

8.2.2 The benefits of home treatments for fevers in malarious areas

The benefits of antimalarial treatment depend on local resistance patterns but efficacious medications can be provided for most areas (Bloland, 2001). The efficacy of paracetamol and tepid sponging for treating fever in children with malaria is less certain (Agbolosu et al., 1997; Choonara, Nunn & Barker, 1992) (see Box 13). Paracetamol and tepid sponging are, however, effective in reducing fever (Newman, 1985; Mahar et al., 1994; Sharber, 1997) and currently there is insufficient evidence to recommend a change in practice (Meremikwu, Logan & Garner, 2001; TDR, 2000).

BOX 13

Controversies regarding the efficacy of paracetamol and tepid sponging for treating fever in children with malaria

Adverse reports about using paracetamol and tepid sponging to treat fever in children with malaria include:

■ lack of impact of paracetamol on comfort or behaviour in children (Kramer et al., 1991)

■ prolongation of malarial parasite clearance time by paracetamol (Brandts et al., 1997)

■ increased mortality in severe viral infections after treatment with antipyretics (Shann, 1995)

■ side-effects of tepid sponging such as shivering and discomfort (Newman, 1985; Mahar et al., 1994).

8.2.3 The impact of interventions to increase the home treatment of malaria

Interventions to increase the home management of malaria by families and communities currently include:

— training and counselling of mothers
— improving packaging and instructions
— improving access to antimalarials.

Behaviour change. The located studies did not report behaviour change data.

Mortality and morbidity. Studies that examine the impact of improving home management of malaria on mortality are detailed in Table B.8.2. Intervention studies in the Gambia and Kenya revealed no association between improving access to village health workers and overall or malaria-specific mortality (Menon et al., 1990; Spencer et al., 1987; Menon et al., 1990). However, child mortality was reduced by 41% after an intervention in Ethiopia that involved using mother coordinators to train mothers to recognize symptoms of malaria and to promptly give chloroquine (Kidane & Morrow, 2000). In terms of morbidity, in Burkina Faso training mothers to recognize malaria and distributing antimalarials through community health workers was associated with a decrease from 4.9% to 3.7% in the number of malaria cases recorded as severe in health centres (Pagnoni et al., 1997). Malaria incidence was also reduced by 73% in the Gambian study (Menon et al., 1990). No studies that examined the impact of improving home management of malaria on growth or development were located.

8.2.4 The feasibility of large-scale programmes

Large-scale home-based malaria treatment programmes using village health volunteers have been effective in reducing malaria incidence and mortality (WHO, 1997b). In Latin America and South-East Asia more than 10 000 village volunteers have played an important role in malaria diagnosis and treatment for more than 35 years (Okanurak & Ruebush, 1996). Using volunteers has a number of long-term feasibility issues including high replacement rates and inactive volunteers.

There are some concerns that encouraging home treatment of antimalarials will foster misuse in the community such as incorrect dosing or the use of the medication for other illnesses. In Burkina Faso, no major problem of misuse emerged when home treatment was encouraged (Pagnoni et al., 1997). Box 14 lists issues to consider when scaling up home management of malaria.

<div style="background: #cfe5dd; padding: 1em;">

BOX 14

Issues to consider when scaling up home management of malaria

- Availability (antimalarials must be produced by the manufacturer at a reasonable price and the supply must be sustainable)
- Adherence
- Information (e.g. through high quality information, education and communication activities)
- Regular training and retraining (e.g. of shopkeepers, health workers, teachers)
- Remuneration (necessary to ensure continued motivation of community-based agents)
- Community ownership
- Supervision
- Monitoring and evaluation (e.g. of sales, patterns of drug use, side-effects, resistance)
- Integration with ongoing community-based health care programmes.

Source: WHO, 2002b

</div>

8.3 Conclusions

- Uncomplicated diarrhoea, malaria and local infections can be managed at home with efficacious treatments. There are some concerns that encouraging home treatment of malaria will foster medication misuse.

- ORT can prevent death from watery diarrhoea in all but the most severe cases. The national control of diarrhoeal disease programmes substantially increased the use of ORT, which is likely to have played a large role in the global reduction of diarrhoea deaths from 4.6 to 1.5 million. In Brazil, ORT is estimated to have contributed to 79% of the decrease in diarrhoeal deaths.

- Reduced osmolarity ORS was shown to decrease the need for unscheduled intravenous infusion and stool output compared to the standard formula, and a new ORS formulation was released in 2002.

- Interventions to improve how ORT is used have focused on reconstitution and correct administration of ORS through health education, but evaluations have not been scientifically rigorous.

- Interventions to improve home treatment of malaria-related fevers by training mothers and increasing access to treatment have had variable impacts on mortality and morbidity, but have the potential to have a large impact, with one well-conducted study reporting a 41% mortality reduction.

- Prescribing by drugsellers, which is often poor, has been identified as influencing home treatment. Only one study was located that addressed shopkeeper behaviours (the proportion of childhood fevers treated adequately increased by 60%).

- Cost of ORS, antimalarials and antipyretics and access to viable delivery systems remain major constraints for many developing countries.

Experiences with malaria treatment programmes using village health workers have been mixed

- To ensure success, interventions need to include social marketing approaches and act at several levels, including manufacturers, retailers, consumers, and governments.
- Policies that include quality control of new drugs are important and will impact on home treatment. Simple and appropriate dosing advice that enables correct use at the community level is especially important

8.4 Questions to be answered
- Long-term effects on child mortality of encouraging home treatment of antimalarials.
- Efficacy of home-based administration of paracetamol and tepid sponging for fever.
- Methods of improving the correct use of home-based ORT and antimalarial treatments.
- Methods of increasing coverage of home-based ORT.

9. CARE-SEEKING

■ **Key practice.** Recognize when sick children need treatment outside the home and seek care from appropriate providers.

Appropriate care-seeking means that the need to take the child for treatment outside the home is recognized, that the care is not delayed, and that the child is taken to an appropriate health facility or provider. Untreated infections are a major cause of childhood mortality and morbidity in developing countries (Aguilar et al., 1998; Mirza et al., 1990; Molbak et al., 1992; Murray et al., 1997) and while uncomplicated illness can be treated at home (see Chapter 8, Home treatment) severe illness should be treated by a health professional. The decision to take a sick child to a health facility is part of a complex care-seeking process that can involve many people. It has three interlinked components which differ in importance depending on the setting. Caregivers:

— initially **recognize** that the child is ill
— **label** the illness, both within the local classification system and by severity, based on the recognized symptoms and illness context
— **resort to care**, influenced by the label, along with barriers such as time and money constraints.

The process is not linear; for example within an illness episode the label may change as community members offer advice, new symptoms are recognized and treatments fail (WHO, 1999).

Care-seeking is a process of recognition and labelling, followed by one of complex decision-making

9.1 The prevalence of appropriate care-seeking

The high number of children who die without ever being taken to a health facility indicates that the prevalence of appropriate care-seeking is low. The results from nine studies (see Table 5) show that a median of 23% (range 7–72%) of fatally ill children were never taken to a health facility (Mirza et al., 1990; Sutrisna et al., 1993; Ministry of Health of the United Republic of Tanzania, 1997; Sodemann et al., 1997; Reyes et al., 1998; Aguilar et al., 1998; Terra de Souza et al., 2000; Bojalil, 2002).

The high number of children who die without ever reaching a health facility indicates the prevalence of appropriate care-seeking is low

TABLE 5
Care-seeking of fatally ill children

STUDY	% DEATHS NOT TAKEN TO FACILITY	FACTORS WHICH CONTRIBUTED TO DEATHS
Kenya (Mirza et al., 1990)	23%	Not reported
West Java (Sutrisna et al., 1993)	64%	God's will: 77%; Financial constraints: 7%
		Did not recognize severity: 10% (mothers' perception)
United Republic of Tanzania (MOH, 1997)	40%	Not reported
Guinea-Bissau (Sodemann et al., 1997)	7%	Care-seeking not reported as a problem
Bolivia (Aguilar et al., 1998)	72%	Poor recognition and ignorance of appropriate care
Mexico (Reyes et al., 1998)	20%	Lack of money: 34%; Distance to facility: 15%
		Not considered necessary: 21%
Brazil (Terra de Souza et al., 2000)	29%	Care-seeking delay: 70%
		Ineffective medical interventions: 43%
		Delays in receiving medical care: 13%
Mexico (Bojalil, 2002)	20%	Severity not recognized: 40%
		Case management: 41%; Care-seeking delay: 59%
		External factors: 17%; Low confidence: 9%

Care-seeking for severe morbidity appears even worse. In Ghana, 40% of non-fatally ill children with various danger signs of severe illness were not taken to a health facility (Hill et al., 2003 in press). In the Philippines, 4% of rural and 10% of urban children with signs of ARI were not taken to a health facility (Tupasi et al., 1989). For children who are taken to a health facility visits are often not timely. Factors associated with care-seeking are shown in Box 15.

BOX 15

Factors associated with care-seeking

CHILD CHARACTERISTICS	CAREGIVER CHARACTERISTICS	FACILITY CHARACTERISTICS	ILLNESS CHARACTERISTICS
■ Age	■ Education	■ Costs	■ Type
■ Sex	■ Occupation	■ Physical and social distance	■ Label
	■ Age	■ Quality of care	■ Severity
	■ Income		■ Local beliefs/perceptions
	■ Autonomy		
	■ Marital status		

Source: Adapted from bibliography by Tipping and Segall, 1995

Recognition varies. In some settings only 39% of caregivers with fatally ill children recognized that their child was severely ill

The prevalence of caregiver recognition of severe illness varies. In Bolivia, only 39% of caregivers with fatally ill children recognized that their child was severely ill (Aguilar et al., 1998). In other settings recognition appears good, with 65% of mothers in Egypt and 73% in the Gambia correctly identifying children with ARI as having fast, abnormal or rapid breathing (Herman et al., 1994; Campbell, Byass & Greenwood, 1990). Ethnographic studies also report variations in recognition. Studies in Ghana and Sri Lanka (Hill et al., 2003 in press; Amarasiri de Silva et al., 2001) found little recognition of the danger signs of diarrhoea, malnutrition and especially ARI. In India, there was little recognition of dehydration or fast breathing (de Zoysa, 1998). In two studies, one in Bangladesh and one in Pakistan and Bangladesh, however, ARI symptoms were recognized but in Bangladesh were not seen as serious (Hussain et al., 1997; Zaman et al., 1997; Hussain et al., 1997).

9.2 The benefits of appropriate care-seeking

Death can occur rapidly after the onset of symptoms

Most severe infections can be effectively treated if the correct treatment is given (Pandey et al., 1991; Reyes et al., 1997; Roesin et al., 1990). In severe illness, death can occur rapidly after the onset of symptoms and care-seeking and treatment must be timely. In Nepal, an interval of 3–5 days was observed from the appearance of fast breathing to death by pneumonia (Pandey et al., 1991) and in the Gambia the mean duration of fatal malaria was three days (Greenwood et al., 1987). Reducing treatment delays thus has the potential to decrease morality and morbidity (Akpede, 1995; Talan & Zibulewsky, 1997; Roesin et al., 1990; Reyes et al., 1997).

Poor care-seeking is implicated in 6–70% of child deaths

Studies that have examined factors that contribute to child deaths have found poor care-seeking implicated in 6–70% of deaths (Sodemann et al., 1997; Reyes et al., 1998; Aguilar et al., 1998; Terra de Souza et al., 2000; Bojalil, 2002). Mexican studies show that even where the majority (80%) of fatally ill children are taken to a health facility, a high number of deaths (59%) can be attributed to delays in care-seeking (Bojalil, 2002), and that children of mothers whose care-seeking is untimely are more likely to die than those whose care is timely (odds ratio 19.5) (Reyes et al., 1997). In Kenya, although 52% of children died in a health facility, 5% of these died within a few hours of arriving (Mirza et al., 1990).

In terms of the mortality impact of the different elements of the care-seeking process (recognition, labelling, resort to care), information was only located regarding recognition. In Mexico, poor recognition was associated with 24% of child deaths (Bojalil, 2002), and in a different Mexican study, caregivers who recognized signs of dehydration were less likely to have a child die from diarrhoea than those who did not (odds ratio 0.8) (Reyes et

al., 1996). Recognition is only part of the care-seeking pathway and is not always the reason for poor care-seeking. For example, in Bolivia, only 44% of mothers who recognized their child was severely sick actually sought care; others had no recognition but still sought care (Aguilar et al., 1998). In Sri Lanka, recognition was not necessary for care-seeking; caretakers could not recognize danger signs and symptoms but overall care-seeking was high (Amarasiri de Silva et al., 2001).

9.3 The impact of interventions to increase appropriate care-seeking

Interventions to improve care-seeking behaviour include:

— health education of mothers
— training of community health workers.

Behaviour change. Only one study was located that examined the impact of interventions to improve care-seeking on behaviour change. In Indonesia, community health workers trained caregivers to recognize and prevent ARI, and identified and referred children with pneumonia. This resulted in increased attendance at health centres, reduction in utilization of traditional healers and improved administration of appropriate medicines (Roesin et al., 1990).

Morbidity and mortality. Only two care-seeking studies were located with mortality outcomes (see Table B.9.1). In Indonesia, ARI deaths decreased by 67% after community health workers trained caregivers to recognize and prevent ARI, and identified and referred children with pneumonia. However, no statistical analysis was performed on the data (Roesin et al., 1990). Pneumonia deaths decreased by 30% in a similar study in the United Republic of Tanzania. However, this reduction was not found to be significant (Mtango & Neuvians, 1986).

Moderating factors

Type of health provider. Improving care-seeking also involves encouraging caregivers to consult appropriate providers. The use of private doctors is as high as 56% in some developing countries (Muhuri, 1996; Berman & Rose, 1996). Private doctors are often perceived as being of better quality, and have more convenient opening hours, a better supply of drugs and shorter waiting times. Studies in Mexico have shown that private doctors provide a poor quality of care compared to public ones, but are often preferred. Bojalil (2002) found that children had 4.2 times the risk of receiving poor quality care and 1.5 times the chance of dying, if taken to a private doctor rather than a public doctor. Box 16 outlines the key problems with private practitioners' quality of care identified in a recent review of private providers (Tawfik, Northrup & Prysor-Jones, 2002).

BOX 16

Key problems with private practitioners' quality of care

DIARRHOEA	ACUTE RESPIRATORY INFECTION	MALARIA
■ ORT is rarely recommended	■ No counting of respiratory rate	■ Inappropriate or incorrect dose of antimalarial drugs
■ No advice on feeding	■ First-line antibiotic is not given in the correct dose	■ No verification of other causes of fever
■ No enquiry on blood in the stools or diarrhoea duration	■ No counselling on feeding	
■ Skin pinch to verify dehydration is not done		

■ No advice on danger signs that require urgent medical care

Source: Tawfik, Northrup & Prysor-Jones, 2002

Studies have also shown that a preference for traditional sources of health care for initial consultations, young infants, and specific illnesses can prevent or delay care-seeking

(Bhattacharyya, 1993; Sutrisna et al., 1993; Gove & Pelto, 1994; Herman et al., 1994; Csete, 1993; WHO, 1999). Drugstores can also be used inappropriately.

Quality of care. Although improving care-seeking has the potential to reduce mortality and morbidity, this relies on a high quality of care. In Guinea-Bissau, overall care-seeking in fatal episodes was high (93%) and a comparison with matched surviving controls showed it had been timely. In 1993, 5% more fatally ill children were taken to a health facility than in 1990 but mortality did not decrease (Molbak et al., 1992; Sodemann et al., 1997). Many children died while waiting for treatment and were not admitted because of bed shortages, or were discharged too soon. This not only shows that care-seeking can be appropriate, but that there is no point improving care-seeking if quality of care is poor (WHO, 1999).

Local illness classification systems. Studies worldwide have shown the existence of complex local illness classification systems for diarrhoea, and that these influence care-seeking (de Zoysa et al., 1984; Nichter, 1988; Weiss, 1988; Kendall, 1983; Kendall, 1984). In Nigeria, even when diarrhoea was recognized, if it was attributed to teething, overeating or dietary indiscretion it was not considered an illness and was not treated (Omatade et al., 2000). In Guinea- Bissau, health facility use was 80% less if diarrhoea was attributed to teething, but children were just as likely to develop signs of dehydration (Sodemann et al., 1996).

Access. The feasibility of increasing care-seeking where access, time and money constraints are great, must be considered. Appropriate care-seeking is of particular importance in areas where access to health services is limited, because it is in these areas that caregivers would benefit most from being able to discern which episodes really need to be taken to the health centre, and which can be successfully treated at home. Several studies have linked mortality with access. In Kenya, fatally ill children who lived more than 2.8 km from the nearest bus stage were admitted to hospital less than those who lived closer (odds ratio 3.9) (Snow et al., 1994). An analysis of *Demographic Health Survey* data in Uganda found that the risk of mortality increased by 19% for every percentage increase in distance from the health centre (Katende, 1994). In Mexico, 10% of child deaths were attributed to poor care-seeking caused by external factors (Bojalil, 2002). However, in Ghana, although mothers reported that external factors were a barrier to care-seeking, illness narratives showed that if the child was considered fatally ill, means were found to overcome these barriers (Hill et al., in press 2003).

9.4 The feasibility of large-scale programmes

Very little is known about the feasibility of improving care-seeking behaviour and no large-scale programmes with a care-seeking element were located. Formative research conducted in Ghana and Mexico and Ghana identified mother-support groups and village volunteers as potential intervention channels (WHO, 1999), but effectiveness, sustainability and feasibility were not explored.

