

## Global Child Health: Promises Made to Children—Not Yet Kept

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This article represents an overview of the state of the world's children from the late 1970s, starting with the high hopes issued from the International Conference in Alma Ata declaring “Health for all by the year 2000.” It progresses through the Revolution for Children including the World Summit for Children in 1990 followed by the Millennium Development Goals of 2000. We are halfway to 2015, the year when the Millennium Development Goals should be realized, but most of these goals are appearing illusive. For millions, many of the promises will not be kept. However, progress toward improving the health and well-being of children has been substantial, and is documented in the last half of the article that ends with a call to get involved.

### THE ALMA ATA 1978 DECLARATION: HEALTH FOR ALL BY THE YEAR 2000

The 1978 Declaration at the International Conference held in Alma Ata, then Kazakhstan, stated that: “Governments have a responsibility for the health of their people which can be fulfilled only by the provision of adequate health and social measures. A main social target of governments, international organizations and the whole world community in the coming decades should be the attainment by all peoples of the world by the year 2000 of a level of health that will permit them to lead a socially and economically productive life. Primary health care is the key to attaining this target as part of development in the spirit of social justice”[1]. The attendees representing almost all of the member nations of World Health Organization (WHO) and the United Nations Children's Fund (UNICEF) affirmed that health care is a fundamental human right requiring a change from the generally accepted narrow concept of health to embrace an interdisciplinary, intersectorial approach involving broad community support and collaboration. The International Conference on Primary Health Care extended an urgent call to all nations to join in a collaborative effort “to develop and implement primary health care throughout the world.”

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## THE REVOLUTION FOR CHILDREN: UNICEF AND JAMES P. GRANT

Motivated by the Declaration of Alma Ata and the visionary leadership of its Executive Director, James Grant, UNICEF launched an ambitious, bold program to bring low-cost, low-level technologies to the developing world. The program was based on the belief that scientific discoveries had advanced at a faster rate than had the application of that knowledge. The plan was to decrease child morbidity and child mortality by training community health workers in 4 basic programs: Growth monitoring, Oral rehydration, Breast feeding, and Immunization: GOBI.

### Growth monitoring

Several important facts make this a cornerstone to the Revolution for Children. (1) The development of malnutrition is insidious. The day-to-day slow loss of body mass often goes unrecognized by the child's family until it is brought to the mother's attention by a family member or friend who has not seen the child for some time. (2) The vicious cycle of infection, malnutrition, and immunoincompetence is unrelenting. The cycle can begin at any one of the interlacing points of the triangle. Infection in a child is invariably associated with anorexia. If the illness is prolonged or if the child is on the edge of malnutrition, the tumble into acute malnutrition is precipitous and predictable. (3) Diets in poor countries are often deficient in essential micronutrients such as iron and vitamin A; a lack of either encourages a swift decline into severe malnutrition and infections. Meats are too expensive. Iron-containing foods are seldom a part of the child's meal. Staples are either rice or corn. Other vegetables and fruits are lacking. Any intake of  $\beta$ -carotene or vitamin A is low. (4) Malnutrition is an integral component of a least 50% of the deaths of the children younger than 5 years. (5) Early detection of a declining nutritional status followed by appropriate intervention could break the vicious cycle.

James Grant expanded the ideas of Dr. David Morley, an English pediatrician who had worked in West Africa where he instituted the Under-Five Clinics. These centers were basically well child clinics that emphasized good nutrition and growth. An important component of these clinics was the "Road to Health Chart" (Fig. 1) [2,3].

The chart has some very unique features. The horizontal axis represents the child's age, but not as the age in months; the columns are identified by the calendar months starting with the month the child was born. This chart eliminates the need for the health care worker to estimate the age of the child, minimizing mistakes. Only weights are recorded and only 2 reference lines (rather than 7) are shown on the graph. On this chart; the upper line is the 50th percentile for boys and the lower line is the third percentile for girls. The chart uses the National Centre for Health Statistics (NCHS) as a reference; not as a standard [4]. The child's individual line is plotted to show the mother the trajectory of her child's weight. The smaller box in the left upper corner shows 3 possible trajectories: an upward line is the best trajectory, a flat line indicates

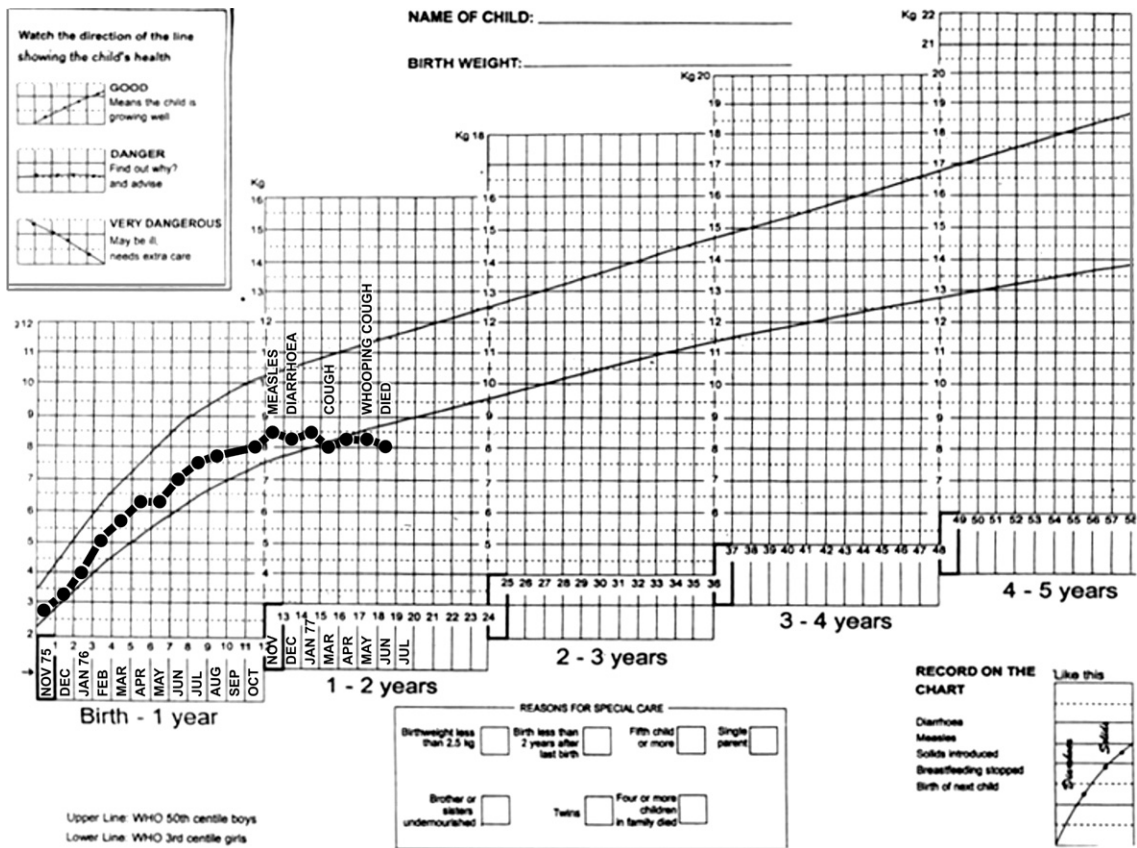


Fig. 1. The road to health chart.

danger, and a downward trajectory shouts an alarm. The chart also contains space to record any perinatal problems or complications at birth as well as birth weight, length, and head circumference, the clinic the child usually attends, and all immunizations the child receives. The health worker is advised to note when the child was weaned from the breast and when the next child was born. Significant illnesses are recorded on the chart in the month they occurred. Any change in weight trajectory with these sentinel events are points for discussion with the mother. There is also information extolling the benefits of breast feeding and when important developmental milestones should be met. The time when immunizations are due is also given on the chart.

The Road to Health Chart is given to the mother in a plastic, watertight bag at the birth of her child. She is instructed to keep it safe and to bring it to the clinic each month. Scenes like the one represented in Fig. 2 are a part of the life of the mother and her new child. Each month the child is weighed, and the weight plotted on the graph along with any significant illnesses the child had had since the last visit. With counsel, the mother can easily see the slope of the child's weight and compare the trajectory with the 3 lines in the smaller box. Intervention can be instituted with the first sign of "danger" before any serious consequences develop.

### Oral rehydration

In much of the developing world, clean uncontaminated water is a rarity. Women and young children must often travel many miles to a river or well each day for portable but, all too frequently, not potable water. Piping water



**Fig. 2.** A typical weight-in scene in East Africa.

to villages and rural homes is very expensive, and “at-source” purification is not frequently practiced. In this environment, every child younger than 5 years will have a minimum of 3 episodes of diarrhea each year [5]. Diarrheal deaths account for 21% of all deaths in children younger than 5 living in developing countries [6]. Although 37% fewer people died of diarrhea in 2002 compared with 1990, 1.8 million continue to die each year, most of which are preventable deaths [7–9].

In the mid 1970s, children with diarrhea and severe dehydration were admitted to “rehydration centers” scattered throughout the cities in developing countries. These centers administered intravenous fluids through butterfly needles. These needles were in short supply, hence the same needles were used repeatedly and interchanged between children. “Sterilization” of the needles was done by soaking them in a dilute “antiseptic” solution. In the 1980s, with the introduction of oral rehydration therapy (ORT), all of that changed. The oral rehydration solution (ORS) was developed in the treatment of cholera, with the discovery that the greatest absorption of water occurred when the ratio of sodium and glucose was close to 1:1. ORS contained 90 mmol/L of sodium and 111 mmol/L of glucose along with potassium and bicarbonate. One packet of the powdered mixture (Fig. 3) was dissolved in one quart (0.95 L) of water. At a cost of less than 10 US cents, many countries manufactured their own packets. This solution was effective in 90% of the cases of diarrhea, even in the presence of hyper- and hyponatremic dehydration. In children who were in shock or who had greater than 10% dehydration, a push of intravenous fluids was initiated, followed by the oral solution. Once hydration



**Fig. 3.** A 10-cent package of rehydration salt to be mixed with 1 quart of clean water.

was reestablished, the ORS was given in quantities equal to the fluid lost in the stool, but this did not immediately stop the watery diarrhea. The mother was told the solution would help her child but when she continued to see diarrhea she was confused, and acceptance was slow. Other formulations were tried in an attempt to thicken the stools, but success was mixed. However, the effect of ORT was dramatic. Each year, 1 million fewer children were dying a diarrheal death. Eight years after the introduction of this treatment (1980–1988), 36% of the cases of diarrhea were being treated with ORT [10]. If this therapy could be extended to all diarrhea episodes, another 2.5 million deaths would be averted. By 2005, 43% of the children with diarrhea in 31 countries in the developing world were receiving ORS; further along, but not there yet (Fig. 4) [11].

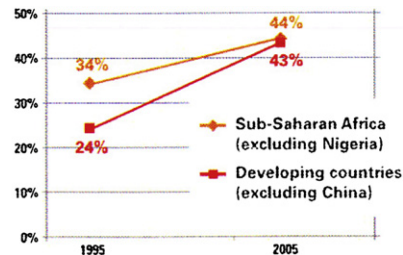
### Breast feeding

Spurred by the unscrupulous behavior of some infant formula companies that were promoting their product as superior to breast milk, the WHO published The International Code of Marketing of Breast Milk Substitutes [12]. The Code was designed to promote the safety, adequacy, and benefits of breast milk. Its guidelines state that the promotion of artificial milk substitutes by manufacturers and their representatives must be limited to discussing scientific and factual matters with health professionals, and were not to imply that bottle feeding is equal to or superior to breastfeeding. Advertisements to the general public and particularly to pregnant women that either explicitly or implicitly indicated that breast milk was inferior to a milk substitute would not be permitted. Representatives of these companies would not be allowed in the nurseries to promote their products to the unsuspecting new mothers. Samples would not be distributed. Health providers would extol the advantages of breast milk and discuss the disadvantages of substitutes.

Shortly after the International Code in 1991, the WHO and UNICEF launched the Baby-friendly Hospital Initiative [13]. Just 15 years later, more than 20,000 hospitals in 152 countries had been designated Baby-friendly. Exclusive breast feeding for at least the first 6 months of life in countless infants had expanded.

### COVERAGE OF RECOMMENDED TREATMENT SIGNIFICANTLY INCREASED FROM 1995 TO 2005 Yet, data are limited

Percentage of children under five with diarrhoea receiving oral rehydration or increased fluids with continued feeding, based on an analysis of findings from 31 developing countries (1995–2005)



**Fig. 4.** (From UNICEF. Progress for children—a world fit for children: statistical review. Number 6, December 2007. [http://www.unicef.org/progressforchildren/2007n6/index\\_41401.htm](http://www.unicef.org/progressforchildren/2007n6/index_41401.htm); with permission.)

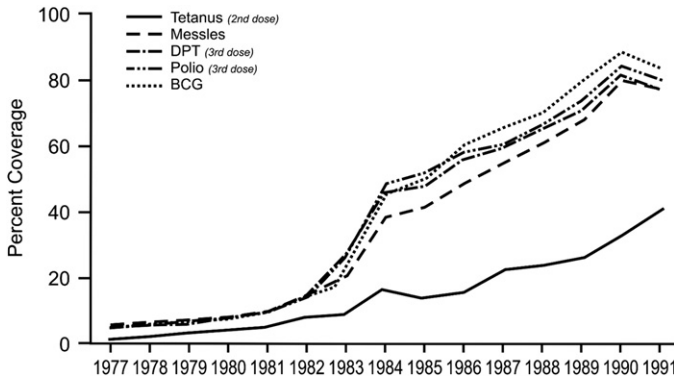
The ten steps to successful breastfeeding inherent in a Baby-friendly Hospital [14]:

1. Have a written breastfeeding policy that is routinely communicated to all health care staff.
2. Train all health care staff in the skills necessary to implement this policy.
3. Inform all pregnant women about the benefits and management of breastfeeding.
4. Help mothers initiate breastfeeding within a half-hour after birth.
5. Show mothers how to breastfeed, and how to maintain lactation even if they should be separated from their infants.
6. Give newborn infants no food or drink other than breast milk, unless medically indicated.
7. Practice rooming-in: allow mothers and infants to remain together 24 hours a day.
8. Encourage breastfeeding on demand.
9. Give no artificial teats or pacifiers (dummies or soothers) to breastfeeding infants.
10. Foster the establishment of breastfeeding support groups and refer mothers to them on discharge from the hospital or clinic.