Three different types of recognition barriers have been identified (see Box 17), each with different feasibility issues (Hill et al., in press2003). Interventions are likely to be more successful if they focus on teaching caregivers to recognize symptoms that they can see but do not consider as abnormal or dangerous.

BOX 17

Types of recognition problem

- Caregivers do not know that some symptoms exist.
- Some symptoms are cited as danger signs but not recognized when they occur.
- Some symptoms are seen but are rarely considered abnormal or dangerous.

Source: Hill et al., 2003

9.5 Conclusions

- Studies examining factors contributing to child deaths have found poor care-seeking implicated in 6–70% of deaths; a high number of deaths has also been attributed to delays in care-seeking.

- Only two care-seeking intervention studies were located and their results were inconclusive – a non-significant impact was found in one study, and no statistical analysis performed in the other.

- Formative research conducted in Mexico and Ghana identified mother-support groups and village volunteers as potential intervention channels but effectiveness was not explored.

- Interventions are likely to be more successful if they:

  — focus on teaching caregivers to recognize symptoms that they can see but do not consider as abnormal or dangerous, rather than symptoms they do not know exist; and

  — incorporate local health beliefs, traditional practices and illness classification systems.

- The impact of interventions to improve care-seeking relies on a high quality of care, and interventions must consider the type of providers utilized. Studies in Mexico have shown that private doctors are often preferred but that children had 4.2 times the risk of receiving poor quality care and 1.5 times the chance of dying if taken to a private doctor rather than a public doctor.

- Appropriate care-seeking is of particular importance in areas where access to health services is limited, because it is in these areas that caregivers would benefit most from being able to discern which episodes really need to be taken to the health centre.

9.6 Questions to be answered

- Whether interventions can be developed to overcome the widespread lack of recognition of disease-specific danger signs, particularly those for pneumonia.

- The effectiveness and feasibility of interventions and programmes to improve care-seeking.

10. ADHERENCE

■ **Key practice.** Follow health workers' advice about treatment, follow-up and referral.

Many childhood illnesses can now be effectively treated, and evidence-based guidelines for treatment, follow-up and referral of children are widely available as part of IMCI (WHO, 1997). To ensure that sick children recover quickly and completely, it is important for caregivers to follow health workers' advice. This involves:

— taking a full course of prescribed medications in the right quantities, manner and at the right times
— keeping appointments and returning for follow-up and referral visits.

Much has been written about adherence to medication, but the literature focuses on developed countries and chronic diseases. Although adherence is frequently identified as a problem in the treatment of acute diseases in developing countries, evidence is mostly anecdotal.

The numerous and interrelated influences of adherence are detailed in Figure 9. These influences will differ by setting, and intervention design must reflect this.

Adherence involves taking prescribed medications in the right quantities and at the right times, and returning for follow-up/ referral visits

The determinants of adherence include knowledge, attitudes, support and therapy characteristics

FIGURE 9
Factors affecting adherence

PROXIMATE DETERMINANTS		
INDIVIDUAL	**INTERPERSONAL**	**THERAPY CHARACTERISTICS**
■ **Knowledge** of health problem and therapy instructions	■ **Support**: beliefs of family and peers	■ **Physical**: size, taste, colour, packaging
■ **Attitudes**: beliefs and experiences of illness	■ **Provider**: adequacy and relevance of information, communication skills	■ **Complexity of dose**: number, schedule, duration, mode of administration
■ **Personality**: self efficacy, memory, coping strategies	■ **Social identity**: empowerment	■ **Side-effects**: perceived harm, disruption to life
■ **Life style**: complexity and stability		■ **Clinical efficacy**
■ **Life situation**: health status, life stage and events		■ **Cost**
■ Appraisal of **costs and benefits**: perceived risk, expectations		

DISTANT DETERMINANTS

■ **Sociocultural**: cultural and subjective norms and beliefs, social networks
■ **Socioeconomic status**
■ **Policy**: local, state and federal.

10.1 The prevalence of adherence

Definitions and measurement of adherence differ among studies. This makes comparisons difficult, but most studies have found low levels of adherence to treatments. In a review of eight studies in developing countries, median adherence to treatments for acute diseases was reported as 58% (range 40–93%) (Homedes & Ugalde, 1993; Reyes et al., 1997) (see Table B.10.1).

The large number of 'non-adherers' can be divided into four groups (Homedes & Ugalde, 1993)

— those motivated to adhere but who lack knowledge
— those knowledgeable but unmotivated
— those constrained by external factors, such as access or poverty
— those who have a change of mind and decide not to follow the regimen (e.g. because of side-effects or early improvement).

Adherence in developing countries ranges from 40–93%

Little information was located about the prevalence of appointment-keeping in developing countries. A study in Ecuador found that 42% of referred children did not follow the referral instructions (WHO, 2001a). In the Sudan, 43% of children referred attended hospital on the day of referral and, in terms of follow-up, 23% returned to the health facility on or before the due date (WHO, 2002). In the United Republic of Tanzania, 48% of referrals that reached a health facility took two or more days to arrive (Font et al., 2002), but in Zimbabwe adherence to referrals appears high with 93% of children attending an urban clinic following referral instructions (Axton & Zwambila, 1982).

10.2 The benefits of adherence

Not adhering to treatment regimens and referral instructions may lead to incomplete treatment, therapy failure, drug resistance and the later misuse of leftover medicines (Madhi, Taha & Al Rifai, 1983; Minchola de Perez, 1984; Abdulaziz Al-Sekait, 1989; El Tom & Sharif, 1997; Homedes & Ugalde, 2001), which can cause unnecessary mortality and morbidity. For example, a study in Nigeria found that 84% of children diagnosed with malaria who did not get better when prescribed chloroquine were 'non-adherers' (Okonkwo et al., 2001).

Adherence is linked to resistance because sub-inhibitory regimens predispose the selection of resistant bacterial strains (Okeke, Lamikanra & Edelman, 1999; WHO, 1999). Resistance is increasing among isolates of diarrhoeal, respiratory, and commensal enteric pathogens, particularly to first-line, inexpensive, broad-spectrum antibiotics (see Box 18). In Senegal, a 2.1–5.1 increase in the risk of malaria deaths in children was linked to the emergence of chloroquine resistance (Trape et al., 1998).

> **BOX 18**
>
> **The spread of resistance**
>
> ■ Formerly first-line antimicrobials were effective in the treatment of chest infections, but today laboratory samples show that approximately 70% of chest infections are resistant to one of the first-line antimicrobials
>
> ■ 10 years ago, Shigella epidemics were easily controlled by cotrimoxazole, but now nearly all Shigella is non-responsive to the drug
>
> ■ In 1976, 30% of malaria cases responded to chloroquine; four years later in 1980 only 2% responded; now 80% of countries where malaria is a major killer are chloroquine-resistant.
>
> Source: WHO, 2000

10.3 The impact of interventions to increase adherence

Interventions to promote adherence include:

— counselling caregivers
— mass communication campaigns
— improving the appearance, taste and packaging of medications.

Behaviour change. Details of interventions to improve adherence behaviour are found in Table B.10.2. Interventions to improve adherence through counselling resulted in increased knowledge and improved adherence (Ngoh, 19972; Sechrist, 1979; Dennis, 1998; Kelley & Black, 2001). In Cambodia for example, training health workers and using posters and videos to educate patients improved adherence to antimalarials from 0.5% to 20% (from 6% to 11% when posters were used alone) (Dennis, 1998). In Malawi, adherence to chloroquine by pregnant women was 25% at baseline, and 91% after health workers were trained and the tablets sugar-coated to disguise the bitter taste (Helitzer-Allen et al., 1994). In Nigeria, mothers who received pictorial instructions for chloroquine adhered 15% more than the control group, and mothers who received both picture and verbal instructions 37% more than the control group (Okonkwo et al., 2001).

Packaging of medications is an aspect often neglected. If patients do not like containers, they may choose to keep the medication elsewhere. In doing this, they may misplace

42% of caregivers in Ecuador and 34% of caregivers in the Sudan did not follow referral instructions

Not adhering may lead to incomplete treatment, therapy failure, drug resistance and the later misuse of leftover medicines

Drug resistance is a growing problem; improving adherence is important for limiting resistance

the instructions or the labels that explain the use of the medication (Homedes & Ugalde, 2001). Blister packs can be used to divide the medication into correct doses for the correct number of days. Six studies were located exploring the impact of improving packaging (see Table B.10.2). In China, adherence to chloroquine in blister packs with clear instructions was 97% compared to 80% for chloroquine distributed in envelopes (Qingjun et al., 1998); and in Ghana, a trial using prepackaged chloroquine found adherence was 82% in the intervention group compared to 60.5% in the control group for tablets, and 54.3% compared to 32.5% for syrup. The prepackaged chloroquine was available in seven treatment regimens based on the weight of the patient. Prescribing was more correct in the intervention clinics as the patients were weighed more often (98% of patients compared to 26%). The use of prepackaged chloroquine also reduced waiting times at dispensaries (Yeboah-Antwi et al., 2001). In Egypt, adherence to antibiotic syrups was higher than adherence to tablets (78% compared to 55%) (Ellerbeck et al., 1995). An intervention in Ghana, however, found that only 42% of caregivers adhered to syrups compared to 91% to tablets; caregivers found that having the tablets already in the correct dose was easier than having to measure the syrup (Ansah et al., 2001). An exploration of the implements used to measure the syrup found the measuring devices varied in volume from 1 to 9 ml.

Only one study, in Sudan (WHO, 2001a), looked at adherence to appointments and referral instructions. This study showed that of children referred, 43% attended hospital on the day of referral, while 62% attended on the same or the next day, and 23% returned to the health facility for follow-up on or before the due date. One of the factors associated with follow-up compliance was whether the child received the first treatment dose at the first visit to the facility. While interventions based around counselling and health education should play an important role in improving referral behaviour, reducing the need for these behaviours may also be an important intervention. This can be achieved by strengthening community-based management of illness (see Chapter 8, Home treatment), including the need for referral by training health workers at primary level facilities to deal with illness episodes effectively. In Uganda, implementing IMCI was estimated to reduce referrals from 22% to 16% (Kolstad et al., 1998).

Mortality and morbidity reduction. Only the Nigerian study, that tested giving pictorial and verbal instructions for chloroquine, had morbidity outcomes. Among control patients, 94% improved (as measured by parasite density, fever and qualitative assessment) compared to 90% in the pictorial group and 97% in the group that received both pictorial and verbal instructions (Okonkwo et al., 2001).

Moderating factors

Diagnosis and prescription. Accurate diagnosis and prescription are important for successful treatment. Evidence of poor diagnosis combined with bad prescribing practices in developing countries led Homedes & Ugalde (1993) to conclude that, in many instances, non-adherence could be a blessing in disguise. Studies in developing countries have found that antibiotics are prescribed in 35–60% of clinic visits but are appropriate in fewer than 20% (Trostle, 1996). In Peru, physicians who knew when antimicrobial drugs should be used, still prescribed them unnecessarily (Parades et al., 1996). This indicates that knowledge does not predict practice, even among highly trained professionals (Britten & Ukoumunne, 1997). Some of the main factors associated with poor prescribing practices are outlined in Box 19. Correct dosing and adherence to treatments bought from drug vendors is also an important issue (see Chapter 8, Home treatment).

Factors associated with poor prescribing practices

- Insufficient knowledge
- Patient demands and preferences, and fear of patients' dissatisfaction if their demands are not met
- Fear of negative clinical outcome in the absence of therapy
- Influence of social and cultural norms
- Promotional pressures of pharmaceutical companies
- Desire to maximize profits.

Source: WHO, 2001b

A review of 31 intervention studies to improve health workers' use of antimicrobials through health worker education, managerial changes, economic intervention or a combined approach, found that 24 of the studies reported at least 10% improvement in outcomes related to antimicrobials (WHO, 2001c). For example, a newsletter promoted 6% change (Angunawela et al., 1991), and face-to-face interventions promoted 17% and 36% change, in the number of antibiotics prescribed (Bexell et al., 1996). Training resulted in 21%, 17%, 9% and a non-significant change in four different studies (Guiscafre et al., 1998; Guitierrez et al., 1994; Hugh & Corrales, 1996; Naivalulevu, 1990).

Health workers' prescribing practices can be successfully changed through education and management interventions

Communication. Adherence requires that caregivers have knowledge and understanding of treatment regimens. This relies on effective communication between health workers and caregivers. Studies have found that patients are rarely active in asking for clarification in their interactions with health workers, consultation time is short, health workers do not always give full or meaningful instructions and socioeconomic, educational, cultural and linguistic differences between patients and health workers make communication difficult (Homedes & Ugalde, 1993).

Meaningful instructions from health workers is essential for good adherence

A multi-centre study in eight developing countries found that the average consultation time was between 2.3 and 3.5 minutes and that a median of 76% (range 27–83%) of patients knew how and when to take the medication after the consultation (INRUD, 2001). In Costa Rica, 8% of patients were not told about the dosage of the medicine, 21% about interval, 69% about the time of day and 79% about duration (Homedes et al., 1989). Data collected through exit interviews and home visits found that information on treatment was only understood by 36% of patients in Chile (Carrasco et al., 1990), and only recalled by 50% of patients in the Dominican Republic (Ugalde, Homedes & Collado, 1986). In South Africa, knowledge was greater if the patient had seen a nurse rather than a doctor (knowledge of dosing was 87% compared to 79%, knowledge of duration was 74% compared to 40%, and knowledge of the purpose of the medicine was 63% compared to 26%) (Wagstaff et al., 1982). A study in Costa Rica observed the prescription of 1023 medicines, yet patients only asked for clarification for ten of these medicines (Homedes & Ugalde, 1993).

27–83% of patients leave the consultation with incomplete knowledge of how to take the medication

10.4 The feasibility of large-scale programmes

The feasibility of large-scale programmes to improve adherence is unknown. The few interventions that have tried to improve adherence to treatment show that behaviour change is possible. The most effective programmes are likely to be those that intervene at many different levels, and that:

— train health workers in prescribing and adherence counselling
— target manufacturers, retailers and governments
— provide medicines in formulations that are acceptable and easy to use
— take into account local perceptions and beliefs.
  (Homedes & Ugalde, 2001).

Health workers, manufacturers, retailers and governments must be included in interventions to ensure meaningful change

No studies were located exploring adherence from the caregiver's point of view, essential to understand in order to develop effective interventions.

No studies were located exploring adherence from the caregiver's point of view, essential to understand in order to develop effective interventions

Little is known about the
feasibility of increasing
adherence to appointment-
keeping and referral

Even less is known about the feasibility of increasing adherence to appointment-keeping and referral. The main reason for not keeping appointments in Sudan was that the child was considered better (WHO, 2001a). Interventions to improve appointment-keeping will have a minimal impact on mortality and morbidity where appointments are not kept because children have recovered. Barriers identified in other studies include the caregiver not receiving a referral slip, the health worker not counselling the caregiver to go to the hospital immediately, transport being too expensive, the mother not being the decision-maker, and the need for the caregiver to spend a night away from home (Kelley & Black, 2001).

10.5 Conclusions

■ Little is known about the impact of adherence on mortality or morbidity, but not adhering to treatment and referral instructions may lead to incomplete treatment, therapy failure, drug resistance and the later misuse of leftover medicines.

■ Although only small-scale adherence interventions were located, all reported a positive impact on adherence. Counselling interventions improved adherence by up to 66%, and improving packaging by 27%. Only one trial had morbidity outcomes; in this study, malaria parasite counts were lower where health workers used picture and verbal instructions to explain antimalarial dosing. The potential impact of mass communication interventions is unknown and should be investigated.

■ No interventions were located focusing on adherence to appointments and referral instructions. While more research in this area is needed, reducing the need for referrals may also be an important intervention. In Uganda, implementing IMCI was estimated to reduce referrals from 22% to 16%.

■ Interventions to improve appointment-keeping will have a minimal impact on mortality and morbidity where appointments are not kept because children have recovered. No studies were located exploring adherence from the caregiver's point of view, essential to understand in order to develop effective interventions. Accurate diagnosis and prescription are important for successful treatment; poor diagnosis and bad prescribing practices are common but can be improved.

■ Community interventions to improve adherence should include materials and messages that consider local perceptions and beliefs, involve simple messages, and provide medicines in formulations that are acceptable and easy to use.

10.6 Questions to be answered

■ Effectiveness and feasibility of interventions and programmes to improve adherence to medications and follow-up.

■ How to improve access to health facilities that provide high quality care.

11. STIMULATION

■ **Key practice.** Promote mental and social development by responding to a child's needs for care, and through talking, playing and providing a stimulating environment

No data exist on the actual prevalence of developmental delay in children in developing countries. However, 39% of those under the age of five in developing countries are growth retarded, and this is a marker for disadvantaged environments and developmental risk (Grantham-McGregor et al., 1999). Other children at risk of developmental delay are low-birth-weight infants, neglected children and children of low socioeconomic status. Box 20 lists factors which influence mental, social and emotional development.

BOX 20

Factors which influence mental, social and emotional development
■ Nutritional and biomedical status
■ Lack of early brain stimulation
■ Genetic inheritance
■ Social and cultural contexts
■ Environment.

It has been suggested that in infancy and childhood the impact of experience on cognitive ability is significantly more powerful than the influence of heredity (Riely, 1999). In order to improve developmental outcomes in children, the family and the community must foster mental, social and emotional development in children, by responding to a child's needs for care, and through talking, playing and providing a stimulating environment.

11.1 The prevalence of early childhood care and development programmes

Currently, only 1% of mothers in developing countries receive assistance with child care beyond that provided by family and friends. In sub-Saharan Africa, 1% of eligible children are enrolled in preschool programmes, and few developing countries have achieved pre-school coverage of even 25–30% (Young, 1996). Of more than 800 million children under the age of six, less than one-third benefit from any form of early childhood education (UNICEF, 2000). In contrast, 80% of three-year-olds in Belgium, Denmark, France and Italy are enrolled in nursery or preschool centres (Young, 1996).

11.2 The benefits of stimulation

There is an extensive scientific basis for the benefits of home and centre based stimulation on early childhood development. Adults born in poverty who participated in a quality active-learning preschool programme at ages three and four, have higher social responsibility, education performance, earnings and property wealth and greater commitment to marriage (Schweinhart, Barnes & Weikart, 1993). Children who participate in early childcare programmes show stronger performance on IQ tests and are less likely to repeat grades or be placed in remedial classes (WHO, 1999). When children experience a variety of optimal emotional, behavioural, cognitive and social stimulation at key times during their development, this results in a healthy cortical modulation ratio (cortical and limbic/mid-brain and brain stem) (Perry, 1997). Animal studies have shown that rats reared in enriched environments have thicker patterns of cortical interconnections and more cerebellar synapses than unstimulated rats (Perry & Pollard, 1998). Neurodevelopmental consequences from affective, tactile and emotional undernourishment have also been well described in children (Perry & Pollard, 1998; Chisholm, 1998; O'Connor et al., 2000).

The way that caregivers relate and respond to young children and mediate their contact with the environment is felt to directly affect the formation of neural pathways. The environment affects not only the number of brain cells and the number of connections be-

tween them, but the way these connections are 'wired' (Perry & Pollard, 1998). A child's capacity for mental and social development hinges on biological systems shaped by early experience and attachment (Chisholm, 1998; O'Connor et al., 2000). Early assessment/ intervention has been shown to prevent prolonged neurophysiological, neuroendocrine and neuropsychological responses to trauma (Perry & Azad, 1999). Early intervention with psychoeducational and critical incident debriefing can also minimize sensitization of alarm reactions (Perry & Azad, 1999).

Children's development will flourish when they form secure attachments to a responsive caregiver. Long-term studies show that children who have secure attachments early in life make better social adjustment as they grow up, and perform better in school (Teo, 1996). When care is inadequate, unresponsive or inconsistent, young children experience tension and stress which affects their heart rate, their brain waves and the biochemistry of the brain. The chronic stress can also have an adverse impact on the brain and can result in developmental delays (Gunnar, 1998).

11.3 The impact of interventions to improve early childhood care and development

Details of randomized controlled trials (RCTs) included in this review can be found in Tables B.11.1–B.11.3. Box 21 lists the types of early childhood care and development (ECCD) interventions.

BOX 21

Types of early childhood care and development (ECCD) interventions

■ Centre-based and child-focused that provide psychosocial stimulation directly to the child
■ Home-based and parent-focused that aim to improve parenting skills for the parents' ability to perform psychosocial stimulation.

Interventions can also be targeted at both the child and the parent. Mass media and group counselling methods are also utilized, but research in these areas is limited (Barnett, 1995).

Non-targeted centre-based interventions have demonstrated greater impact than home-based interventions (Barnett, 1995; WHO, 1999). However, interventions which combine both home and centre based non-targeted approaches appear to be more effective than home or centre based approaches alone (Field et al., 1982; Gray & Klaus, 1970; Jester & Guinagh, 1983; Wasik et al., 1990; Weikart, 1993).

Behaviour change in families and communities. RCTs have shown that centre and home based ECCD interventions can improve parental verbal interaction, behaviour management and attitudes towards the child (Gutelius et al., 1977; Thompson et al., 1982; Field et al., 1982; Weikart et al., 1994; Schweinhart et al., 1993).

Growth in malnourished children. In Colombia, home-based ECCD interventions demonstrated significant impacts on growth in malnourished children (Waber et al., 1981; Super, Herrera & Mora, 1990) (see Table B.11.1). In those studies, combined stimulation and supplementation interventions resulted in greater effects on growth than stimulation or supplementation alone (Waber et al., 1981; Super, Herrera & Mora, 1990).

Developmental outcomes in malnourished children. Nutritional supplementation is known to have a significant impact on long-term developmental outcomes in malnourished children in developing countries (WHO, 1999; Grantham-McGregor et al., 1997; Grantham-McGregor et al., 1991; Pollitt, Watkins & Husaini, 1997; Haas et al., 1995). ECCD interventions in Colombia and Jamaica have also demonstrated short- and long-term developmental outcomes in malnourished children, even in the absence of a nutritional intervention (see Table B.11.1) (Grantham-McGregor et al., 1991; Grantham-McGregor et al., 1997; Powell et al., 1995; Grantham-McGregor et al., 1994; Grantham-McGregor, Schoefield & Powell, 1987).

Interventions combining centre and home stimulation or stimulation and nutritional supplementation have a greater impact than either one alone

Interventions are most successful if they target those most in need

However, the combination of ECCD interventions with nutritional supplementation has been shown to have a greater effect on developmental outcomes than either intervention alone (Grantham-McGregor et al., 1997; McKay et al., 1978; Waber et al 1981).

Developmental outcomes in low-birth-weight infants. All RCTs located were from developed countries (see Table B.11.2). Two studies found no difference in developmental outcome at 15–18 months (Brooten et al., 1986; Barrera, Rosenbaum & Cunningham, 1986). However, many other home and centre based ECCD interventions have demonstrated improvements in long-term developmental outcomes of low-birth-weight and premature infants (Olds & Kitzman, 1993; Hertzman & Wiens, 1996; Resnick, Armstrong & Carter, 1988; Scarr-Salapatek & Williams, 1973; Field et al., 1980; IHDP, 1990; Brooks-Gunn, Liaw & Klebanov, 1992; Brooks-Gunn et al., 1994).

Developmental outcomes in children of low socioeconomic status. Only one RCT from a developing country (Jamaica) was located, all other RCTs targeting children of low socioeconomic status were based in the USA (see Table B.11.3). The interventions had variable impacts on developmental outcome. Centre based early childhood interventions improved cognitive outcomes by school entry but did not sustain improvements in the long term (Campbell et al., 1994; Campbell et al., 2001; Miller & Bizzell, 1984). ECCD interventions appeared to have a greater impact on long-term educational achievements (such as school readiness, grade repetition, placement in remedial classes or high school graduation) (Campbell et al., 1994; Campbell et al., 2001; Garber, 1988; Johnson & Walker, 1991; Reynolds, 1994), and social outcomes (such as reduced rates of delinquency, juvenile aggression and incarceration) (Reynolds et al., 2001).

A review of 36 centre based interventions supported these findings (Barnett 1995). He found that centre based interventions increased average IQ scores of children from the United States by eight points by the time they were ready to start school, and that although the increase was not sustained, long-term positive effects were seen on school readiness, grade repetition, placement in remedial classes and high school graduation. Short-term cognitive impacts have also been shown to narrow but not close the developmental gap between advantaged and disadvantaged children in observational studies (Boocock 1995; Hertzmann & Wiens, 1996; Caughy, DiPietro & Strobino, 1994; Miller & Bizzell, 1984).

Home based ECCD interventions in children of low socioeconomic status have demonstrated no effect on long-term cognitive outcomes and inconsistent effects on long-term educational achievements and social outcomes (Powell & Grantham-McGregor, 1989; Infante-Rivard, Filion & Baumgarten, 1989; Black et al., 1995; Gutelius et al., 1977; Gutelius et al., 1972; Lambie, Bond & Weikart, 1974; Epstein, 1974; Olds, Henderson & Kitzman, 1994; Olds et al., 1998; Thompson et al., 1982) (see Table B.11.3).

Developmental outcomes in children who are not at high risk. Observational longitudinal studies of ECCD interventions in American children of moderate to high socioeconomic status showed accelerated attainment of early developmental milestones but no significant differences at long-term follow-up (Barnett, 1995; Caughy, DiPietro & Strobino, 1994). However, observational studies of day care centre programmes in Sweden showed improved developmental outcomes in children of high socioeconomic status (Andersson 1992; Broberg et al., 1989; Cochran & Gunnarsson, 1985). United Kingdom programme evaluations also indicate that disadvantaged children gained more from preschool than more advantaged children but that both had gains in school achievement to age 10 (Osborn & Milbank, 1987). In Canada, quality of care exerted more influence on the development of lower class than middle class children (Goelman & Pence, 1987).

The family, as a unit, is widely acknowledged as important for child development (Belsey, 2000; WHO, 1999). For example, the impact of an intervention is more likely to be sustained if parents are involved (Young, 1996; WHO, 1999). Parental involvement also decreases the risk of the intervention creating feelings of inadequacy or disempowering

Ensuring caregivers provide for a child's nutritional needs improves development

Centre based intervention programmes targeting children of low socioeconomic status do not appear to improve long-term cognitive outcomes but can improve educational achievements and social outcomes

Home visiting improves development for low-birthweight, premature and undernourished children but has inconsistent impacts on disadvantaged children

Parents and communities must be involved in the projects

parents. However, little research has been conducted exploring the potential roles of fathers and older siblings in changing child-rearing practices of both mothers and fathers (Belsey, 2000).

Moderating factors

Age at enrolment. The vulnerable period for psychosocial development is during the early years of life (Bloom, 1964; Condry, 1983). Approximately 50% of a child's intellectual development potential is established by age four (Bloom, 1964; Condry, 1983; Dobbing, 1974; Dobbing, 1973; Kolb, 1989; Pollitt, 1996; Ramey & Ramey, 1998). Evidence from experimental and observational studies indicates that interventions which focus on antenatal care or the first few years of life have a greater impact than those which involve older children (Caughy, DiPietrro & Strobino, 1994; Garber, 1988; Campbell et al., 2001; McKay et al., 1978; Waber et al., 1981; Perez-Escamilla & Pollitt, 1995; Pollitt, Watkins & Husaini, 1997; Chisholm, 1998; O'Connor et al., 2000).

Gender. ECCD programmes have been shown to have greater effects on achievement test scores among girls than boys in low-income groups (Campbell et al., 2001; Johnson & Walker, 1991; Gray, 1970) but results are generally inconsistent.

Intensity and duration of ECCD interventions. Intensity and duration of ECCD interventions have a marked influence on developmental outcomes (Olds & Kitzman, 1993; Hertzman & Wiens, 1996). Intensive interventions and time periods of 2–5 years are felt to be needed for long lasting impact (Barnett, 1995).

Staffing. Using professionals rather than paraprofessionals as the home visitor resulted in a greater impact in the United States (Korfmacher et al., 1999). In Jamaica, this was also found to have an effect but the intensity of the intervention was more important (Powell & Grantham-McGregor, 1989).

11.4 The feasibility of large-scale programmes

Large-scale ECCD programmes in the United States have demonstrated improved short-term and long-term educational outcomes (Currie & Thomas, 1995; Currie & Thomas, 1996; Fuerst & Fuerst, 1993; Lee et al., 1990) and improved cost-effectiveness (Currie & Thomas, 1995; Barnett, 1995; Barnett & Escobar, 1989). Large-scale ECCD programmes in developing countries have also demonstrated improved short- and long-term educational outcomes (ICDS, 1995; Chaturvedi et al., 1987; ICBF, 1997; Herscovitch, 1997; Myers et al., 1985; Myers, 1992).

In Colombia, Jamaica, Peru and Turkey, children enrolled in early child development programmes had higher scores in intellectual aptitude tests at five-year follow-up than non-participants. (Young, 1996; ICDS, 1995; ICBF, 1997; Herscovitch, 1997; Myers et al., 1985; Myers, 1992).

Cost-effectiveness has also been demonstrated in developed-country studies (Barnett, 1985; Barnett, 1995; Young, 1995; WHO, 1999). ECCD programmes are likely to be very cost-effective in developing countries, however data is limited from those areas. Coverage of ECCD programmes in most developing countries has been poor. New approaches are needed to improve participation rates and improve access to the most disadvantaged children. The High/Scope Perry Preschool Longitudinal Study (Weikart, 1993) shows that over the participants' lifetimes, the public is receiving an estimated US $7.16 for every dollar originally invested.

Large-scale programmes vary in content, venue and delivery channel throughout the world and programmes evaluated have varied widely in approach. Detailed investigation into the most effective components of the programmes is needed. There has also been little research into socioeconomic factors that influence a child's ability to respond to a particular programme. The scope of projects will vary by the needs and resources of the

Interventions have the biggest impact if they target children when they are young

Longer more intense interventions are likely to have a greater impact

Programme evaluations suggest that early child development interventions are effective when implemented on a large scale

The scope of the project will vary by the needs and resources of the country

country. Multiple delivery channels, combining interventions, community development approaches, mobilizing community interest and resources and coordinating government, private, grass-roots and family efforts are also important components (Young, 1996).

11.5 Conclusion

- There is an extensive scientific basis for the benefits of home and centre based stimulation on early childhood development. Adults born in poverty who participated in a quality preschool programme have higher social responsibility, education performance, earnings and property wealth and greater commitment to marriage.

- RCTs have shown that centre and home based ECCD interventions can improve parental verbal interaction, behaviour management and attitudes towards the child.

- Centre based interventions appear to be more effective than home based approaches. However, interventions that utilize more than one delivery channel appear to have the greatest impact. Intensive interventions and time periods of two to five years are felt to be needed for long lasting impact.

- Home based interventions appear to be effective in low-birth-weight and malnourished children but have inconsistent impacts on low-risk children.

- In malnourished children, the combination of supplementation and stimulation interventions appears to have a greater effect on cognitive development than either one alone. Such combined programmes are likely to be more efficient at delivering services.

11.6 Questions still to be answered

- Methods of increasing coverage and improving access of the most disadvantaged children to early childhood care and development programmes in developing countries.

- Effectiveness of community development approaches.

12. ANTENATAL CARE

■ **Key practice.** Ensure that every pregnant woman has adequate antenatal care. This includes her having at least four antenatal visits with an appropriate health-care provider, and receiving the recommended doses of the tetanus toxoid vaccination. The mother also needs support from her family and community in seeking care at the time of delivery and during the postpartum and lactation period.

Maternal health during pregnancy can affect the health of the unborn child in many ways. These include maternal–fetal transmission of diseases, fetal exposure to harmful substances, the effect of maternal nutrition on outcomes such as birth weight and mortality, and birth trauma/asphyxia related to pregnancy or delivery complications. Maternal mortality also affects child health; one study found that two-thirds of infants died within a year of their mother's death (Abdulghani., 1994). A maternal death has a strong social and economic impact through the loss of a productive worker and a primary caregiver.

Antenatal care aims to reduce maternal and infant mortality and morbidity through health workers providing a variety of pregnancy-related care and information. Early approaches to antenatal care were based on models developed in Europe in the early decades of last century, which advocated as many as 16 visits, and focused on identifying women who were at risk of obstetric complications (Carroli, Rooney & Villar, 2001). The components of the visits were not adjusted to meet the needs of developing countries and have not been sufficiently well evaluated. As more research was conducted, it became clear that such frequent antenatal visits were not needed to improve pregnancy outcomes (Munjanja, Lindmark & Nystrom, 1996; Carroli et al., 2001), that identifying high-risk women was difficult (Yuster, 1995), and that some of the visit components such as looking for ankle oedema were not effective (Enkin et al 2001; Carroli, Rooney & Villar, 2001). In response, in 1994, WHO began to advocate a minimum of four focused, goal-directed visits tailored to each woman's individual needs (Berg, 1995). The recommended components of the visits are shown in Box 22.

> **Antenatal care aims to reduce maternal and infant mortality and morbidity through health workers providing a variety of pregnancy-related care**

> **The content of antenatal visits has not been well evaluated. It is known that frequent visits are not needed to improve pregnancy outcome and that identifying high-risk women is not feasible.**

> **The elements of antenatal care are to detect and manage existing conditions, detect and manage complications and prevent problems**

BOX 22

The elements of antenatal visits

■ **Detection and management of existing diseases and conditions:**

HIV (voluntary counselling and testing)	STIs including syphilis
Tuberculosis	Malaria

■ **Detection and management of complications:**

Severe anaemia	Vaginal bleeding
Pre-eclampsia/eclampsia	Malpresentation after 36 weeks

■ **Prevention of illness and complications:**

Tetanus toxoid	Iron and folate supplementation

Birth preparedness and complication readiness planning

Counselling for family planning, breastfeeding, danger signs, HIV/STI, nutrition

■ **In some populations:**

Malaria (intermittent preventive treatment)	Vitamin A supplementation
Hookworm treatment	Iodine supplementation

Antiretrovirals to prevent mother-to-child transmission of HIV/AIDS

Source: WHO, 2003

For women to receive adequate antenatal care, it must be:

— accessible
— effective/good quality (including a functioning referral system)
— utilized at the correct times

and women:

— must follow the behavioural advice and adhere to any treatments or preventive therapies.

12.1 The prevalence of antenatal care

Antenatal attendance is high, with 65% of pregnant women in developing countries receiving at least one antenatal check-up with a skilled health worker during their pregnancy (see Figure 10 for regional levels). In 1990, the figure was only 53% (UNICEF, 2001a). Only 52% of pregnant women in developing countries are fully immunized against tetanus (UNICEF, 1999).

FIGURE 10
Percentage of pregnant women receiving at least one antenatal check-up

Source: UNICEF, 2001a

Observational studies have found that women who do not attend antenatal care tend to:

— be rural
— be less educated
— be young
— have no history of obstetric complications
— have poor social capital.