Of all the arguments extolling the virtues of breast milk or “breast is best,” perhaps the most convincing is the “enteromammary system” [15]. Any antigen that inhabits the intestinal tract of the lactating mother stimulates the production of IgA antibodies in the Peyer patches in her intestinal tract. Those specific antibodies enter the adjacent lymphatic nodes; travel to the thoracic duct, and into the blood stream. The antibodies then *hone* to the mother’s breast. The specific IgA levels in her breast milk are higher than the levels in her blood stream. Two molecules of IgA fuse forming secretory IgA, the predominant immunoglobulin in human milk. The infant ingests these antibodies, which enter the infant’s intestinal tract where they attach to the epithelial cells. Invasion by the antigen is prevented. This system is so effective that pathogenic viruses, bacteria, and even some parasites have been cultured or found in the infant’s stool yet the infant is not diseased!

### Immunizations

When the Revolution for Children began in the early 1980s, immunization rates for children younger than 2 years living in the developing world were from 5% to 10%. Fourteen years later, rates for 5 of the 6 targeted diseases, diphtheria, pertussis, tetanus, polio, and measles, were close to 80% and the sixth, the BCG vaccine against tuberculosis given at birth, was greater than 80%. However, only 40% of pregnant women had received the second dose of tetanus (Fig. 5). This low rate kept the incidence of neonatal tetanus high [16]. Mortality and morbidity from these diseases decreased proportionately. By 2006, global coverage of infants with 3 doses of diphtheria/polio/tetanus vaccine was still close to 80% but 114 countries (59% of all countries) had achieved 90% coverage. However, there is a sharp disparity. In many African



**Fig. 5.** Global immunization coverage 1977 to 1991. (Data from Expanded Programme on Immunizations Programme report for the year 1992. Incorporating the recommendations of the global advisory group, October 1992. World Health Organization. January 1993. [http://whqlibdoc.who.int/hq/1993/WHO\\_EPI\\_GEN\\_93.1.pdf](http://whqlibdoc.who.int/hq/1993/WHO_EPI_GEN_93.1.pdf).)

countries, coverage is 82%, whereas in the Americas it is 94% and in Europe, 95% [17,18].

The efficacy of both the polio and measles vaccines decreases when the “cold chain” is broken. This finding prompted the use of thermal indicators packed with these vaccines to alert health care workers if the “cold chain” has been violated and the efficacy of the vaccine has been reduced. Appropriate authorities are notified to prevent recurrence of the problem.

In the fall of 1991, the last case of polio was seen in the Americas and by 2003 polio had been eradicated from all but 3 countries in the world. Then a few cases were imported from Nigeria and soon 21 countries were reporting polio cases. The involved countries rapidly instituted “Supplementary Immunization Activity” to quickly abort any new cases. It is expected that very soon polio will meet the same fate as smallpox: elimination [19].

Eradicating measles has been a more difficult job. Whereas coverage has improved, it has been slow. Dr. Margaret Chan, WHO Director-General, reported that measles deaths decreased by 60% (873,000 to 345,000) from 1999 to 2005 [20] (Fig. 6), a remarkable achievement, but unfortunately coverage is insufficient. Too many children are still dying from this preventable illness.

One hundred and twenty-three countries have added the Rubella vaccine to the list of immunizations [17]. By 2006, many countries had expanded coverage of children to include hepatitis B and *Haemophilus influenzae* type B (Fig. 7) [11].

## FFF: THREE OTHER LOW-COST, LOW-LEVEL TECHNOLOGIES WERE ADDED

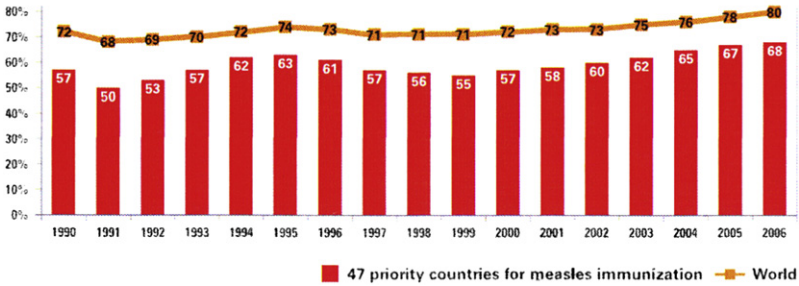
### Female education

It is generally accepted that the more education a woman has, the healthier she and her family are, the fewer children she has, and the greater is her potential



**MEASLES IMMUNIZATION COVERAGE HAS INCREASED STEADILY SINCE 1990 IN 47 PRIORITY COUNTRIES AND WORLDWIDE**

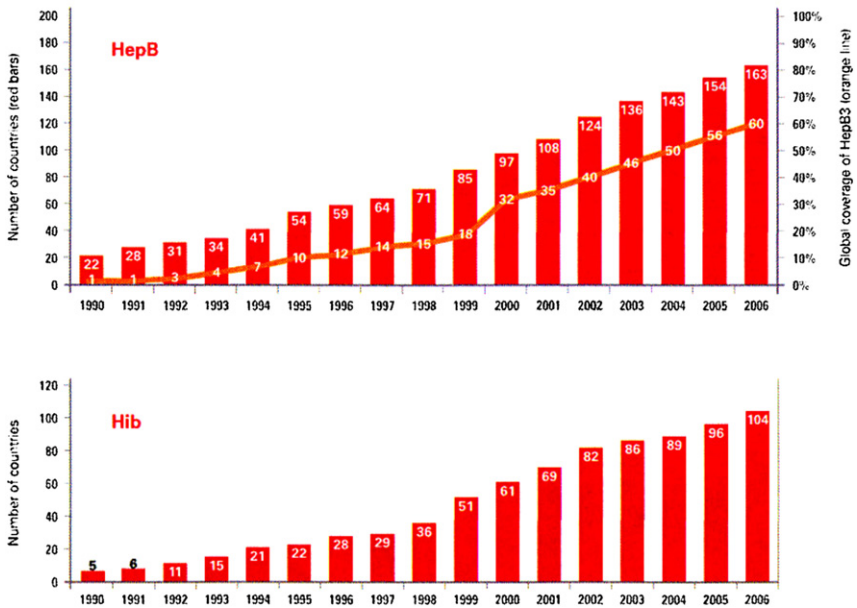
Trends in first-dose coverage of measles-containing vaccine (MCV; 1990–2006)



**Fig. 6.** (From UNICEF. Progress for children—a world fit for children: statistical review. Number 6, December 2007. [http://www.unicef.org/progressforchildren/2007n6/index\\_41401.htm](http://www.unicef.org/progressforchildren/2007n6/index_41401.htm); with permission.)