— have high parity
— have lower socioeconomic status
— not desire the pregnancy

(Becker et al., 1993; McCaw-Binns, La Grenade & Ashley, 1995; Addai, 2000; Eggleston, 2000; Magadi, Madise & Rodrigues, 2000; Nielsen et al., 2001; Cindoglu & Sirkeci, 2001).

Accessibility and quality of care have also been found to be associated with attendance (Materia et al., 1993; Magadi, Madise & Rodrigues, 2000; Nielsen et al., 2001; Acharya & Cleland, 2000; Abrahams, Jewkes & Mvo, 2001).

12.2 The benefit of antenatal care

Intervention studies exploring the efficacy of antenatal care have either looked at the maternal and child health impact of the individual elements of antenatal care or have compared the impact of different antenatal protocols (i.e. different number of visits, and focused versus 'standard' protocols). This review concentrates on the child outcomes. No intervention studies were located comparing groups receiving antenatal care versus no antenatal care, thus the extent to which the antenatal care package can reduce infant and child mortality and morbidity is yet to be shown.

A review of the impact of the individual elements of antenatal care is not within the scope of this report, and can be found elsewhere (Bergsjo & Villar, 1997). Box 23 gives some examples of studies that support four of the recommended components of antena-

65% of women in developing countries attend antenatal care at least once during their pregnancy, only 52% are fully immunized against tetanus

Sociodemographic and pregnancy-related factors are associated with attendance. Access is also important

No intervention studies were located comparing groups receiving antenatal care versus no antenatal care; thus the extent to which the antenatal care package can reduce infant and child mortality and morbidity is yet to be shown

tal care. Although reviewing the individual components is important, the antenatal package as a whole may have an impact greater than that of the individual components. For example, it may familiarize women with the health facility, enabling them to seek help more effectively in a crisis (Palaniappan, 1995).

> **BOX 23**
>
> **Examples of the impact of some of the individual components of antenatal care on child health**
>
> ■ **TETANUS TOXOID**. Neonatal tetanus causes approximately 200 000 deaths per year, corresponding to 14% of all neonatal deaths (UNICEF, 2001b). It usually occurs through infection of the umbilical stump in infants born to mothers with insufficient antibodies to protect the child through transplacental transfer. Being immunized against tetanus during pregnancy both protects the mother from tetanus and passes immunity to the unborn child. Although there are some unresolved questions about the minimum dose required, two doses are recommended (Berg, 1995) and have been shown to provide significant protection against neonatal tetanus for up to four years and reduce deaths from 14.4 per 1000 live births to 3.8 per 1000 (Koenig et al 1998). Studies on a single dose have either found a short-lived or no protective effect (Black, Huber & Curlin, 1980; Newell et al., 1966; Hardegree et al., 1970; Kielmann & Vohra, 1977; Breman et al., 1981).
>
> ■ **IRON SUPPLEMENTATION**. About half of all pregnant women are estimated to be anaemic (WHO, 1997), and severe anaemia is associated with increased preterm delivery, inadequate interuterine growth and increased perinatal mortality (Allen, 2000). A meta-analysis of 12 trials found that iron supplementation resulted in a significant reduction in severe anaemia, but conclusions could not be drawn about the effects on maternal and fetal outcomes due to a lack of data (Mahomed, 2000a).
>
> ■ **FOLATE SUPPLEMENTATION**. Folate depletion may also result in anaemia during pregnancy. A meta-analysis found that folate supplementation in pregnancy was associated with increased or maintained serum folate levels (eight trials) and a decrease in the number of women with low haemoglobin levels late in pregnancy (odds ratio 0.61) (six trials). The analysis found no effect on clinical outcomes of the mother or child. However, the methodological quality of the studies was not good and the reviewer concluded that there was not enough evidence to evaluate the effect (Mahomed, 2000b).
>
> ■ **INTERMITTENT TREATMENT FOR MALARIA**. Annually, 24 million pregnancies are threatened by malaria (WHO, 2002). A meta-analysis of trials giving effective malaria drugs regularly during pregnancy, found fewer women with severe anaemia and a higher average birth weight in the intervention groups (Garner & Gulmezoglu, 2000). The effect was greatest in primigravidae, with a 102 g difference in birth weight between the control and intervention groups (five studies), and an odds ratio of 0.55 for the prevalence of low birth weight (three studies). No difference in preterm birth, perinatal, neonatal or infant mortality were detected (five studies).

Observational studies tend to show that women who receive antenatal care have lower maternal and perinatal mortality and better pregnancy outcomes (Gray et al., 1991; Mavalankar, Trivedi & Gray, 1991; Hulsey et al., 1991; Galvan et al., 2001), but their interpretation is plagued with problems of confounding factors. These studies also tend to demonstrate an association between the number of visits and the pregnancy outcomes. Intervention studies do not support the findings regarding the number of visits. A meta-analysis of seven trials (mostly in developed countries) (see table B.12.1) involving more that 60 000 women, found that four visits were not associated with an increase in any of the negative perinatal outcomes compared to more frequent visits (e.g. odds ratio 1.04 (CI 0.93–1.17) for low birth weight and 1.06 (CI 0.82–1.36) for perinatal mortality) (Carroli et al., 2001).

A WHO multi-site study in four developing countries (see table B.12.1) (Villar et al., 2001) compared a focused, goal-directed protocol with the 'standard' protocol. The focused protocol consisted of the components outlined in Box 23 with women having a median of five antenatal visits. The standard antenatal care varied in each country, with women having a median of eight visits. The study found that a higher proportion of women received iron in the new model (86% versus 64%) – mostly due to very low iron supplementation in the standard model in Argentina; syphilis was treated more frequently in the new model (1.1% versus 0.7%); and the proportion with completed tetanus immunization was similar. A higher proportion of women in the new model were referred to a higher level

of antenatal care but fewer were admitted to hospital once referred, resulting in similar rates of hospital admission between the two groups (8.9% for the new model and 7.7% for the standard model). The outcome measures for the two groups are shown in Table 6. There was no statistical difference in low birth weight or treated urinary-tract infections between the models; rates of pre-eclampsia were slightly higher in the new model; and there was a large protective effect for postpartum anaemia in the new model in Argentina where there was very low iron supplementation in the standard model. The authors of the trial conclude that a reduction in the number of antenatal visits, including goal-oriented effective activities, is not associated with increased risk for mothers or their infants.

TABLE 6
Primary outcome measures for a multi-site study comparing a new model of antenatal care to the 'standard model'
(Source: Villar et al., 2001)

OUTCOME	NEW MODEL	STANDARD MODEL	ADJUSTED ODDS RATIO (95% CI)
Low birth weight (<2500 g)	7.86	7.14	1.06 (0.97–1.15)
Pre-eclampsia/eclampsia	1.69	1.38	1.26 (1.02–1.56)
Postpartum anaemia	7.59	8.67	1.01*
Treated urinary-tract infections	5.95	7.41	0.93 (0.79–1.10)

* Confidence intervals not shown, as effect was heterogeneous across sites and strata.

The study also explored women's satisfaction with the two models. There was no difference between the groups in terms of satisfaction with the number of visits, waiting times, or information provided, but women in the new model were more satisfied with the time spent with the provider (Langer et al., 2002).

12.3 The impact of interventions to increase antenatal care
Interventions to increase the number of pregnant women receiving adequate antenatal care can address this by:

— improving the delivery system (access, cost, waiting times); and/or
— improving utilization (through social mobilization or mass communication campaigns).

No intervention studies were located on the impact on utilization of improving access, although an association between access and utilization has been found in observational studies (Materia et al., 1993; Magadi, Madise & Rodrigues, 2000; Nielsen et al., 2001; Acharya & Cleland, 2000; Abrahams, Jewkes & Mvo, 2001). No interventions were located which aimed to increase use of antenatal care through social mobilization or mass communication.

Moderating factors
Quality of care. Adequate quality of care is essential for effective antenatal care. In South Africa, syphilis is widespread. However, although 73% of women received antenatal care, only 38% of these were estimated to be screened for syphilis (Gloyd, Chai & Mercer, 2001). In such cases, efforts are needed to improve quality.

12.4 The feasibility of large-scale programmes
The recommended minimum number of four antenatal care visits is feasible if women are aware of the importance of this care-seeking behaviour for their health and their infant's health outcomes, and if health workers are trained for antenatal care screening procedures (height, weight, blood pressure, checking for anaemia). The community must be involved

and aware of the importance of antenatal care practices to support and encourage women in seeking such care.

In the context of antenatal care, referrals are feasible if central referral hospitals are in place. The cost of screening procedures could be high. Adequacy of the visits is critical to ensure good neonatal and maternal health outcomes, since quality must be maintained even if the number of visits is reduced.

The recommended two doses of tetanus toxoid vaccine need to be administered at least four weeks apart, and the second dose must be at least two weeks before delivery. Feasibility of this practice depends on women's awareness of the importance of the immunization and follow-up to the first vaccine. Tetanus toxoid must be kept cold and special training may be needed to administer immunizations.

12.5 Conclusions

■ The extent to which the antenatal care package can reduce infant and child mortality and morbidity is yet to be shown. Interventions have explored the health impact of individual elements of the visit or have compared the different antenatal protocols (i.e. different number of visits, and focused versus 'standard' protocols).

■ A meta-analysis of seven trials found that four antenatal visits were not associated with an increase in negative perinatal outcomes compared to more frequent visits (e.g. no statistically significant differences in low birth weight or perinatal mortality).

■ A multi-site study found that fewer goal-oriented antenatal visits were not associated with increased risk for mothers or their infants compared to the standard model (e.g. no statistical difference in low birth weight or treated urinary-tract infections between the models; rates of pre-eclampsia were slightly higher in the new model).

■ No interventions were located which aimed to increase use of antenatal care through social mobilization or mass communication.

12.6 Questions still to be answered

■ The impact of the individual components and the extent to which the package can reduce infant and child mortality and morbidity are yet to be shown.

■ Effectiveness of strategies to improve coverage/utilization.

TABLE B.1.1
Measles immunization and all-cause childhood mortality

STUDY	DESIGN	TARGET GROUP	INTERVENTION	COMPARISON GROUP	FOLLOW-UP	OUTCOMES	RESULTS (95% CONFIDENCE INTERVAL)
BANGLADESH Clemens 1988	Case control study	Children aged 9–60 months	Measles immunization given at 9–60 months	No measles immunization	—	Deaths in unimmunized Deaths in immunized Crude vaccine efficacy (%) Adjusted vaccine efficacy (%)	536 deaths — 36 (21–48) 36 (20–50)
Koenig 1990	Prospective follow-up study with concurrent controls	Children aged 9–60 months	Measles immunization given at 9–60 months	No measles immunization	22 months	Mortality unimmunized Mortality immunized Crude vaccine efficacy (%) Adjusted vaccine efficacy (%)	339/14940 195/15327 44 (33–53) 46 (35–95)
BENIN Velema 1991	Case control study	Children aged 9–23 months	Measles immunization given at 9–23 months	No measles immunization	—	Deaths in unimmunized Deaths in immunized Crude vaccine efficacy (%) Adjusted vaccine efficacy (%)	74 deaths — 45 (-7–72) 45 (-7–72)
BURUNDI Chen 1994	Prospective follow-up study with concurrent controls	Children aged 9–23 months	Measles immunization given at 9–23 months	No measles immunization	15 months	Mortality unimmunized Mortality immunized Crude vaccine efficacy (%) Adjusted vaccine efficacy (%)	51/1083 14/1201 75 (55–86) —
GUINEA-BISSAU Aaby 1984a	Prospective follow-up study with concurrent controls	Children aged 6–36 months	Measles immunization given at 6–36 months	No measles immunization	13 months	Mortality unimmunized Mortality immunized Crude vaccine efficacy (%) Adjusted vaccine efficacy (%)	5/75 7/170 38 (-95–80) —
Aaby 1984b	Prospective follow-up study with concurrent controls	Children aged 6–35 months	Measles immunization given at 6–35 months	No measles immunization	12 months	Mortality unimmunized Mortality immunized Crude vaccine efficacy (%) Adjusted vaccine efficacy (%)	10/71 7/361 86 (64–95) —
Aaby 1989	Prospective follow-up study with concurrent controls	Children aged 7–24 months	Measles immunization given at 7–24 months	No measles immunization	24 months	Mortality unimmunized Mortality immunized Crude vaccine efficacy (%) Adjusted vaccine efficacy (%)	7/93 6/245 67 (3–89) 83 (35–95)
Aaby 1990	Prospective follow-up study with concurrent controls	Children aged 9–23 months	Measles immunization given at 9–23 months	No measles immunization	19 months	Mortality unimmunized Mortality immunized Crude vaccine efficacy (%) Adjusted vaccine efficacy (%)	34/368 20/596 64 (37–79) 66 (32–83)
SENEGAL Garenne 1986	Prospective follow-up study with concurrent controls	Children aged 6–35 months	Measles immunization given at 6–35 months	No measles immunization	32 months	Mortality unimmunized Mortality immunized Crude vaccine efficacy (%) Adjusted vaccine efficacy (%)	1104/6699 46/398 30 (6–48)
Aaby 1993	Prospective follow-up study with concurrent controls	Children aged 9–18 months	Measles immunization given given at 9–18 months	No measles immunization	23 months	Mortality unimmunized Mortality immunized Crude vaccine efficacy (%) Adjusted vaccine efficacy (%	86/1611 90/2807 40 (19–55) —
HAITI Holt 1990	Prospective follow-up study with concurrent controls	Children aged 6–13 months	Measles immunization given at 6–13 months	No measles immunization	30 months	Mortality unimmunized Mortality immunized Crude vaccine efficacy (%) Adjusted vaccine efficacy (%)	70/2500 3/759 86 (55–96) 90 (59–98)
DEMOCRATIC REPUBLIC OF THE CONGO (FORMERLY ZAIRE) Kasongo 1981	Prospective follow-up study with concurrent controls	Children aged 7–9 months	Measles immunization given at 7–9 months	No measles immunization	24 months	Mortality unimmunized Mortality immunized Crude vaccine efficacy (%) Adjusted vaccine efficacy (%)	66/1811 6/349 53 (-9–80) —

TABLE B.2.1
Breastfeeding and all-cause childhood mortality
(deaths due to non-infectious diseases and in the first week of life excluded)

STUDY	DESIGN	TARGET GROUP	BREASTFEEDING STATUS	COMPARISON GROUP	MORTALITY ASSOCIATED WITH LACK OF BREASTFEEDING	
					AGE GROUP (MONTHS)	ODDS RATIO (95% CONFIDENCE INTERVAL)
BREASTFEEDING AT 0–11 MONTHS						
BRAZIL Victora 1987	Case control study	Urban children aged 0–11 months	Exclusive or partial breastfeeding before admission to hospital	Not breastfeeding before admission	0–1 2–3 4–5 6–8 9–11	7.2 (3.3–15.9) 3.8 (2.3–6.1) 2.5 (1.4–4.5) 2.4 (1.2–4.7) 1.9 (0.7–5.3)
PAKISTAN Hanson 1994	Prospective follow-up study with concurrent controls	Rural and urban children aged 0–23 months	Exclusive or partial breastfeeding before onset of fatal disease or seven days before death	Not breastfeeding in the age intervals described	0–1 2–3 4–5 6–8 9–11	21.3 (7.9–57.7) 11.8 (3.1–45.4) 1.6 (0.0–10.3) 3.5 (0.0–27.1)
PHILIPPINES Yoon 1996	Prospective follow-up study with concurrent controls	Urban children aged 0–23 months	Exclusive or partial breastfeeding before onset of fatal disease or 7 days before death	Not breastfeeding in the age intervals described	0–1 2–3 4–5 6–8 9–11	2.5 (1.0–6.3) 5.1 (1.9–13.7) 2.6 (1.1–5.8) 1.5 (0.8–2.6) 1.2 (0.6–2.5)
POOLED RESULTS OF THE ABOVE WHO Collaborative Study Group 2000			Studies: Victora 1987, Hanson 1994, Yoon 1996		0–1 2–3 4–5 6–8 9–11	5.8 (3.4–9.8) 4.1 (2.7–6.4) 2.5 (1.6–3.9) 1.8 (1.2–2.8) 1.4 (0.8–2.6)

TABLE B.2.2
Breastfeeding and diarrhoeal morbidity

STUDY	DESIGN	AGE GROUP (MONTHS)	BREASTFEEDING PRACTICE*	EFFECT SIZE	COMMENT
USA Scariati 1997	Prospective follow-up with concurrent controls	2–7	EBF PBF FF	1 0.9–1.3 1.8	Adjusted odds ratio of experiencing diarrhoea
USA Dewey 1995	Prospective follow-up with concurrent controls	0–12	BF FF	0.14 0.31	Adjusted incidence of number of days of diarrhoea per 100 at risk
SCOTLAND Howie 1990	Prospective follow-up with concurrent controls	0–13wks 14–26wks 27–39wks 40–52 wks	See comment	6.6–16.8 4.0–16.2 2.5–16.1 5.1–18.5	Confidence interval for risk difference among BF and FF infants (% point reduction in risk)
INDIA Mondal 1996	Prospective follow-up with concurrent controls	<12	EPF>4 months BF<3 months	3.02 1	Incidence rate ratio
PHILIPPINES VanDerslice 1994	Prospective follow-up with concurrent controls	< 6	EBF PBF FF	0.1 0.13 0.25	Predicted probabilities of diarrhoea
Popkin 1990	Prospective follow-up with concurrent controls	0–11	EBF FBF PBF FF	1 2.0–3.2 4.7–13.1 4.7–16.8	Range of adjusted relative risks for diarrhoea depending on age
ETHIOPIA Ketsela 1990	Cross sectional	<6	EBF PBF	1 5–5.42	Age-adjusted relative risk for developing diarrhoea
BANGLADESH Ahmed 1992	Case control	<6	BF FF	0.02 1	Adjusted odds ratio of episodes of Shigellosis and dysentery

BF: Breastfed; FBF: Fully breastfed; EBF: Exclusively breastfed; PBF: Partially breastfed; FF: Formula fed

TABLE B.3.1
Randomized controlled trials of complementary feeding interventions and childhood growth

STUDY	TARGET GROUP	INTERVENTION	COMPARISON GROUP	FOLLOW-UP	OUTCOMES	RESULTS
GUATEMALA Schroeder 1993 Schroeder 1995	Rural children aged 0–84 months	A high-energy, moderate-protein, micronutrient-fortified drink was provided daily at feeding centres	Normal care	9 months	Change in WAZ* from baseline to 6–12 months of age Change in HAZ† from baseline to 6–12 months of age	+0.25 greater than comparison group +0.17 greater than comparison group
COLOMBIA Lutter 1990 Mora 1981	Rural children aged 3–12 months	Whole powdered milk and commercial high-protein vegetable mix (428 kcal/day) with 10 mg/day of iron and 1552 IU/day vitamin A were distributed to families weekly	Normal care	9 months	Change in WAZ from baseline to 6–12 months of age Change in HAZ from baseline to 6–12 months of age	+0.40 greater than comparison group +0.35 greater than comparison group
JAMAICA Walker 1991	Rural children aged 9–24 months	Milk-based formula, skim milk powder and cornmeal (750 kcal/day and 20 g/day protein) were distributed to families weekly	Normal care	9 months	Change in WAZ from baseline to 6–12 months of age Change in HAZ from baseline to 6–12 months of age	+0.44 greater than comparison group +0.29 greater than comparison group
INDONESIA Husaini 1991	Rural children aged 6–20 months	20 snacks of local foods containing bread, rice, wheat flour, sweet potato, coconut milk, cassava, potatoes, sugar and oil (400 kcal/day and 5 g/day protein) were offered daily to children attending day-care centres	Normal care	5 months	Change in WAZ from baseline to 6–12 months of age Change in HAZ from baseline to 6–12 months of age	+0.29 greater than comparison group +0.04 greater than comparison group
BANGLADESH Brown 1992	Rural children aged 8 months	Provided specific feeding advice and cooking demonstrations to caregivers in their home on how to enrich meals with energy and protein (using oil, molasses, fish, lentil flour, fruits and vegetables), and the importance of frequent and persistent feeding of local food made from brown sugar, wheat flour and oil.	Normal care	5 months	Change in WAZ from baseline to 6–12 months of age	+0.46 greater than comparison group

*Weight-for-age z-score. †Height-for-age z-score.

Randomized controlled trials of vitamin A supplementation and all-cause childhood mortality

STUDY	INTERVENTION	COMPARISON GROUP	OUTCOMES	RELATIVE RISK	DESIGN EFFECT*
CHILDREN AGED 0–5 MONTHS					
JUMLA, NEPAL Daulaire 1992	Supplementation with one dose of 100 000 IU vitamin A, 50 000 IU for children aged < 1 month	Placebo	Mortality rates at 5 months	0.99	1.416
TAMIL NADU, INDIA Rahmathullah 1990	Weekly supplementation with 8333 IU vitamin A	Placebo	Mortality rates at 12 months	—	1.329
SARLAHI, NEPAL West 1991	Four-monthly supplementation with 100 000 IU vitamin A, 50 000 IU for children aged < 1 month	Placebo	Mortality rates at 12 months	0.97	1.187
NORTHERN SUDAN Herrera 1992	Six-monthly supplementation with 200 000 IU vitamin A	Placebo	Mortality rates at 18 months	—	1.000
GHANA, INDIA, PERU WHO/CHD 1998	Supplementation with 25 000 IU vitamin A at 6, 10, 14 weeks and 9 months	Placebo	Mortality rates at 2 months	—	2.003
META-ANALYSIS Vitamin A and Pneumonia Working Group 1995	Daulaire 1992, Rahmathullah 1990, West 1991, Herrera 1992, WHO/CHD 1998			Summary relative risk 0.97 (0.73–1.29)	
BANDUNG, INDONESIA Humphrey 1996	Supplementation with 50 000 IU vitamin A on first day of life	Placebo	Mortality rates at 12 months	0.36 (0.16–0.87)	
CHILDREN AGED 6 MONTHS TO 5 YEARS					
ACEH, INDONESIA Sommer 1986	Six-monthly supplementation with 200 000 IU vitamin A	Placebo	Mortality rates at 12 months	0.73 (0.56–0.96)	1.11
KINTAMPO, GHANA VAST 1993	Four-monthly supplementation with 200 000 IU vitamin A, 100 000 IU for children aged 6–11 months	Placebo	Mortality rates at 24 months	0.80 (0.70–0.93)	1.22
HYDERABAD, INDIA Vijayaraghavan 1990	Three-monthly supplementation with 200 000 IU vitamin A, 100 000 IU for children aged 6–11 months	Placebo	Mortality rates at 12 months	0.94 (0.57–1.56)	1.34
JUMLA, NEPAL Daulaire 1992	Supplementation with 200 000 IU vitamin A, 100 000 IU for children aged 6–11 months, once only at baseline	Placebo	Mortality rates at 5 months	0.74 (0.55–1.01)	1.92
INDONESIA, BOGOR Muhilal 1988	Daily supplementation with vitamin A in MSG	Placebo	Mortality rates at 11 months	0.70 (0.57–0.86)	1.25
SARLAHI, NEPAL West 1991	Four-monthly supplementation with 200 000 IU vitamin A, 100 000 IU for children aged 6–11 months	Placebo	Mortality rates at 12 months	0.71 (0.56–0.89)	1.22
NORTHERN SUDAN Herrera 1992	Six-monthly supplementation with 200 000 IU vitamin A	Placebo	Mortality rates at 18 months	1.04 (0.81–1.34)	1.00
TAMIL NADU, INDIA Rahmathullah 1990	Weekly supplementation with 8333 IU vitamin A	Placebo	Mortality rates at 12 months	0.50 (0.34–0.75)	1.14
META-ANALYSIS Beaton 1993	Sommer 1986, Muhilal 1988, Rahmathullah 1990, Vijayaraghavan 1990, West 1991, Daulaire 1992, Herrera 1992, as above.			Summary relative risk 0.77 (0.71–0.84)	

TABLE B.4.2
Randomized controlled trials of iron supplementation and child development

STUDY	TARGET GROUP	INTERVENTION	COMPARISON GROUP	OUTCOMES	RESULTS
TREATMENT TRIALS IN ANAEMIC CHILDREN AGED 0–24 MONTHS					
USA Oski 1978	Children aged 9–24 months	Intramuscular iron for 5–8 days (dose was enough to raise Hb to 120 g/L)	Anaemic children given placebo	Bayley scales of infant development and infant behaviour record at end of intervention	MDI* and reactivity significantly improved. PDI† and attention no difference
GUATEMALA Lozoff 1982a, Lozoff 1982b	Children aged 6–24 months	5mg/kg ferrous ascorbate for seven days	Anaemic children given placebo	Bayley scales of infant develop-ment at end of intervention	Fear, reactivity and MDI significantly improved
CHILE Walter 1989	Children aged 12 months	15 mg of ferrous salt for 10 days	Anaemic children given placebo	Bayley scales at end of intervention	No differences in MDI and PDI
GREECE Driva 1985	Children aged 3–25 months	One dose of 50 mg intra-muscular iron at day 1 and follow-up for 20 days.	Anaemic children given iron at day 10	Bayley scales of infant develop-ment at day 10 and at end of intervention	No significant differences in MDI or PDI
UNITED KINGDOM Aukett 1986	Children aged 17–19 months	24 mg iron plus 10 mg vitamin C per day for 2 months	Anaemic children given 10 mg vitamin C for 2 months	Denver developmental screening test at end of intervention	Expected rate of develop-ment significantly improved
COSTA RICA Lozoff 1987	Children aged 12–23 months	Oral and intramuscular iron treatment for seven days	Anaemic children given placebo	Bayley scales of infant develop-ment and infant behaviour record at end of intervention	No significant differences
INDONESIA Idjradinata 1993	Children aged 12–18 months	3 mg/kg/day iron sulphate for four months	Anaemic children given placebo	Bayley scales of infant develop-ment at end of intervention	No significant differences
PROPHYLACTIC TRIALS IN NON-ANAEMIC CHILDREN AGED 0–24 MONTHS					
PAPUA NEW GUINEA Heywood 1989	Children aged 2–13 months	IM dextran, 150 mg of elemental iron for 10 months	Non-anaemic children given placebo	Visual attention scores at end of intervention	No significant differences except total fixation time significantly improved
CHILE Walter 1989	Children aged 3–12 months	Iron fortified formula for nine months in exclusively breastfed and weaned infants	Non-anaemic children given unfortified formula	Bayley scales of infant develop-ment and infant behaviour record at end of intervention	No significant differences
Lozoff 1997	Children aged 6–12 months	Iron supplementation for six months	Non-anaemic children given placebo	Bayley scales of infant develop-ment and Fagan test at end of intervention	No significant differences on Bayley scales, significant improvements in fixation time on Fagan test
CANADA Moffatt 1994	Children aged < 2–15 months	Iron fortified formula (12.8 mg/L Fe) for 13 months	Non-anaemic children given low iron formula (1.1 mg/L iron)	Bayley scales of infant develop-ment and infant behaviour record at 6, 9, 12 and 15 months after the onset of the intervention	At 15 months no significant differences
UNITED KINGDOM Williams 1999	Children aged 7–18 months	Iron fortified formula (1.2 mg Fe/100 mls) for 12 months	Non-anaemic children given cow's milk	Griffith Scales at 12 months after the end of the intervention	Mean scores fell significantly less in treatment group
Morley 1999	Children aged 9–18 months	High iron formula (1.2 mg iron/L) for 9 months	Usual cow's milk or low iron formula (1.2 mg iron/L)	Bayley scales nine months after the end of the intervention	No significant differences
TREATMENT TRIALS IN ANAEMIC CHILDREN AGED MORE THAN 24 MONTHS AND ADULTS					
USA Pollitt 1983	Children aged 3–6 years	4–5 mg/kg/day elemental iron for 4–6 months	Anaemic children given placebo	Discrimination learning tasks, oddity learning, short term memory, Stanford Binet at end of intervention	No significant differences
Deinard 1986	Children aged 18–60 months	6 mg/kg/day elemental iron for six months	Anaemic children given placebo	Bayley scales of infant develop-ment 18–24 months, Stanford Binet for > 2 years, behaviour rating at end of intervention	No significant differences

*Mental development index. †Psychomotor development index.

STUDY	TARGET GROUP	INTERVENTION	COMPARISON GROUP	OUTCOMES	RESULTS
Bruner 1996	Girls aged 13–18 years	260 mg per day of elemental iron for eight weeks	Anaemic children given placebo	Brief test of attention, symbol digits modalities test, visual search and attention, Hopkins verbal learning test at end of intervention	No difference in brief test of attention, symbol digits modalities test, visual search and attention. Hopkins verbal learning test significantly improved.
INDONESIA Soemantri 1985	Mean age of 11.7 years	10 mg/kg/day ferrous sulfate for three months	Anaemic children given placebo	Standard achievement tests, Wisconsin test for concentration at end of intervention	Significant improvements in school achievement and concentration
Soewondo 1989	Mean age of 56 months	50 mg iron per day for eight weeks	Anaemic children given placebo	Peabody picture vocabulary test, discrimination learning tasks, oddity tasks at end of intervention	Discrimination learning tasks and oddity tasks significantly improved. No difference in the Peabody picture vocabulary test.
EGYPT Pollitt 1985	Mean age of 9.5 years	50 mg of ferrous sulfate daily for 3–4 months	Anaemic children given placebo	Matching familiar figure test at four months	Significant improvements
GUATEMALA Pollitt 1986	Children aged 30–72 months	Iron sulfate 3 mg/kg/day for 11–12 weeks	Anaemic children given placebo	Discriminant learning, short-term memory, oddity learning tasks at end of intervention	Discriminant learning significantly improved, no differences in short-term memory or oddity learning tasks
THAILAND Politt 1989	Children aged 9–11 years	50 mg per day of ferrous sulfate for two weeks, then 100 mg per day for 14 weeks	Anaemic children given placebo	Raven progressive matrices, Thai language and maths tests at end of intervention	Raven progressive matrices, Thai language and maths tests all significantly improved
INDIA Seshadri 1989	Children aged 5–8 years	20 mg elemental iron and 0.1 mg folic acid per day for 60 days	Anaemic children given placebo	Indian adapted WISC at end of intervention	Verbal, performance and global IQ significantly improved
UNITED KINGDOM Lynn 1998	Children aged 12–16 years	17 mg of elemental iron plus 17 mg ascorbic acid daily for 16 weeks	Anaemic children given placebo	Raven progressive matrices at end of intervention	No significant differences

Randomized controlled trials of zinc supplementation and incidence of childhood diarrhoea and pneumonia

STUDY	TARGET GROUP	INTERVENTION	COMPARISON GROUP	OUTCOMES	ODDS RATIO (95% CONFIDENCE INTERVALS)
CONTINUOUS ZINC SUPPLEMENTATION					
INDIA Sazawal 1997 Sazawal 1998	6–35 months	Continuous supplementation with 10 mg zinc gluconate daily for 26 weeks plus vitamins A, B, D, E	Vitamins A, B, D, E only	Incidence of diarrhoea Prevalence of diarrhoea Incidence of pneumonia	0.9 (0.85, 1.0) 0.95 (0.90, 0.99) 0.57 (0.34–0.93)
MEXICO Rosado 1997	18–36 months	Continuous supplementation with 20 mg zinc methionate five times per week for 54 weeks. 50% also received iron supplementation.	50 % received placebo and 50 % received iron supplementation	Incidence of diarrhoea Prevalence of diarrhoea Incidence of pneumonia	0.7 (0.6–0.8) 0.7 (0.65. 0.77) Not available
PAPUA NEW GUINEA Shankar 1997	6–60 months	Continuous supplementation with 10 mg zinc gluconate six times per week for 46 weeks	Placebo	Incidence of diarrhoea Prevalence of diarrhoea Incidence of pneumonia	Not available Not available Not available
PERU Penny 1999	6–35 months	Continuous supplementation with 10 mg zinc gluconate daily for 26 weeks	Placebo	Incidence of diarrhoea Prevalence of diarrhoea Incidence of pneumonia	0.85 (0.8, 1.0) 0.95 (0.8, 0.9) 0.85 (0.35–2.04)
VIET NAM Ninh 1996	4–36 months	Continuous supplementation with 10 mg zinc sulphate daily for 22 weeks	Placebo	Incidence of diarrhoea Prevalence of diarrhoea Incidence of pneumonia	0.55 (0.4–0.76) 0.45 (0.4–0.6) 0.54 (0.39–0.80)
GUATEMALA Ruel 1997	6–9 months	Continuous supplementation with 10 mg zinc sulphate daily for 28 weeks	Placebo	Incidence of diarrhoea Prevalence of diarrhoea Incidence of pneumonia	0.82 (0.72, 0.92) 0.75 (0.7, 0.8) Not available
JAMAICA Meeks 1998	6–24 months	Continuous supplementation with five mg zinc sulphate daily for 12 weeks plus vitamins A, B, C, D	Vitamins A, B, C, D only	Incidence of diarrhoea Prevalence of diarrhoea Incidence of pneumonia	0.9 (0.58, 1.42) 0.80 (0.62, 1.1) 0.12 (0.00–13.58)
META-ANALYSIS Bhutta 1999a		Sazawal 1997, Sazawal 1998, Rosado 1997, Penny 1999, Ninh 1996, Ruel 1997, Meeks 1998		Incidence of diarrhoea Prevalence of diarrhoea Incidence of pneumonia	Summary odds ratio 0.82 (0.72–0.93 0.75 (0.63–0.88) 0.59 (0.41–0.83)
SHORT COURSE ZINC SUPPLEMENTATION					
BANGLADEH Roy 1999	3–24 months	Short course supplementation with 20 mg zinc acetate daily for two weeks plus vitamins A, B, D, E	Vitamins A, B, D, E only	Incidence of diarrhoea Prevalence of diarrhoea Incidence of pneumonia	Not available Not available Not available
PAKISTAN Bhutta 1999	6–36 months	Short course supplementation with 20 mg zinc sulphate daily for two weeks plus vitamins A, B, C, D	Vitamins A, B, C, D only	Incidence of diarrhoea Prevalence of diarrhoea Incidence of pneumonia	Not available Not available Not available
Roy 1999	3–24 months	Short course supplementation with 20 mg zinc acetate daily for two weeks plus vitamins A, B, D, E	Vitamins A, B, D, E only	Incidence of diarrhoea Prevalence of diarrhoea Incidence of pneumonia	Not available Not available Not available
META-ANALYSIS Bhutta 1999b		Roy 1999, Bhutta 1999		Incidence of diarrhoea Prevalence of diarrhoea Incidence of pneumonia	Summary odds ratio 0.89 (0.62–1.28) 0.66 (0.52–0.83) 0.74 (0.40–1.37)