**SINCE 1990, MOST COUNTRIES HAVE BEGUN IMMUNIZING AGAINST HEPATITIS B (HepB) AND HAEMOPHILUS INFLUENZAE TYPE B (Hib)**

Number of countries that have introduced HepB and Hib into infant immunization schedules, with global percentage of target population reached with three doses of HepB vaccine (1990–2006)



**Fig. 7.** Immunization against hepatitis B and *Haemophilus influenzae*. (From UNICEF. Progress for children—a world fit for children: statistical review. Number 6, December 2007. [http://www.unicef.org/progressforchildren/2007n6/index\\_41401.htm](http://www.unicef.org/progressforchildren/2007n6/index_41401.htm); with permission.)

for income generation. In the early 1980s, the disparity in primary and secondary education between the genders was large and unacceptable [21]. Perhaps the best example of the impact female education can have on the whole population is in the State of Kerala in India. The per capita income in Kerala is less than throughout most of India, yet in Kerala the commitment to female education is strong. In India, one-half of girls drop out of school before completing 5 grades, and only 34% of women are literate. In Kerala, the dropout percentage is zero before grade 5, and 87% of the women are literate. The average number of births per woman in 1990 in India was 4. In Kerala, it was half that (1.9), and twice as many women in Kerala use birth control. In 1990, infant mortality was 83 per 1000 live births in India. In Kerala it was only 17 per 1000 live births. The life expectancy in Kerala for women was 15 years longer than in the whole of India (74 compared with 59) [22].

### Family spacing

The rallying cry of nongovernmental organizations (NGO) as well as many governments was “too young, too many, too soon.” In many developing countries, the custom is for young adolescent girls to marry older men and start having babies at a very early age. Fertility is good. Sterility is not. A 1992 survey in Niger found that 47% of women aged 20 to 24 years had married before they were 15 years old and 87% had married before the age of 18. More than half had had a child before they had left the teenage years [23].

Complications from a teen pregnancy are numerous and include a high percentage of school dropouts as well as a high prevalence of anemia, and due to the smaller pelvis of young mothers, obstructed labor is more frequent. The WHO estimates that maternal mortality rates are fivefold greater for girls between 10 and 14 and twice as high for adolescents who are between 15 and 19 compared with women who are 20 to 24 years old. In societies where the infant and childhood mortality rates are high, families have grown to anticipate that several of their children will die prematurely. To ensure a significant work force, women have more children. In country after country, as infant and childhood mortality rates decrease and more children live, fertility rates also decrease, although it may take a generation or two to realize this [24]. From 1960 to 1980, infant and childhood mortality rates fell close to 60% and fertility rates decreased by 48%. The “too soon” refers to too short a period between one pregnancy and the next. The “simple” strategy of waiting 2 to 3 years between pregnancies will cut infant mortality almost by half and if the interval is greater than 4 years, infant mortality decreases by 60%. Due to the contraceptive effects of *exclusive* breast feeding, delaying weaning has helped lengthen the time between pregnancies.

### Food supplementation

Many studies have reported the benefits of supplementing diets of pregnant women and young children. Perhaps the most well known is the Guatemala study conducted by the Institute of Nutrition of Central America and Panama (INCAP) [25–27]. Two randomly chosen villages received a nutritious

supplement (atole, containing 163 kcal of energy and 11.5 g of protein for each 180 mL of fluid). Two other randomly chosen villages received a less nutritious supplement (fresco, which contained approximately one-third as many calories and no protein). The women in the study who supplemented their usual diet with 20,000 kcal or more during pregnancy had half the risk of delivering a low birth weight infant. Infant mortality rates were reduced by 66% in the atole villages compared with 24% in the fresco villages. A follow-up study in 1987 to 1988 reported that half of the women who as children had received the fresco supplement had short stature compared with only one-third of the women who had received the more nutritious atole supplement [28]. Short stature is associated with a small pelvis. Thus, the infants fared better and the girls were less likely to have obstructed labor when they became pregnant themselves.

The Guatemala food supplementation programs has also had very significant long-term economic effects [29,30]. A follow-up study involved 60% of the 2392 children, aged 0 to 7 years, from the original INCAP study. Linear regression models were adjusted for confounding variables to estimate the annual income, hours worked, and average hourly wages of the adults. The adult men, who as children had received the more nutritious supplement atole from birth to age 2, had a 46% increase in average wages compared with those who received the less nutritious supplement. Boys who had received the atole during their first 3 years of life had an increase of 37% in hourly wages. However, there was no difference in hourly wages in those who received the atole after age 3.

## **MICRONUTRIENT DEFICIENCIES CAUSED CONCERN AND ACTION**

### **Iodine**

In 1993, it was estimated that iodine deficiency was responsible for cretinism in 5.7 million and for mental retardation in another 26 million of the 1.6 billion at-risk populations. In 1990, a goal was set to eliminate all new cases of iodine deficiency by the year 2000. To achieve that goal, every country was to have iodized 95% of the salt supplies by 1995 [22]. The goal has not been met; but by 2003 approximately 70% of the world's salt consumed by humans was iodized. Areas where there is much work yet to be done include some West and East African countries, some Middle Eastern countries, and Russia. China is a story of success. In a span of just 10 years, the population of that huge country had increased its use of iodized salt from 50% to 95% [31].

### **Vitamin A**

In 1994, of the 562 million children younger than 5 years living in the developing world, 500,000 suffered severe eye damage or were blind as a result of vitamin A deficiency; another 3 million had xerophthalmia, and another 13.5 million had "night blindness." Forty-four percent of the entire under-5

population was deficient in vitamin A, inviting a 20% to 30% increased risk of death from common diseases [22]. The risk was even higher for those children who contracted measles. This exanthem is a highly desquamating disease, with loss of epithelium in numerous organs. Vitamin A is essential in the repair of these epithelial cells. With a deficiency of vitamin A, corneal necrosis (keratomalacia) occurs and ulcerates, with the potential expulsion of the lens and blindness. The denuded epithelium-lined tracts are susceptible to bacterial invasion through pneumonia, gastroenteritis, and nephritis. Sepsis is often the result. Without epithelial repair, death can occur as long as 9 months after the measles exanthem. An observant ophthalmologist, Dr. Al Sommer, reported that the survival of children who are deficient in vitamin A can be increased by 35% if they are given a high dose of vitamin A supplementation (200,000 units on 2 successive days) [32]. A meta-analysis by Fawzi and colleagues concluded with the recommendation that "Vitamin A supplements should be given to all measles patients in developing countries whether or not they have symptoms of vitamin A deficiency" [33].

UNICEF and other NGOs, and some countries started programs to orally administer 200,000 units of vitamin A every 5 to 6 months to all children between the ages of 12 months and 5 years. The vitamin A is dispensed in a capsule containing oil to improve absorption, which costs less than 10 cents. The vitamin is stored in the liver, and an adequate supply is maintained unless the child develops repeated illnesses that call on an excessive amount of vitamin A to repair damaged epithelial cells. In southern Nepal, a high percentage of pregnant women are deficient in vitamin A [34]. If the pregnant woman's diet remains inadequate in  $\beta$ -carotene or vitamin A and is without supplementation, her newborn will be deficient and will remain so due to inadequate levels in her breast milk. Until the intake is sufficient, the newborn will be more susceptible to disease and death.

### Iron

It is estimated that more than 1 billion people have iron deficiency anemia; 16% of the world's population [35]. In 1990, half of the pregnant women in the developing world suffered from iron deficiency anemia. These women were tired and having difficulty doing all the chores of daily living, and were at an increased risk of death in childbirth. Their infants were more likely to be small, with lower birth weights and with impaired development [36]. In some areas it was even worse; 90% of pregnant women living in an urban area in Pakistan had anemia [37]. The anemia was mild in 75% of these women, with hemoglobin (Hg) level between 9 and 10.9 g/dL, and in 14% it was moderate, with Hg level between 7 and 8.9 g/dL. More than 40% of children younger than 5 years have a Hg level less than 11 g/dL. In the short term this is responsible for considerable morbidity and mortality. Long-term consequences include a diminution in cognitive abilities and less income potential. This major problem has not been adequately addressed.

## Zinc

Thirty percent of the world's population is deficient in zinc, largely due to the fact that zinc is mainly found in red meat (expensive) and there are no tissue stores. The areas with the highest deficiencies are in Central and East Africa, Angola, Zambia, Zimbabwe, Afghanistan, India, and South East Asia. Zinc supplementation benefits children with diarrhea and respiratory illnesses, and improves linear growth. Pooled analysis of zinc studies has not shown a reduction in *infant* mortality, but has shown an 18% reduction in mortality in children between 12 months and 5 years old. The lack of effect on mortality in infants has a biological basis, as this age group is not thought to have a deficiency of zinc [38].

A recently published community-based, cluster-randomized, double-masked, placebo-controlled, and zinc supplemental trial involved 41,276 children aged 1 to 35 months living in southern Nepal [39]. The 4 groups received daily doses of: (1) placebo; (2) zinc (10 mg); (3) iron (12.5 mg) and folic acid (50 µg); or (4) zinc plus iron and folic acid. The mortality in children younger than 12 months was not affected by the supplemental zinc. Although mortality was 20% lower in the older children, the difference did not reach statistical significance. Contrary to the 1999 report of the Zinc Investigators Collaborative Group [40], the study in Nepal found no difference in the frequency and duration of diarrhea and respiratory infections between the groups. The discrepancy was explained with the observation that most of the studies cited in the Collaborative review involved high-risk children; those just recovering from acute diarrhea or who had persistent diarrhea, and children who were underweight or stunted. Results from studies on unselected populations published after the Collaborative Group report are mixed. The final chapter on morbidity data has not been written.

## THE INTEGRATED MANAGEMENT OF CHILDHOOD ILLNESS (IMCI)

Within the past few years, the WHO and UNICEF have adopted a more comprehensive approach to child care that emphasizes not just the child's acute illness and nutritional deficiencies but the child's total well-being. The child's presenting complaint is dealt with first. The community health care worker makes a careful and systematic assessment of common symptoms and well-selected specific clinical danger signs that provide sufficient information to guide rational and effective actions. The emphasis is on the severity of the acute problem rather than on a specific diagnosis. Algorithms have been developed to assist the health care worker who may have had limited training to make an informed determination as to where and how best to treat the child. The worker follows a chart color-coded by red (danger), yellow (caution), or green (safe). For example, danger signs are depicted on a chart whose center has a big red stop sign surrounded by danger words ("lethargy or unconscious," "inability to drink or breast feed," and "convulsions"). If the child has the danger signs, immediate referral is made to the nearest appropriate facility. If the danger signs are not present and the child can be treated at home, the

family is given an explanation of the problem, why it has occurred, and instructions on how to implement the care suggested.

After addressing the acute problem, the focus shifts to addressing what is necessary to promote the child's growth and development. In addition to the assessment and management of the child's acute condition, more chronic issues are identified and addressed, including nutritional status and immunization coverage. The child younger than 5 years receives the greatest scrutiny.

IMCI not only includes both curative and preventative elements, but also strives to engage the family and the entire community in health promotion. IMCI is a full program that also involves improving the training of the health workers, educating the community in preventive measures to decrease morbidity and mortality of the children, upgrading the available care in the local health clinics, strengthening the available care in the hospital for those children too sick to be treated at the local clinic, and helping local governments plan and include the program as part of the national health policy [41].

The Revolution for Children predicted that if the low-cost, low-technology strategies were put in place, half of the children who would have died would now be alive. The goal was within reach. The cost was not great. The success has largely been the result of implementing the vision of James Grant. He pushed the agenda for nations and NGOs to adopt these simple strategies, and knew that the main obstacles would be creating the political will to place children at the level of highest priority (Table 1).

## THE CONVENTION ON THE RIGHTS OF THE CHILD

This document was presented at the World's Summit for Children in the fall of 1990. In 1989, the General Assembly of the United Nations had adopted this Convention and by the time of the Summit, it had a sufficient number of signatures to become law [42]. This international Convention enumerates the civil, political, economic, social, and cultural rights of children, and a country's signature binds the country to carry out the Articles through international law. The Convention has now been ratified by every country except two: Somalia and the United States. The United Nation's Committee on the Rights of the Child monitors each country to ensure that its Articles are observed.

**Table 1**

Significant improvement in major health indicators in the past 40+ years

Revolution for children			
Indicator	1960	2006–2007	Change
Child deaths	20,000,000	9,700,000 in 2007	51% less
Infant mortality ratio	126	49 in 2006	61% less
Under-5 mortality	197	72 in 2006	63% less
Fertility rate	5.0	2.5 in 2006	48% less
Life expectancy	56 in 1970	68 in 2006	12 more years

## THE WORLD'S SUMMIT FOR CHILDREN

Close to one-half of the world's Presidents and Prime Ministers convened in New York in September of 1990 to ensure that the welfare of children would be placed highest on their political agendas. The challenge of the Summit was: "Enhancement of children's health and nutrition is a first duty, and also a task for which solutions are now within reach. The lives of tens of thousands of boys and girls can be saved every day because the causes of their death are readily preventable. Child and infant mortality is unacceptably high in many parts of the world, but can be lowered dramatically with means that are already known and easily accessible."

From the Summit came the World Declaration on the Survival, Protection and Development of Children and Plans of Action [43]. In September 1990, the following Declaration was signed by 71 heads of state and governments and has subsequently been endorsed by 181 countries.

1. We will work to promote earliest possible ratification and implementation of the Convention on the Rights of the Child. Programs to encourage information about children's rights should be launched worldwide, taking into account the distinct cultural and social values in different countries.
2. We will work for a solid effort of national and international action to enhance children's health, to promote prenatal care, and to lower infant and child mortality in all countries and among all peoples. We will promote the provision of clean water in all communities for all their children, as well as universal access to sanitation.
3. We will work for optimal growth and development in childhood, through measures to eradicate hunger, malnutrition, and famine, and thus to relieve millions of children of tragic sufferings in a world that has the means to feed all its citizens.
4. We will work to strengthen the role and status of women. We will promote responsible planning of family size, child spacing, breastfeeding and safe motherhood.
5. We will work for respect for the role of the family in providing for children and will support the efforts of parents, other caregivers, and communities to nurture and care for children, from the earliest stages of childhood through adolescence. We also recognize the special needs of children who are separated from their families.
6. We will work for programs that reduce illiteracy and provide educational opportunities for all children, irrespective of their background and gender; that prepare children for productive employment and lifelong learning opportunities, ie, through vocational training; and that enable children to grow to adulthood within a supportive and nurturing cultural and social context.
7. We will work to ameliorate the plight of millions of children who live under especially difficult circumstances—as victims of apartheid and foreign occupation; orphans and street children and children of migrant workers; the displaced children and victims of natural and man-made disasters; the disabled and the abused, the socially disadvantaged and the exploited. Refugee children must be helped to find new roots in life. We will work for special protection of the working child and for the abolition of illegal child labor. We will do our best to ensure that children are not drawn into becoming victims of the scourge of illicit drugs.