Handwashing interventions and childhood diarrhoea

STUDY	DESIGN	TARGET	INTERVENTION	COMPARISON GROUP	FOLLOW-UP	EFFECT SIZE
BANGLADESH Khan 1982	Prospective with concurrent controls	People with confirmed cases of Shigella	Soap and water pitchers distributed and handwashing education given	Matched controls	10 days	Intervention: secondary infection rate 10.1 Control: secondary infection rate 32.4
Stanton & Clemens 1987	Randomized control trial	Urban slum communities	Soap distributed and hygiene education given – handwashing, no defecation in living area, no garbage into children's mouths.	No intervention	6 months	Intervention: rate of diarrhoea 4.3 Control: rate of diarrhoea 5.8 Protective effect 26%
Alam et al. 1989	Prospective with concurrent controls	Rural mothers of children 6–23 months	Access to water improved and hygiene education given – handwashing, hand pump use, clear faeces from yard.	No intervention	3 years	Intervention: 3.4 episodes/year Control: 4.1 episodes/year
Shahid et al. 1996	Prospective with historical controls	All households in peri-urban slum	Soap and water container distribution, and handwashing education	No intervention	1 year	2.6 reduction in diarrhoeal episodes in the intervention area during the observation period
MYANMAR Han and Hlaing 1989	Randomized control trial	Urban mothers with children 6–59 months	Soap distributed and hand-washing education given	No intervention	4 months	Diarrhoea incidence density ratio: 0.70 (0.54–0.92)
GUATEMALA Torun 1982	Not available					
INDONESIA Wilson et al. 1991	Prospective with historical controls	Rural mothers with children under 11 years	Soap distributed and hand-washing education given	Education about ORT	5 months	89% less diarrhoea episodes in the intervention area during the observation period
THAILAND Pinfold & Horan 1996	Prospective with concurrent controls	Rural	Social marketing approach promoting hand-and dish-washing. One community received more media and free soap sample.	No intervention	3 months	39% less diarrhoeal episodes in children in the intervention than the control villages
DEMOCRATIC REPUBLIC OF THE CONGO (FORMERLY ZAIRE) Haggerty et al. 1994	Randomized control trial	Rural mothers of children 3–35 months	Hygiene education – dispose of children's and animal faeces from yard, wash hands after defecation, before preparing meals and eating.	Education about ORS and breastfeeding	3 months	Children in the intervention experienced an 11% reduction in reporting diarrhoea during the peak diarrhoea season
THE GAMBIA Hoare et al. 1999	Prospective with concurrent controls	Rural mothers of children under 3 years	Hygiene education – handwashing and skin hygiene.	Education about family planning	1 year	No significant difference in incidence of diarrhoea between the intervention and control groups

TABLE B.5.2
Sanitation and all-cause childhood mortality

STUDY	DESIGN	TARGET GROUP	FACTOR EXPLORED	OUTCOMES	RESULTS
BRAZIL Merrick 1983	Prospective follow-up study with historical controls	Children aged 0–4 years living in urban areas	Improved water and sanitation	Mortality rates in children aged 0–11 months	Not available
COSTA RICA Haines 1982	Cross sectional study	Children aged 0–4 years living in rural areas	Improved sanitation	Ratio of expected to actual child deaths provided an index of whether each mother was doing better or worse than the national mortality average	Moving from a home with fair sanitation (latrine) to one with a sewer or septic tank would reduce the child mortality index by 16%
EGYPT Weir 1952	Prospective follow-up study with historical controls	Children aged 0–4 years living in rural areas	Improved sanitation	Mortality rates in children aged 0–11 months and 1–4 years	Not available
GUATEMALA Ascoli 1967	Prospective follow-up study with historical controls	Children aged 0–4 years living in rural areas	Improved sanitation	Mortality rates in children aged 0–11 months and 1–4 years	Not available
MALAYSIA Butz 1984	Case control study	Children aged 0–12 months living in urban and rural areas	Installation of flush toilets, piped water	Probability of death in infants aged 8–28 days, 2–6 months, 7–12 months	No significant effect for infants aged 2–6 months breastfed without supplementation for the first four weeks of life. Among non-breastfed infants, death rates were 60/1000 less for those living in houses with a toilet.
SRI LANKA Meegama 1980	Not available				Not available
Patel 1980	Cross sectional	Children aged 0–4 years living in urban and rural areas	Improved water and sanitation	Associations between regional infant mortality rate and sanitation provision	Association between provision of latrines and infant mortality (r = -0.79)
SUDAN Bannaga 1978	Cross sectional study	Children aged 0–4 years living in urban and rural areas	Improved water and sanitation	Infant mortality rate	Not available
SYNTHESIS OF ABOVE STUDIES Esrey 1985			Merrick 1983, Haines 1982, Weir 1952, Ascoli 1967, Butz 1984, Bannaga 1978, Patel 1980, Meegama 1980	Mortality rates in children aged 0–4 years	Median reduction 21%, range (0–81) % More rigorous studies: 30% range (8–64)%

TABLE B.6.1
Randomized controlled trials of insecticide-treated bednet provision and all-cause childhood mortality

STUDY	TARGET GROUP	INTERVENTION	COMPARISON GROUP	FOLLOW-UP (MONTHS)	OUTCOMES	RESULTS (95% CONFIDENCE INTERVAL)
GHANA Binka 1996	Children aged 1–59 months with entomological inoculation rate 100–300 and no *Plasmodium vivax*	Treatment of nets every six months with permethrin 500 mg per square metre	No nets	24 months	Intervention rate Control rate Rate difference Relative risk Protective efficacy	28.2 34.2 6.0 (1.4–10.6) 0.72 18 (1–30) %
KENYA Nevill 1996	Children aged 1–59 months with entomological inoculation rate 10–30 and no *Plasmodium vivax*	Treatment of nets every six months with permethrin 500 mg per square metre	No nets	24 months	Intervention rate Control rate Rate difference Relative risk Protective efficacy	9.4 13.2 3.8 (1.1–6.6) 0.81 29 (3–47)%
BURKINA FASO Habluetzel 1997	Children aged 1–59 months with entomological inoculation rate 300–500 and no *Plasmodium vivax*	Treatment of nets every six months with permethrin 1000 mg per square metre	No nets	24 months	Intervention rate Control rate Rate difference Relative risk Protective efficacy	41.8 48.7 6.9 (-2.5–16.2) 0.86 14 (-8–30) %
THE GAMBIA D'Alessandro 1995	Children aged 1–59 months with entomological inoculation rate 1–10 and no *Plasmodium vivax*	Treatment of nets at baseline with permethrin 200 mg per square metre	Untreated nets	12 months	Intervention rate Control rate Rate difference Relative risk Protective efficacy	18.7 24.3 5.6 (0.4–10.7) 0.77 23 (1–41) %
META-ANALYSIS OF STUDIES COMPARING INSECTICIDE-TREATED NETS TO NO NETS OR UNTREATED NETS						
Lengeler 2001	D'Alessandro 1995, Binka 1996, Nevill 1996, Habluetzel 1997				Summary protective efficacy Summary relative risk	0.82 18%
META-ANALYSIS OF STUDIES COMPARING INSECTICIDE TREATED NETS TO NO NETS						
Lengeler 2001	Binka 1996, Nevill 1996, Habluetzel 1997				Summary relative risk Summary protective efficacy	0.83 17%

TABLE B.7.1
Feeding solids during illness and diarrhoeal morbidity

STUDY	DESIGN	TARGET GROUP	INTERVENTION	COMPARISON GROUP	OUTCOMES	RESULTS
CHILE						
Garcia 1975	Prospective follow-up study with concurrent controls	Children aged 1–21 months	Chick peas with skim milk	Controls who received acid milk alone	Any diarrhoea at day 6	More children were diarrhoea-free compared to controls
Ibanez 1979	Prospective follow-up study with concurrent controls	Children with mean age of 4.6 months	Carrots, acid milk, sugar, oil	Controls who received acid milk or undiluted cow's milk alone	Duration of diarrhoea Weight gain	Duration of diarrhoea shorter compared to controls No significant differences compared to controls
Ibanez 1986	Prospective follow-up study with concurrent controls	Children with mean age of 5.4 months	Carrots, acid milk, sugar, oil	Controls who received acid milk or undiluted cow's milk alone	Duration of diarrhoea Weight gain	Duration of diarrhoea shorter compared to controls No significant differences compared to controls
BANGLADESH						
Molla 1983a	Prospective follow-up study with historical controls	Children aged 0–59 months	Chicken-lentils-oil, rice-egg-milk-butter-sugar, bread, banana, milk	Historical controls	Stool volume	Intervention did not increase stool volume
Molla 1983b	Prospective follow-up study with historical controls	Children aged 6–54 months	Chicken-lentils-oil, rice-egg-milk-butter-sugar, bread, banana, milk	Historical controls	Stool volume	Intervention did not increase stool volume
Molla 1989	Prospective follow-up study with historical controls	Children aged 29–59 months with cholera	Boiled rice, chicken and pulses	Historical controls	Stool volume	Stool volume decreased with introduction of intervention diet
PERU						
Brown 1982	Prospective follow-up study with historical controls	Children aged 7–28 months	Wheat noodles, milk or casein, oil and sugar	Historical controls	Stool volume	Intervention did not increase stool volume
Brown 1988	Prospective follow-up study with concurrent controls	Children aged 4–31 months	Potatoes and casein-oil-sugar	Controls who received soya formula	Stool volume	No increase in stool volume compared to controls
Alarcon 1991	Prospective follow-up study with concurrent controls	Children aged 5–24 months	Wheat-peas-carrots-oil-sugar	Controls who received lactose free soya formula	Stool volume Duration of diarrhoea	Significantly lower than controls Significantly shorter than controls
GUATEMALA						
Torun 1990	Prospective follow-up study with historical controls	Children aged 7–32 months	Corn-cottonseed flour, rice-corn-black beans or mixed Guatemalan diet	Controls who received lactose-hydrolysed milk	Duration of diarrhoea Stool volume	Markedly lower than controls Markedly lower than controls
Dardano 1990	Prospective follow-up study with historical controls	Children aged 5–24 months	Wheat-peas-carrots-oil-sugar	Historical controls	Duration of diarrhoea Severity of diarrhoea	Intervention did not increase duration or severity

Home treatment of diarrhoea with oral rehydration therapy and childhood mortality

COUNTRY	TRENDS IN USE OF ORT*	FACTORS OTHER THAN ORT THAT COULD EXPLAIN CHANGE IN INFANT AND CHILD MORTALITY	OUTCOMES	RESULTS
BRAZIL Victora 1996	ORT introduced in 1980. National survey in 1991 showed that ORS† or RHF‡ were used in 35% of all episodes and 62% of episodes regarded as severe by mother.	Socioeconomic conditions: decreased Water supply: improved Vaccine coverage: improved Duration of breastfeeding: improved Nutritional status: improved Socioeconomic conditions, water supply, vaccine coverage, duration of breastfeeding and nutritional status explained 21% of the reduction in infant mortality attributable to diarrhoea and one-third of the actual decline.	1980–1989: Infant deaths as proportion of total deaths Proportion of infant deaths due to diarrhoea Diarrhoea-specific infant mortality rate Ecological analysis correlating ORT use with proportionate infant mortality caused by diarrhoea	15% decrease 16% decrease 57% decrease Negative association (r = −0.61, p = 0.04)
PHILIPPINES Baltazar 2002	ORT introduced in 1980. National survey in 1993 showed that one-quarter to one-third of diarrhoea cases were treated with ORS or RHF.	Income: increased Availability of safe water: increased Availability of sanitation: increased Vaccine coverage: improved Duration of exclusive breastfeeding: improved Nutritional status: improved	1975–1993: Diarrhoea-specific infant mortality rate Ecological analysis correlating ORT use with proportionate infant mortality caused by diarrhoea	5% per year decrease No association
EGYPT Miller 1995	ORT introduced in 1981 and became fully operational in 1984. National survey in 1990 showed that ORS was being used to treat one-third to one-half of all diarrhoea episodes. Use rates were twice as high when diarrhoea was perceived to be severe as when mild episodes occurred.	Socioeconomic status: decreased Water supply: little change Sanitation: little change Measles vaccination coverage: increased Nutritional status: little change	1970–1977: Diarrhoea-specific infant mortality rate 1978–1983: Diarrhoea-specific infant mortality rate 1984–1990: Diarrhoea-specific infant mortality rate	4.2% decrease 7.8% decrease 15.9% decrease
MEXICO Gutierrez 1996	ORT introduced in 1984. ORS availability increased from 7.6 to 19.7 million packets per year. ORS or RHF use (approximately 50% received ORS and 50% received RHF) for diarrhoeal episodes increased from 47.5% in 1986 to 80.7% in 1993; ORS use increased from 24.3% to 41.9%.	Intensive measles vaccination in 1990 Improvement in water supply in 1990 Improvement in sanitation in 1990	1983–1993: Proportion of infant deaths due to diarrhoea in children aged 0–5 years Correlation between ORT use rates and diarrhoea specific death rates	Decreased by 15.4% Negative association Pearson's (correlation coefficient 0.93–0.99)

*Oral rehydration therapy. †Oral rehydration salts. ‡Recommended home fluids.

Home treatment of fevers with antimalarial medications and all-cause childhood mortality

STUDY	DESIGN	TARGET GROUP	INTERVENTION	COMPARISON GROUP	OUTCOMES	RESULTS
ETHIOPIA Kidane 2000	Randomized controlled trial	Children aged 0–4 years living in rural villages	Mother coordinators were trained to teach other mothers to recognize symptoms of malaria and to promptly give chloroquine	Normal care	Mortality rates in children aged 0–4 years	41% reduction in intervention compared to control group (95% confidence interval 29.2–50.6)
KENYA Spencer 1987	Prospective follow-up study with historical controls	Children aged 0–4 years living in rural villages	Providing chloroquine for treatment of malaria by village health workers in each village	Historical controls	Mortality rates in infants aged 0–1 month	33.4% reduction from pre- to post-intervention (not statistically significant)
					Mortality rates in children aged 1–12 months	8% reduction pre-intervention to post-intervention (not statistically significant)
					Mortality rates in children aged 1–4 years	27% reduction from pre- to post-intervention (not statistically significant)
THE GAMBIA Menon 1990	Prospective follow-up study with concurrent controls	Children aged 3–59 months living in rural villages	Education to village health workers to treat all fevers with chloroquine	Villages without a village health worker	Mortality rates in children aged 3–11 months	16% reduction in intervention compared to control group (not statistically significant)
					Mortality rates in children aged 12–59 months	7% increase in intervention compared to control group (not statistically significant)
					Mortality rates in children aged 3–59 months	0 % reduction in intervention compared to control group (not statistically significant)

TABLE B.9.1
Interventions to improve care-seeking and all-cause childhood mortality

STUDY	DESIGN	TARGET GROUP	INTERVENTION	COMPARISON GROUP	OUTCOMES	RESULTS	COMMENTS
INDONESIA Roesin 1990	Prospective follow-up study with historical controls	Children aged 1 week to 5 years	Health education of mothers and family members on signs and symptoms of serious ARI requiring health worker consultation, supportive measures for mild ARI, and prevention of ARI.	Historical controls	ARI-specific mortality rate for children aged 0–4 years	Reduction of 66.7% from 11.92 to 3.98 per 1000 over two years	No statistical analysis performed
UNITED REPUBLIC OF TANZANIA Mtango 1986	Prospective follow-up study with historical controls	Children aged 1 week to 5 years	Health education of mothers and family members on recognition and prevention of ARI, treating children with pneumonia or referring them to the next higher level of care.	Historical controls	Pneumonia-specific mortality rate for children aged 0–4 years	Reduction of 30.1% from 14.3 to 10.0 per 1000 over two years	Not statistically significant when cluster analysis performed, p> 0.05, confidence intervals not provided.