8. We will work carefully to protect children from the scourge of war and to take measures to prevent further armed conflicts, in order to give children everywhere a peaceful and secure future. We will promote the values of peace, understanding, and dialogue in the education of children. The essential needs of children and families must be protected even in times of war and in violence-ridden areas. We ask that periods of tranquility and special relief corridors be observed for the benefit of children, where war and violence are still taking place.
9. We will work for common measures for the protection of the environment, at all levels, so that all children can enjoy a safer and healthier future.
10. We will work for a global attack on poverty, which would have immediate benefits for children's welfare. The vulnerability and special needs of the children of the developing countries, and in particular the least developed ones, deserve priority. But growth and development need promotion in all States, through national action and international cooperation. That calls for transfers of appropriate additional resources to developing countries as well as improved terms of trade, further trade liberalization, and measures for debt relief. It also implies structural adjustments that promote world economic growth, particularly in developing countries, while ensuring the well-being of the most vulnerable sectors of the populations, in particular the children.

In 2000, The Millennium Development Goals (MDGs) were signed by 189 countries, and were to be accomplished in the next 15 years (2015) [44].

- Goal 1 Eradicate extreme poverty and hunger: Decrease by half from 1990 the proportion of people whose income is less than 1 dollar a day and the proportion of people who suffer from hunger. Achieve full and productive employment and decent work for all, including women and young people.
- Goal 2 Achieve universal primary education: Ensure that children everywhere, boys and girls alike, will be able to complete a full course of primary schooling.
- Goal 3 Promote gender equality and empower women: Eliminate gender disparity in primary and secondary education at all levels.
- Goal 4 Reduce child mortality: Reduce the under-5 mortality rate by two-thirds from 1990.
- Goal 5 Improve maternal health: Reduce the maternal mortality ratio by three-quarters from 1990. Achieve universal access to reproductive health.
- Goal 6 Combat human immunodeficiency virus (HIV)/AIDS, malaria, and other diseases: Have halted and begun to reverse the spread of HIV/AIDS. Achieve universal access to treatment for HIV/AIDS for all those who need it. Have halted and begun to reverse the incidence of malaria and other major diseases.
- Goal 7 Ensure environmental sustainability: Integrate the principles of sustainable development into country policies and programs; reverse loss of environmental resources. Reduce biodiversity loss and a significant reduction in the rate of loss. Halve the proportion of people without sustainable access to safe drinking water and



basic sanitation. By 2020, achieve a significant improvement in the lives of at least 100 million slum dwellers.

- Goal 8 Develop a global partnership for development: Further develop an open trading and financial system that is rule-based, predictable, and nondiscriminatory, and that includes a commitment to good governance, development and poverty reduction; nationally and internationally. Address the special needs of the least developed countries, including tariff and quota free access for their exports; enhanced program of debt relief for heavily indebted poor countries; and cancellation of official bilateral debt; and more generous official development assistance for countries committed to poverty reduction. Address the special needs of landlocked and small-island developing States. Deal comprehensively with the debt problems of developing countries through national and international measures in order to make debt sustainable in the long term. In cooperation with developing countries, develop and implement strategies for decent and productive work for youth. In cooperation with pharmaceutical companies, provide access to affordable essential drugs in developing countries. In cooperation with the private sector, make available the benefits of new technologies, especially information and communications.

### **WORLD HEALTH ORGANIZATION ALTERING COURSE: VERTICAL TO HORIZONTAL PROGRAMS**

Dr. Margaret Chan, the WHO's Director-General, recently stated that international evidence overwhelmingly demonstrates that the primary health care approach is the most efficient and cost-effective way to organize a health system and is the way to achieve "Health Care for All" [45–47]. She observed that whereas it was once thought that attacking single diseases (the vertical approach) would strengthen health care systems, the opposite has occurred. In fact, when some targeted projects implemented by some NGOs or large foundations initiated strategies to ameliorate a specific disease their good intentions often actually disrupted basic health care services. The limited numbers of health care workers were drawn from their government-sponsored jobs of delivering primary health care to these outside higher-paying, more attractive, and more narrowed focused jobs. Dr. Chan argued for a return to primary health care as the only means to meet the 8 Millennium Developmental Goals. This call is emphasized in the World Health Report 2008, *Primary Health Care Now More than Ever* [48].

Dr. Chan confirmed her strong commitment to social justice and equity in health care, and noted the ever widening gaps between wealthy urban populations and poor rural populations. She recognized the link between health and poverty, and described the vicious circle of how poor health induces poverty and poverty is embedded in poor health. Both must be addressed actively, vigorously, and urgently. She emphasized the necessity of the multisectorial approach outlined at the Alma Ata Conference on Primary Health Care. Dr. Chan extolled governments to strengthen health

policies, with particular attention to poor communities. Equity of access was a strong theme of her remarks, and is given further emphasis in the World Health Report 2008 [46,47].

## THE PROGRESS FOR CHILDREN: A WORLD FIT FOR CHILDREN 2007

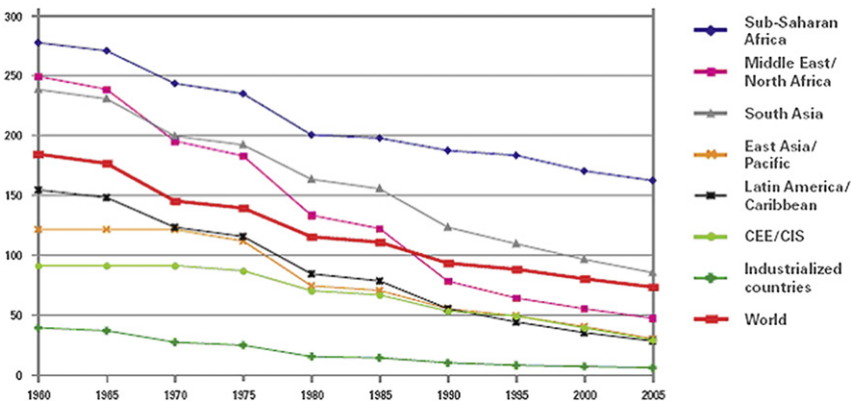
During the 25 years from 1980 to 2005, under-5 mortality fell 34%; from 110 in 1000 to 72 in 1000 live births (Fig. 8). Worldwide, the annual mortality dropped from 13.5 million to 9.7 million. In Latin America, North Africa, the Middle East, Europe, and Southeast Asia, the annual rate of decline was more than 4%. But from 1970 to 2005 in the subregions of West, East, and Central Africa the total number of deaths actually rose 25% [49]! The inequality is explained by a slower decline in under-5 mortality in these regions in Africa, only minimal reductions in the fertility rate with an increase in total population, and the HIV/AIDS epidemic. It is estimated that by 2015, 56% of all under-5 deaths will occur in sub-Saharan Africa; an increase from 19% in 1970. Another 31% will occur in south Asia. In China between 1980 and 1985, the rate of decline was 5%, but since 1985 the decline has slowed to less than 3% [49].