TABLE B.10.1
Prevalence of adherence behaviours

STUDY	TARGET GROUP	METHOD	ADHERENCE TO TREATMENTS FOR ACUTE DISEASES
BRAZIL Bezerra et al. 1987	121 children discharged from urban hospital aged 1 month to 14 years with any condition	Self report and pill count	Instructions: 52%
COSTA RICA Homedes et al. 1989	404 patients in urban and rural primary health care facilities with any condition	Self report and pill count	Dosing: 78% Interval: 67% Timing: 56% Duration: 53%
Vargas et al. 1978	476 patients in an urban primary health care facility with any condition	Pill count	Took over 76% of prescribed medicine: 43%
MEXICO Tovar et al. 1987	154 patients in urban primary health care facility with gastro-intestinal and upper respiratory tract infections	Self report	Instructions: 63%
Reyes et al. 1997	Children in a rural primary health care facility aged 2 months to 5 years treated for diarrhoea or ARI with antibiotics	Self reported and direct observation	Consumed 80% or more of the drug: ARI: 40% Diarrhoea: 56%
SOUTH AFRICA Buchanan 1977	200 children in outpatients at an urban hospital with any condition	Pill count	Took expected medication: 64%
VENEZUELA Ramos et al. 1983	312 children in outpatients at an urban primary health care facility with any condition	Self report	Dosage, timing and interval: 69%

FAMILY AND COMMUNITY PRACTICES THAT PROMOTE CHILD SURVIVAL, GROWTH AND DEVELOPMENT

TABLE B.10.2
Interventions to improve adherence behaviour

STUDY	DESIGN	TARGET GROUP	INTERVENTION	COMPARISON GROUP	OUTCOMES	RESULTS
EDUCATION INTERVENTIONS						
CAMBODIA Dennis 1998	Prospective follow-up study with historical controls	Community members with malaria	Doctors and vendors educated on appropriate quinine/ tetracycline regimes (Q/T) for seven days; doctors and vendors encouraged to provide and prescribe appropriately; and patients educated through posters and video.	Historical controls	At end of intervention: Proportion of patients purchasing full Q/T regime Proportion of patients completing full Q/T regime	28% improvement 14% improvement
CAMEROON Ngoh 1997	Prospective follow-up study with historical controls	Illiterate women aged 15–55 years attending government health centres for antibiotics	Visual aids and health worker counselling when antibiotics were dispensed	No visual aids and health education when antibiotics were dispensed	Self report of adherence at end of intervention	Significant improvements
MALAWI Helitzer-Allen 1994	Prospective follow-up study with historical controls	Pregnant women with malaria attending hospital out-patient clinic	Group 1: health education message given by nurses. Group 2: sugar-coated chloroquine capsules. Group 3: sugar-coated chloroquine capsules and health education message given by nurses.	Historical controls	Self report of adherence to full regime at end of intervention	Group 1: 32% improvement Group 2: 62% improvement Group 3: 66% improvement
NIGERIA Sechrist 1979	Randomized controlled trial	Adults attending urban hospital with infectious diseases	Instructions on how to administer the medication	No additional information	Knowledge of drugs to be taken at home at end of intervention	Significant improvements
Kelley 2001	Prospective follow-up study with concurrent controls	Children attending clinics prescribed cotrimoxazole or chloroquine	Counselling using IMCI guidelines	Children attending clinics without IMCI counselling training	Proportion of caretakers who administered a complete course of cotrimoxazole or chloroquine in the home at end of intervention	Significant but modest improvements for cotrimoxazole, no significant difference for chloroquine
Okonkwo 2001	Prospective follow-up study with concurrent controls	Children with uncomplicated malaria	Chloroqine syrup packaged with pictorial insert and verbal instructions	Children attending clinics without verbal training or pictorial instructions	Overdosing or under-dosing of chloroquine	Control: 36.5% Picture: 51.9% Picture and verbal: 73.3%

Randomized controlled trials of early childhood care and development interventions in malnourished children and childhood development

STUDY	AGE AT ENROLMENT	EARLY CHILDHOOD CARE AND DEVELOPMENT INTERVENTION	COMPARISON GROUPS	AGE AT FOLLOW-UP	OUTCOMES MEASURED AT FOLLOW-UP	RESULTS*
COLOMBIA McKay 1978, Perez-Escamilla 1995	3–6 years	Duration six months for the oldest children ranging to two years for the youngest children. Day care based educational intervention for 20 hours per week with activities to stimulate psychological development.	1. Supplement 2. Supplement + stimulation 3. No supplement or stimulation	10 years	Cognitive tests	Compared to group 3, group 1 significantly improved, group 2 had greatest increase. Most significant improvements with earlier and longer exposures
					Weight and height	No difference
Waber 1981	Third trimester	Duration 3.3 years. Home visits twice weekly. Parental education and activities to stimulate psychological development were provided.	1. Stimulation 2. Supplement 3. Stimulation + supplement 4. No stimulation or supplement	3 years	Griffith mental development scales	Compared to group 4, group 1 significantly improved, group 2 significantly improved, group 3 had greatest increase
					Weight and height	Compared to group 4, group 1 no difference, group 2 significantly improved, group 3 had greatest increase
Super 1990	Birth	Duration three years. Home visits twice weekly. Activities to promote cognitive development were provided.	1. Nutritional supplement to whole family 2.Stimulation 3.Supplement + stimulation 4. No supplement or stimulation	6 years	Weight and height	Compared to group 4, group 2 significantly improved, group 3 had greatest increase
JAMAICA Grantham-McGregor 1991 Grantham-McGregor 1997, Powell 1995	9–24 months	Duration 15 months. Home visits weekly. Community health aide provided toys and activities for child and training of parents in stimulating child.	1. Stunted controls 2. Supplement 3. Stimulation 4.Stimulation + supplement 5.Non-stunted controls	2 years	Griffith mental development scales	Compared to group1, group 2 significantly improved, group 3 significantly improved, group 4 had greatest increase
					Weight and height	Compared to group1, group 2 significantly improved, group 3 no difference, group 4 no difference
Grantham-McGregor 1987 Grantham-McGregor 1994	0–4 years (severely malnourished children who were hospitalized) 6 years	Duration three years. Home visits weekly or biweekly for three years after hospital discharge. Community health aides provided toy demonstrations and psychosocial stimulation.	Children who received standard medical care malnourished and non-malnourished	14 years	Stanford Binet	Significantly improved
					WISC verbal scale	Significantly improved

* Statistically significant = p<0.05. For sample sizes and confidence intervals see primary source.

Randomized controlled trials of early childhood care and development interventions in low-birth-weight and premature infants and childhood development

STUDY	AGE AT ENROLMENT	EARLY CHILDHOOD CARE AND DEVELOPMENT INTERVENTION	COMPARISON GROUPS	AGE AT FOLLOW-UP	OUTCOMES MEASURED AT FOLLOW-UP	RESULTS*
CANADA						
Barrera 1986	Discharge from hospital	Duration one year. Home visits weekly progressing to biweekly then monthly. Professional therapists provided parental education and training in cognitive stimulation of child.	Care as usual	1.3 years	IQ	No difference
USA						
Brooten 1986	Discharge from hospital	Duration 18 months. Home visits within one week of discharge and at 1,9,12,18 months. Nurses provided education and counselling to parents.	Care as usual	1.5 years	IQ	No difference
Field 1980	Discharge from hospital	Duration 12 months. Home visits biweekly for first four months then monthly. Trained interventionist and student therapist provided parental education and training in cognitive stimulation of child.	Care as usual	2 years	Bayley scales of infant development	Significantly improved (9 points)
Brooks Gunn 1992, Brooks Gunn 1994, IHDP 1990, (*The Infant Health and Development Program*)	Discharge from hospital	Duration three years. Home visits monthly. Nurses provided parental education and educational curriculum focused on child development. High quality full-time educational day care for years 1–3.	Paediatric surveillance	5 years	IQ (all) IQ (weight 2001–2500g)	No difference Significantly improved (3.7 points)
Resnick 1988	Birth	Duration two years. Home visits biweekly for two years. Child development specialist provided parental education/counselling and training in cognitive stimulation of child.	Care as usual	2 years	Bayley scales of infant development	Significantly improved (14%)
Scarr-Salapatek 1973	Birth	Duration 12 months. Home visits weekly. Social worker provided toys/books and parental training in cognitive stimulation of child.	Care as usual	1 year	IQ	Significantly improved (10 points)

* Statistically significant = p<0.05. For sample sizes and confidence intervals see primary source.

Randomized controlled trials of early childhood care and development interventions of low socioeconomic status children and childhood development

STUDY	AGE AT ENROLMENT	EARLY CHILDHOOD CARE AND DEVELOPMENT INTERVENTION	COMPARISON GROUPS	AGE AT FOLLOW-UP	OUTCOMES MEASURED AT FOLLOW-UP	RESULTS*
CANADA Infante-Rivard 1989	Birth	Duration seven months. Monthly home visits by nurses providing parental education.	Care as usual	15 months	Bayley scales of infant development	No difference
JAMAICA Powell 1989	6–30 months	Duration one year. Group 1: home visits weekly. Group 2: home visits monthly. Group 3: home visits bimonthly. Health paraprofessionals provided toys and books and parental education and training in cognitive stimulation of child.	No home visits	18–42 months	Griffith mental development scales	Group 3. Significantly improved (by 11 points compared to controls). As the frequency of visits increased from none through monthly and biweekly to weekly, the benefits increased significantly.
USA Black 1995	0–24 months	One-year intervention. Home visits weekly for 12 months. Lay home visitors provided maternal support and promoted parenting, child development, use of formal and informal resources and parent advocacy.	Care as usual	1–3 years	Bayley scales of infant development	Significantly improved
Campbell 1994, Campbell 2001 (*Carolina Abecedarian Project*)	6 weeks	Duration five years. Full-time high quality educational child care.	Children in other child care	15 years	IQ Special education Grade retention at 15 years	No difference Significantly improved (24% improvement) Significantly improved (20% improvement)
Field 1982	Birth	Duration six months. Group 1: home visits biweekly; psychology graduate student and co-worker provided training in cognitive stimulation of child. Group 2: parents employed as teacher's aide trainees in infant nursery.	Care as usual	2 years	Bayley scales of infant development	Group 1. Significantly improved (19 points higher than control group). Group 2. (6 points higher than control group).
Garber 1988 (*Milwaukee project*)	3 months	Duration six years. Full-time child care and job counselling and training for parents.	Care as usual	12 years	IQ at 12 years Special education Grade retention	Significantly improved (10 points higher) Significantly improved (48% improvement) Significantly improved (27% improvement)
Gray 1970 (*Early Training Project*)	4 years	Duration three years. Half-day preschool in summer; home visits weekly in winter.	Care as usual	17 years	IQ Special education Grade retention School graduation	No difference Significantly improved (24% improvement) No difference No difference
Gutelius 1977, Gutelius 1972	Birth	Duration three years. Home visits monthly. Nurse provided toys and books, parental education and training in cognitive stimulation of child.	Care as usual	6 years	IQ Behaviour	No difference No difference
Jester 1983	3 months	Duration three years. Home visits weekly and biweekly. Para-professionals provided parental education and training in cognitive stimulation of child. Half-day preschool from age 3 years.	Care as usual	11 years	IQ at 11 years Special education Grade retention at 11 years	No difference Significantly improved (31% improvement) No difference

STUDY	AGE AT ENROLMENT	EARLY CHILDHOOD CARE AND DEVELOPMENT INTERVENTION	COMPARISON GROUPS	AGE AT FOLLOW-UP	OUTCOMES MEASURED AT FOLLOW-UP	RESULTS*
USA						
Johnson 1991 (*Birmingham PCDC*)	1 year	Duration four years. Full-time high quality educational child care and parent training.	Care as usual	6 years	Special education	Significantly improved (16% improvement)
					Grade retention	Significantly improved (13% improvement)
Lambie 1974, Epstein 1979. (*Ypsilanti-Carnegie Infant Education Project*)	3 months	Duration 16 months. Home visits weekly. Professional teachers provided toys and books and parental education and training in cognitive stimulation of child.	Care as usual	6 years	Bayley scales of infant development	No difference
Olds 1994, Olds 1998	Birth	Duration two years. Home visits weekly/ biweekly. Nurses provided information about health-related behaviours during the early years of the child's life, competent care of children, maternal personal development, infant neuro-developmental screening/ referral.	Standard prenatal and well-child care in a clinic	15 years	Arrests	Significantly improved (25% improvement)
					Convictions	Significantly improved (48% improvement)
					Behavioural problems	Significantly improved (19% improvement)
Schweinhart, Barnes & Weikart 1993 (*High Scope Perry Preschool Project*)	3 years	Duration two years. Home visits weekly. Home visitors provided parental education and training in cognitive stimulation of child. Centre-based care 12.5 hours per week.	Care as usual	24 years	IQ Special education	No difference Significantly improved (13% improvement)
					Grade retention	Significantly improved (5% improvement)
					High school graduation	Significantly improved (18% improvement)
Thompson 1982	Birth	Duration two years. Home visits monthly. Nurse provided parental education and training in cognitive stimulation of child.	Care as usual	2.5 years	Stanford Binet tests	Significantly improved (improved by 8 points)
Wasik 1990 (*Project CARE*)	Birth	Duration five years. Home visits biweekly. Full-day child care five days per week.	Care as usual	5 years	IQ	No difference

* Statistically significant = p<0.05. For sample sizes and confidence intervals see primary source.

B.12.1
Number of antenatal visits

STUDY	DESIGN	TARGET GROUP	INTERVENTION	COMPARISON GROUP	OUTCOMES	RESULTS
CARROLI ET AL. 2001 Systematic review of randomized controlled trials (1995–2001)	Systematic review of seven randomized control trials	Pregnant women attending antenatal care clinics	New model of reduced number of antenatal control (ANC) visits	Standard schedule of ANC visits	Low birth weight, perinatal mortality, pre-eclampsia, urinary tract infections, postpartum anaemia, and maternal mortality	No differential effect of intervention for LBW, pre-eclampsia, and severe postpartum anaemia (in case of two RCTs), urinary tract infection (in case of two RCTs) when results pooled. Odds ratio of 1.06 (0.82–1.36) for perinatal mortality and of 0.91 (0.55–1.51) for maternal mortality. A model with reduced number of ANC visits with or without goal-oriented components could be introduced into clinical practice without risk to the mother or the child, but with dissatisfaction on part of the mother.
VILLAR ET AL. 2001 Systematic review randomized controlled trials (six looking at number of ANC visits; three looking at type of provider)	Systematic review of nine randomized control trials	Pregnant women attending ANC clinics considered to be low risk for developing complications during pregnancy and labour	New model of reduced number of ANC visits	Standard schedule of ANC visits	Preterm delivery, pre-eclampsia, caesarean section, induction of labour, antepartum haemor-rhage, postpartum haemorrhage, low birth weight, perinatal mortality, and maternal mortality.	Three trials found tendency towards increased rate of preterm delivery. For LBW, small for gestational age, C-section, induction of labour, antepartum haemorrhage, postpartum haemorrhage, maternal mortality, and perinatal mortality, no difference found between intervention and control groups.
VILLAR ET AL. 2001 Multi-centre randomized controlled trial	Randomized controlled trial	Pregnant women attending ANC clinics	New model of ANC emphasizing essential elements of care (median of five ANC visits). Involves screening for health conditions that might increase risk of specific adverse outcomes, therapeutic inter-ventions known to be beneficial, alerting pregnant women to emergencies and instructions on appropriate responses.	Traditional "Western" package of ANC (once/month during first six months, one visit every 2–3 weeks for next two months, then once/week until delivery (average of about 12 visits). (Median of eight ANC visits).	Low birth weight, pre-eclampsia/ eclampsia, severe postpartum anaemia, treated urinary tract infection	Higher proportion of women referred to higher level of ANC care, especially in 1st and 2nd trimester of pregnancy in new model than in standard model. Women in new model less likely than standard model to be referred with diagnosis. Among women referred, rate of admission lower in new model than standard model. Two models found equivalent for LBW and urinary tract infection rates, for pre-eclampsia rates clinically similar, for severe postpartum anaemia, large protective effect of new model found in country with largest increase in provision of iron supplements.

C. Conclusions and recommendations

In this section, the evidence from the individual key practices is synthesized. General themes are highlighted, conclusions are summarized, and recommendations are made for next steps. In particular, consideration is given to how this review might be used to assist the development of priority action for programmes and research in this arena.

Summary of evidence

Table C.1 presents a summary of the evidence reviewed for each key practice. It lists the intervention approaches that have either been tested in research studies or implemented in programmes, and the levels of impact that have been demonstrated to be achieved with these approaches.

Potential impact

1. The review of the evidence confirms the importance of each of the 12 key practices. There are major gaps between current and desired behaviours for each practice. Interventions to close these gaps have the potential to make a substantial contribution to the reduction in mortality/morbidity, and/or improvement in child development.

2. There is considerable variation between the practices in the experience that exists in developing relevant effective interventions. On the one hand are the notable successes with strategies to improve immunization coverage (key practice 1) and to promote the use of oral rehydration salts (ORS) (part of key practice 8). At the other extreme, no substantive evidence was found concerning attempts to intervene to improve recognition of when sick children need treatment outside the home (key practice 9), and the evidence on improving adherence (key practice 10) is confined to small-scale interventions applied in a limited setting.

3. The impact that can be achieved by intervening to improve a key practice depends not only on how strong the link is between inadequate behaviour and child mortality, but also on how low the current prevalence of adequate behaviour is, and on the feasibility of available interventions to increase the proportion of the target population that successfully carries out the key practice. The potential impact will therefore vary considerably not only between countries, but also within countries.

TABLE C.1
Summary of evidence for each key practice, with gaps in knowledge highlighted

TYPE OF INTERVENTIONS	KEY HEALTH IMPACT OF INTERVENTIONS TO INCREASE THE PREVALENCE OF THE BEHAVIOUR	COMMENTS
TAKE CHILDREN AS SCHEDULED TO COMPLETE A FULL COURSE OF IMMUNIZATIONS (BCG, DTP, OPV & MEASLES) BEFORE THEIR FIRST BIRTHDAY		
Improve access through quality routine delivery **Improve access through quality mass campaigns such as National Immunization Days (NIDs)** **Reduce missed opportunities at health facilities** **Improve utilization through social mobilization/ communication campaign**	• Immunizations already prevent an estimated three million child deaths each year. • Despite the global immunization coverage of 80%, high coverage is not universal and there are as many deaths due to vaccine preventable diseases as there are deaths prevented by immunization. A different level of effort is needed to reach the last 20% of children un-immunized. • Using results from efficacy studies it has been estimated that increasing coverage a further 10% would reduce measles deaths by 11%, diarrhoeal deaths by 4% and acute lower respiratory infections (ALRI) deaths by 2%. • NIDs have been effective in the control and elimination of polio, and are being planned for measles. However, improving routine delivery services is important to ensure sustainable high coverage. • Reducing missed opportunities for immunization during health visits could potentially reduce mortality as 41% (median) of children in developing countries have had a missed opportunity. • Social mobilization can increase coverage and is an important principal in expanding coverage. It is estimated that nearly three million children in Africa do not receive measles immunizations even though they probably have access. No studies exploring the impact of social mobilization on mortality or morbidity were located.	• Improving immunization safety is important, as up to half of injections are currently unsafe. • The private sector provides up to 40% of immunizations but their potential role in routine delivery has not been fully explored.
BREASTFEED INFANTS EXCLUSIVELY FOR SIX MONTHS		
Changes in hospital policies/actions **Counselling/ education from peers or health workers** **Mass media and community education** **Mother support groups**	• Breastfeeding is associated with reduced child mortality/morbidity and improved development. Evidence includes a meta-analysis that found breastfed infants under two months of age were six times less likely to die of infectious diseases than non-breastfed infants and a protective effect against diarrhoea has been observed in developed and developing countries. • Interventions to improve exclusive breastfeeding (EBF) have focused around changing hospital practices (0–43% difference in EBF) and education/ counselling (4–64% difference in EBF). • Counselling interventions were further explored in a meta-analysis; women who received lay support were less likely to stop exclusive breastfeeding (RR 0.66) than those who received no support, but there was no significant difference between those who received professional support and those who received no support. • Data on the impact of support groups or mass media on exclusive breastfeeding are scarce and only peer counselling interventions reported morbidity impacts (children in the intervention groups were 1.9–2.9 times less likely to have diarrhoea). • It is not known whether breastfeeding counselling/education is more effective with individuals or in a group setting.	• Breast milk provides all the nutrients needed for most infants up to six months of age (evidence for the optimal duration of EBF includes a trial demonstrating protection against gastrointestinal tract infection and studies suggesting that infants breastfed for six months do not show growth deficits). • The prevalence of human immunodeficiency virus (HIV) in a country must be considered when breastfeeding promotion interventions are designed.