The current rates of decline are not enough to achieve the MDG #4. Diversity of rates within countries and regions presents opportunities to identify the most effective policy changes that should be adopted and implemented.

The Progress for Children: a World Fit for Children [11] presents data proclaiming many important achievements related to the MDGs [11,44,50].

### TRENDS IN CHILD MORTALITY

Under-five mortality rate (per 1,000 live births), by region (1960–2005)



**Fig. 8.** (From UNICEF. Progress for children—a world fit for children: statistical review. Number 6, December 2007. [http://www.unicef.org/progressforchildren/2007n6/index\\_41401.htm](http://www.unicef.org/progressforchildren/2007n6/index_41401.htm); with permission.)

*Promoting healthy lives*

- In 2006, the number of deaths in children younger than 5 years fell below 10 million (9.7 million)—half what it was in 1960 (20 million)
- In 2005, 4 times as many children received 2 doses of vitamin A as in 1999.
- The use of insecticide-treated bed nets tripled in 16 of 20 African countries.
- From 1990 to 2006, in the 47 countries which account for 95% of measles deaths, measles immunization coverage had increased 11% (57% to 68%).
- More than 1.2 billion people gained access to improved drinking water sources.
- Sanitation increased but not at a rate to meet the MDG #7.
- Insufficient progress has been made to reduce maternal mortality.

*Providing a quality education*

- From 2002 to 2006, the number of school-aged children out of school decreased by 18 million or 19% (115 to 93 million).
- But, in sub-Saharan Africa only 1 out of 4 children of secondary school age attend secondary schools.

*Combating HIV/AIDS*

- Almost two-thirds of all people with HIV live in sub-Saharan Africa.
- Only 11% of over 2 million pregnant women living with HIV/AIDS received antiretroviral therapy to prevent transmission to their unborn child.
- Only 15% of children younger than 15 years in need of antiretroviral therapy received that therapy.

**MORTALITY AND MORBIDITY: HOW ACCURATE ARE THE NUMBERS?**

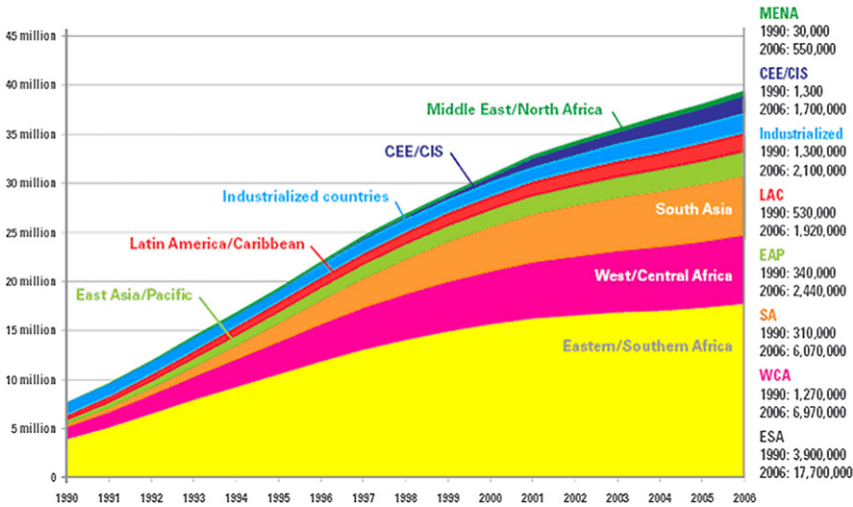
Murray and colleagues site 5 problems that raise questions concerning the accuracy of the statistical reports from the WHO and UNICEF [49]: (1) child mortality data are missing in some countries; (2) figures do not distinguish between actual measurements and predictions; (3) Methods used to obtain the numbers are not transparent and are not reproducible; (4) data from different countries are not obtained with the same precision; and (5) there has been a trend to overestimate mortality in several sub-Saharan countries (Fig. 9).

**THE 2008 HIV/AIDS PROGRESS REPORT (MDG #6): POSITIVE AND NEGATIVE STATISTICS**

From 2006 to 2007, access to antiretroviral therapy in low- and middle-income countries increased 7.5-fold, an increase of almost 1 million; but coverage remains low, with only 31% of those in need receiving therapy and in 2007 an estimated 2.5 million becoming newly infected. Decreases in mortality of those receiving treatment is the same for low- and middle-income countries as for high-income countries. In 2007, 33% of HIV-positive pregnant women in low- and middle-income countries received antiretroviral drugs to prevent transmission to their child; almost a 3-fold increase from 2004 when only 12% received the drugs. Tuberculosis is the leading cause of death among people with HIV. Unfortunately, many people do not know their HIV status

### SUB-SAHARAN AFRICA HAS THE MOST PEOPLE LIVING WITH HIV

Estimated number of people living with HIV, by region (1990–2006)



**Fig. 9.** Human immunodeficiency virus. (From UNICEF. Progress for children—a world fit for children: statistical review. Number 6, December 2007. [http://www.unicef.org/progress-forchildren/2007n6/index\\_41401.htm](http://www.unicef.org/progress-forchildren/2007n6/index_41401.htm).; with permission.)

and a large number live with undiagnosed HIV. Unless that status is checked and only the tuberculosis is treated, satisfactory results are elusive. Targeting of high-risk groups is effective [51].

New evidence from the Comprehensive International Program for Research in AIDS suggests that diagnosis of infants as young as 6 weeks followed by a combination of 3 antiretroviral drugs (lopinavir-ritonavir, zidovudine, and lamivudine) substantially reduces infant mortality (75%) as well as the progression of HIV (76%). The randomized study involved infants 6 to 12 weeks old; 252 received early treatment and 125 received treatment delayed by a mean of 40 weeks. Four percent of the infants in the early treatment group died compared with 16% in the delayed group [52].

Male circumcision reduces the risk of heterosexually acquired HIV infection in men. A large Randomized Clinical Trial (RCT) of HIV-negative men aged 15 to 49 years were assigned either to an immediate circumcised group (2474) or to a 24-month delayed circumcision group (2522) [53]. The subjects were followed with HIV testing, physical examination, and interviews at baseline, and at 6, 12, and 24 months. The groups were similar at baseline and at each evaluation period. There was 90% to 92% retention in both groups. Over the 24 months, the incidence of HIV conversion in the group who received immediate circumcision was 0.66 cases per 100 person-years

compared with an incidence of 1.33 cases per 100 person-years in those who had delayed circumcision.