STARTING AT SIX MONTHS OF AGE, FEED CHILDREN FRESHLY PREPARED ENERGY- AND NUTRIENT-RICH COMPLEMENTARY FOODS, WHILE CONTINUING TO BREASTFEED UP TO TWO YEARS OR LONGER

Family counselling/ nutrition education

Provision of high energy and protein food supplements

- Breast milk continues to be a source of key nutrients and to confer protection against infectious diseases throughout the second year of life, but after six months is not sufficient alone to meet nutritional requirements. However, complementary foods are often inadequate in energy and micronutrient concentration or quality, and are often prepared, stored, or fed to children in ways that increase their risk of illness.

- Observational studies indicate that improving feeding practices could save 800 000 lives per year.

- No complementary feeding interventions with mortality outcomes were located. Five efficacy trials to improve intake of complementary foods found net increases in energy intake of between 65 and 300 kcal/day and improvements in growth of between 0.25 and 0.46 SD units for weight-for-age, and 0.04 and 0.35 SD units for height-for-age. The growth improvements should translate into a reduction in deaths associated with malnutrition of between 2% and 13%.

- Nutritional supplementation has a significant impact on long-term developmental outcomes in malnourished children in developing countries.

- A recent pilot study in Brazil, implementing nutritional counselling through IMCI, has also been encouraging, reporting significant weight gains in children aged one year or more but not in younger children.

- Programmes demonstrate that it is possible to develop nutritionally improved complementary foods in diverse cultural settings, that poor mothers are willing to prepare new foods, and their children are willing to eat them, but that caregivers face considerable time and resource constraints.

ENSURE THAT CHILDREN RECEIVE ADEQUATE AMOUNTS OF MICRONUTRIENTS (VITAMIN A, IRON AND ZINC IN PARTICULAR), EITHER IN THE DIET OR THROUGH SUPPLEMENTATION

Supplementation

Fortification

Dietary modification

- Improving intake of vitamin A, iron and zinc will have a substantial impact on mortality, morbidity and development in poor or micronutrient deficient populations.

- Evidence comes from randomized control trials which show that vitamin A supplementation can reduce mortality by 23% (the morbidity and mortality impact varies across different diseases). No mortality studies were located for iron or zinc supplementation. However, iron supplementation improved development in children over two years of age and zinc supplementation reduced diarrhoea incidence by 18% and pneumonia incidence by 41%. None of the micronutrients had a consistent impact on growth except zinc.

- Micronutrient deficiency will not be easily tackled through interventions to improve the micronutrient content of diets, although these may be a useful part of the solution, and may have wider benefits. Supplementation and/or fortification will be necessary.

- Vitamin A supplementation programmes are being implemented in nearly 50% of countries where supplementation is advised and fortification in developed countries has been effective in helping reduce deficiencies.

- Supplementation and fortification programmes need to be accompanied by promotion and communication activities but little information was located on this area.

- There is a strong case for tackling micronutrient deficiencies together, since diets deficient in zinc, are almost certainly iron deficient, and likely to be so in vitamin A.

- Vitamin A supplementation is more easily delivered than iron and zinc, since megadoses can be given every 4–6 months. New technologies such as iron sprinkles may make supplementation more feasible.

DISPOSE OF FAECES, INCLUDING CHILDREN'S FAECES SAFELY; AND WASH HANDS AFTER DEFECATION, BEFORE PREPARING MEALS, AND BEFORE FEEDING CHILDREN

Hygiene education

Provision of services (soap/clean water/ sanitation facilities)

- Handwashing interventions reduced diarrhoeal incidence by a median of 33% (range 11–89%). The impact was higher in studies that targeted handwashing alone rather than as part of a package of behaviours.

- All types of handwashing are not equally effective. Using large quantities of water, vigorous rubbing, using cleansing agents such as soap, ash or clean mud, and drying with a clean cloth or in the air appear to be the most effective ways of removing pathogens.

- Few faeces disposal interventions were located. However, six rigorous observational studies demonstrated a median reduction of 55% (range 20–82%) in all-cause child mortality associated with improved access to sanitation facilities. Little is known about the impact of disposing of faeces in the absence of latrines.

- Improving faeces disposal is likely to have the greatest effect in high density areas.

- Large scale handwashing promotion programmes have been effective in initiating behaviour change. However, concerns still exist about feasibility because of the complexity of the behaviour and the resources required to carry out such a programme.

- Latrines can be costly and difficult to maintain and keep clean and in some settings they are unfeasible; for example where housing density is extremely high or terrain unsuitable.

PROTECT CHILDREN IN MALARIA-ENDEMIC AREAS, BY ENSURING THEY SLEEP UNDER INSECTICIDE-TREATED BEDNETS

Social marketing

- A meta-analysis of four African randomized controlled trials showed that insecticide-treated bednets (ITNs) are associated with a 17% reduction in child mortality compared to control populations with no or untreated nets. The majority of the benefits may be due to the insecticide treatment rather than the physical presence of the net.

- The long-term effect of ITN use on mortality in high transmission areas is unclear. Lack of exposure to the malaria parasite at an early age may reduce long-term immunity.

- Social marketing can increase ITN use by as much as 50% and child survival by as much as 25%.

- Whether ITNs only protect those who sleep under them or whether they protect others in the community is still unclear, with studies on vector ecology providing conflicting evidence.

- Affordability is an important factor for both purchase and ret-reatment of ITNs. Even at subsidized prices the poorest may still be excluded. Strategies are needed to ensure equity without undermining the commercial market.

- Health, environmental impacts and resistance of insecticides need monitoring.

CONTINUE TO FEED AND OFFER MORE FLUIDS, INCLUDING BREAST MILK, TO CHILDREN WHEN THEY ARE SICK

Group or individual counselling

- Randomized control trials have found that feeding nutritionally-complete diets to children with diarrhoea increases net energy and nutrient absorption without affecting stool output or the efficacy of ORS. Feeding locally-available foods does not increase duration of diarrhoea.

- Anorexia to non-human milk and solids appears more severe than to breast milk during illness, highlighting the critical role of breastfeeding during illness.

- No studies were located exploring the impact of interventions to improve feeding and giving fluids during illness on mortality or morbidity. There is evidence that counselling interventions can improve behaviour but there is little evidence about how best to scale up the interventions.

- Lessons can be learned from programmes aiming to improve the feeding of healthy children, which have shown the importance of involving many channels, behavioural aspects of feeding and peer counsellors.

TYPE OF INTERVENTIONS	KEY HEALTH IMPACT OF INTERVENTIONS TO INCREASE THE PREVALENCE OF THE BEHAVIOUR	COMMENTS

GIVE SICK CHILDREN APPROPRIATE HOME TREATMENT FOR INFECTION

Training and counselling mothers

Training drug sellers

Mass media campaigns

Social marketing/ improving access

Improving packaging and instructions

- Uncomplicated diarrhoea, malaria and local infections can be managed at home with efficacious treatments. There are some concerns that encouraging home treatment of malaria will foster medication misuse.

- Oral rehydration therapy (ORT) can prevent death from watery diarrhoea in all but the most severe cases. The national control of diarrhoeal disease programmes substantially increased the use of ORT, which is likely to have played a large role in the global reduction of diarrhoea deaths from 4.6 to 1.5 million. In Brazil ORT is estimated to have contributed to 79% of the decrease in diarrhoeal deaths.

- Interventions to improve how ORT is used have focused on reconstitution and correct administration of ORS through health education, but evaluations have not been scientifically rigorous.

- Interventions to improve home treatment of malaria-related fevers by training mothers and increasing access to treatment have had variable impacts on mortality and morbidity, but have the potential to have a large impact with one well-conducted study reporting a 41% mortality reduction.

- Drug sellers prescribing, which is often poor, and has been identified as influencing home treatment. Only one study was located that addressed shopkeeper behaviours (the percentage of childhood fevers treated adequately increased by 60%).

Comments:
- Reduced osmolarity ORS was shown to decrease the need for un-scheduled intravenous infusion and stool output compared to the standard formula and a new ORS formulation was released in 2002.

RECOGNIZE WHEN SICK CHILDREN NEED TREATMENT OUTSIDE THE HOME AND SEEK CARE FROM APPROPRIATE PROVIDERS

Health education of mothers

Training of community health workers

- Studies examining factors contributing to child deaths have found poor care-seeking implicated in 6–70% of deaths; a high number of deaths have also been attributed to delays in care-seeking.

- Only two care-seeking intervention studies were located and their results were inconclusive (a non-significant impact found in one study, and no statistical analysis performed in the other).

- Formative research conducted in Mexico and Ghana identified mother support groups and village volunteers as potential intervention channels but effectiveness was not explored.

- Interventions are likely to be more successful if they focus on teaching caregivers to recognize symptoms that they can see but do not see as abnormal or dangerous, rather than symptoms they just do not know exist.

- The impact of interventions to improve care-seeking relies on a high quality of care, and interventions must consider the type of providers utilized. Studies in Mexico have shown that private doctors are often preferred but that children had 4.2 times the risk of receiving poor quality care and 1.5 times the chance of dying if taken to a private doctor rather than a public doctor.

Comments:
- Appropriate care-seeking is of particular importance in areas where access to health services is limited, because it is in these areas that caregivers would benefit most from being able to discern which episodes really need to be taken to the health centre.

FOLLOW HEALTH WORKERS' ADVICE ABOUT TREATMENT, FOLLOW-UP AND REFERRAL

Counselling **Mass communication campaigns** **Medication appearance**	• Little is known about the impact of adherence on mortality or morbidity, but not adhering to treatment and referral instructions may lead to incomplete treatment, therapy failure, drug resistance and the later misuse of the leftover medicines. • Only small-scale adherence interventions were located, all reported a positive impact on adherence. Counselling interventions improved adherence by up to 66% and improving packaging by 27%. Only one trial had morbidity outcomes; in this study malaria parasite counts were lower where health workers used picture and verbal instruction to explain antimalarial dosing. The potential impact of mass communication interventions is unknown and should be investigated. • No interventions were located focusing on adherence to appointments and referral instructions. Whilst more research in this area is needed, reducing the need for referrals may also be an important intervention. In Uganda implementing IMCI was estimated to reduce referrals from 22% to 16%. • Interventions to improve appointment-keeping will have a minimal impact on mortality and morbidity where appointments are not kept because children have recovered.	• Accurate diagnosis and prescription are important for successful treatment; poor diagnosis and bad prescribing practices are common but can be improved. • No studies were located exploring adherence from the caregiver's point of view; this is essential to understand in order to develop effective interventions.

PROMOTE MENTAL AND SOCIAL DEVELOPMENT BY RESPONDING TO A CHILD'S NEEDS FOR CARE, AND THROUGH TALKING, PLAYING AND PROVIDING A STIMULATING ENVIRONMENT

Centre-based and child-focused that provide psychosocial stimulation directly to the child **Home-based and parent-focused that aim to improve parenting skills or the parent's ability to perform psychosocial stimulation**	• There is an extensive scientific basis for the benefits of home- and centre-based stimulation on early childhood development. Adults born in poverty who participated in a quality preschool programme have higher social responsibility, education performance, earnings and property wealth and greater commitment to marriage. • Randomized controlled trials have shown that centre- and home-based early childhood care and development interventions can improve parental verbal interaction, behaviour management and attitudes towards the child. • Centre-based interventions appear to be more effective than home-based approaches. However, interventions that utilize more than one delivery channel appear to have the greatest impact. Intensive interventions and time periods of 2–5 years are felt to be needed for long-lasting impact. • Home-based interventions appear to be effective in low-birth-weight and malnourished children but have inconsistent impacts on low-risk children. • In malnourished children, the combination of supplementation and stimulation interventions appears to have a greater effect on cognitive development than either one alone. Such combined programmes are likely to be more efficient at delivering services.	• New approaches are needed to improve participation rates and improve access to the most disadvantaged children. • There has been little research into socioeconomic factors that influence a child's ability to respond to a particular programme.

ENSURE THAT EVERY PREGNANT WOMAN HAS ADEQUATE ANTENATAL CARE. THIS INCLUDES HER HAVING AT LEAST FOUR ANTENATAL VISITS WITH AN APPROPRIATE HEALTH CARE PROVIDER, AND RECEIVING THE RECOMMENDED DOSES OF THE TETANUS TOXOID VACCINATION		
Improving access **Social mobilization** **Mass communication campaigns**	• The extent to which the antenatal care package can reduce infant and child mortality and morbidity is yet to be shown. Interventions have explored the health impact of individual elements of the visit or have compared the different antenatal protocols (i.e. different number of visits and focused versus 'standard' protocols). • A meta-analysis of seven trials found that four antenatal visits were not associated with an increase in negative perinatal outcomes compared to more frequent visits (e.g. no statistically significant differences in low birth weight or perinatal mortality). • A multi-site study found that fewer goal-oriented antenatal visits were not associated with increased risk for mothers or their infants compared to the standard model (e.g. no statistical difference in low birth weight or treated urinary tract infections between the models; rates of pre-eclampsia were slightly higher in the new model). • No interventions were located which aimed to increase use of antenatal care through social mobilization or mass communication.	

Interventions to change key practices

The review confirms much of what is already known from extensive experience in behaviour change and community-based programmes:

4. All the key practices are complex and involve several different behaviours. Some involve different behaviours at different times. Successful interventions need to acknowledge this and are likely to need a combination of different strategies, both to achieve coverage and to reinforce and support families in making the necessary changes.

5. Changing behaviours is complex and requires both perseverance and time. Various models have outlined the steps needed to accomplish this. Decision-making and behaviour-change involve not only the caregiver and the child, but the whole family and sometimes the whole community.

6. Different strategies will be appropriate in different settings and at different times. Cultural beliefs that inhibit the desired behaviour must be addressed, and those that enhance it utilized.

7. Interventions must tackle barriers, and not just proclaim benefits. They also need to reflect the realities of people's lives and their access to resources. Many households, even in conditions of poverty, will have the resources to perform the key practices, but will lack knowledge and skills about how to do this. Many others, however, are more severely constrained economically. In addition to knowledge and skills, they will require assistance, such as the provision of food or nutrient supplements for their children.

8. Interventions to improve the key practices cannot be conducted in isolation from the provision of services. Most practices rely on accessibility to good quality health services. Many also rely on the availability of certain products or pharmaceuticals. These must be acceptable, accessible and affordable. Where the interventions rely on social marketing, with families purchasing a product creating demand, a favourable market and good quality responses are important. Interventions need, therefore, to interact with a variety of players, including the health sector and other relevant public sectors at the local, district and national levels, as well as manufacturers and private retailers.

9. In summary, success in reducing childhood mortality requires more than the availability of adequate health services with well-trained personnel. It also requires a range of associated key practices at family and community level, to tackle adequately the excess burden of child mortality, and to ensure that children reach their full physical and mental potential. To achieve success requires a partnership between health workers and families, with support from their communities.

Next steps and priority-setting for family and community practices that promote child survival, growth and development

10. Improving family and community practices is a critical intervention area that requires political commitment and resources to generate the necessary action in the field. The potential benefits are enormous. Governments and societies have a responsibility to enable families to provide the best possible care to their children.

11. Although all twelve key practices aim to improve child survival, growth and/or development through adequate prevention and treatment of the five IMCI conditions, it is important to recognize the diversity of their nature and of the level of development of interventions to promote them. Thus the practices differ with respect to:

— the levels of impact achievable with improvement in the practice;

— the complexity of the behaviour change involved, and whether any benefits are immediately apparent or cumulative over the long term;

— the frequency of the required behaviour, and its likely sustainability;

— the relative inputs required from the household, the health services and other actors including other relevant public sectors, manufacturers and retailers;

— the different levels of development concerning intervention strategies;

— the differing state of the strength of the evidence base concerning the impact of the practice and/or of the level of experience that exists in how to improve it;

— the time-scale of possible implementation of different types of interventions.

It is crucial to take these factors into account when planning the implementation of the community component of the IMCI strategy, and in particular when deciding which practices to tackle and how to tackle them.

D. References

Executive summary/introduction

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