### Breast milk transmitted HIV

The HIV/AIDS epidemic and the strong likelihood of vertical transmission of the virus through breast milk to the suckling infant and milk substitutes introduced considerable controversy. Were deaths more likely from newborns ingesting breast milk contaminated with the AIDS virus or from drinking formula mixed with water contaminated with bacteria or enteroviruses? In areas where water contamination is not a serious problem, mothers who are HIV-infected are advised not to breastfeed their newborn infant. In regions where the water supply is not optimal, breast milk was safer; provided it was the *exclusive and only* nutrient the infant ingested. Maternal characteristics that enhance transmission include recently acquired HIV infection, a high viral load, lower CD4 counts, and breast abnormalities or breast infections. Infant characteristics that promote transmission are oral lesions or sores such as candidiasis [54]. Breast milk contaminated with HIV is responsible for transmitting the virus to 200,000 (40%) of the 500,000 new infections occurring in children each year. Observational cohort studies in Africa indicate that postnatal transmission of HIV through breast feeding increases the risk of infection by a factor of 7.5 [55]. *Exclusive* breast feeding for the first 4 to 6 months will reduce the risk of transmission. A single dose of peripartum prophylaxis with antiretroviral agents reduces intrapartum transmission, but the effect does not extend beyond 4 to 6 weeks. The large RCT study by Kumwenda and colleagues provided evidence that extended antiretroviral prophylaxis reduces breast milk transmission. These investigators screened 46,186 pregnant women for HIV in Malawi and enrolled 3016 infants in the 3-armed study [56]. All infants in the control group (788) received only a single dose of nevirapine plus 1 week zidovudine given twice daily. Infants in another group (800) received what the control group received plus daily prophylaxis with nevirapine for 14 weeks. Infants in the third group (801) received what the control group received, plus daily nevirapine and zidovudine for 14 weeks. The frequency and duration of breast feeding did not differ between the 3 groups. Nearly 90% were breastfeeding at 6 months but only 27% to 32% were still nursing at 9 months. The control group had consistently higher conversion rates from 6 weeks through 18 months than the infants in either the second or third group, with no statistical difference between the latter 2 groups. At 9 months, conversion rates were 10.6%, 5.2%, and 6.4%, respectively. Regardless of HIV infection, 9.5% or 285 of the 3016 infants in the study died. At 9 months, mortality in the control group was 8.9% and 6.8% in group 2 and 6.3% in group 3 (no statistical difference). The primary causes of death were gastroenteritis and pneumonia. Survival in the HIV-negative infants was significantly better in both extended prophylaxis groups at 9 months and in the extended nevirapine group at 15 months [57]. (For reference: in 2006, the infant mortality rate in Malawi was 76/1000 or 7.6%.)

## THE WHO CONSENSUS STATEMENT ON HIV AND INFANT FEEDING (NEW FINDINGS)

“The most appropriate infant feeding option for an HIV-infected mother should continue to depend on her individual circumstances, including her health status and the local situation, but should take greater consideration in the health services available and the counseling and support she is likely to receive. *Exclusive* breastfeeding is recommended for HIV-infected women for the first 6 months of life unless replacement feeding is acceptable, feasible, affordable, sustainable and safe for them and their infants before that time. When replacement feeding is acceptable, feasible, affordable, sustainable and safe, avoidance of all breastfeeding by HIV-infected women is recommended. At 6 months, if replacement feeding is still not acceptable, feasible, affordable, sustainable and safe, continuation of breastfeeding with additional complementary foods is recommended, while the mother and baby continue to be regularly assessed. All breastfeeding should stop once a nutritionally adequate and safe diet without breast milk can be provided” [58].

The new findings that prompted the statement included: *exclusive* breastfeeding (BF) for up to 6 months is associated with a 3- to 4-fold decrease in the risk of HIV transmission compared with nonexclusive BF; where free infant formula was provided the combined risk of HIV transmission and death was similar whether infants were formula fed or breast fed from birth; early cessation of breast feeding was associated with reduced HIV transmission but with an increase risk of morbidity and child mortality.

In places where water contamination was inevitable, if formula was supplied and hygienic preparation was insured, would it make a difference [59]? Based on the following observations, the answer is no. Promotion of *exclusive* BF in HIV-endemic countries would prevent 13% of current deaths whereas use of nevirapine and formula feeding would prevent only 2% of current childhood deaths. In a comprehensive “formula plus” program in Haiti, including weekly visits for formula milk and education of proper preparation and growth monitoring, HIV transmission was greatly reduced but infant mortality was very high (217/1000 live births). In 1999, a program in Botswana provided free formula to HIV-infected mothers. In the first quarter of 2006, an area in that country experienced a diarrhea epidemic, and reported 35,000 cases of diarrhea and 532 deaths compared with 100 cases and 21 deaths during the same period a year earlier. Powdered formulas are not sterile products and may contain pathogenic bacteria. Health care professionals need to go beyond the “molecular-level” of disease and address larger issues such as “social, economic, and political determinants of health and sickness.” This issue will be addressed more extensively later, but note that lack of clean water kills 5 times more children than HIV/AIDS, and hampers economic growth. Of the 6 billion people in the world, 1.1 billion lack proper access to clean water and 2.6 billion lack access to sanitation. Sub-Saharan Africa loses 5% of its Gross Domestic Product (GDP) every year due to a lack of proper access to clean water and sanitation. That is more money than it obtains from aid.

The “water crisis” is “deeply rooted in poverty, inequality, and unequal power relationships.”

### **THREE ROOT CAUSES OF CHILD MORBIDITY AND MORTALITY**

Health professionals working in the international child health arena need to look beyond the long lines of patients that gather at the health facilities. The numbers defy the resources. The diseases they present are but the consequences of fundamental underlying problems. The diseases are merely symptoms of more basic issues. Until the root causes are ameliorated, the lines will not go away. As populations increase, so will the hordes of patients. The lines will grow longer and longer. The needs will continue to increase and even further outstrip the limited resources.

There are at least 3 basic “wrongs” or disparities that are responsible for the still unacceptably high rate of infant and childhood mortality and of maternal mortality, as well as the enormous levels of morbidity seen in many parts of the developing world. In the leading author’s (B.D.) view, the big 3 priorities are: (1) the elimination of severe poverty, (2) improving the levels of education particularly for females, and (3) the provision of accessible potable water and adequate sanitation.

Raising the level of income gives families the ability to purchase nutritious food and to send their children to school. Thus, improving economic levels will increase the likelihood that the children will receive higher education, resulting in a spiral of better jobs and improved income. An informed, educated mother will see that her child gets immunized and is taken to the health facility early in the course of an illness. The treatment of diarrhea is ORS, but the solution is clean water.

#### **1. Elimination of severe poverty (MDG #1, #4, and #8)**

*Growth and development are more dependent on socioeconomic status than genetics*

In April 2006, the WHO published a set of new growth charts for children from birth to 5 years of age [60]. The charts were based on a prospective international sample of infants and children selected to represent optimal growth from 6 diverse countries; Brazil, Ghana, India, Norway, Oman, and the United States. Prospective longitudinal data were collected from a favorable socioeconomic population of more than 8000 single, term infants without any significant morbidity, who had been exclusively breastfed for at least 4 months and had been born to mothers who did not smoke before or after delivery. This study found that the growth of children is less influenced by genetics or divergent populations than it is from the environment and feeding practices. Although individual children grow differently, the growth pattern of the children in these 6 countries was very similar. The charts also documented times when key motor milestones should be met.

Most of the world has been using the National Center for Health Statistics charts published over 30 years ago as a growth reference [4]. Those curves

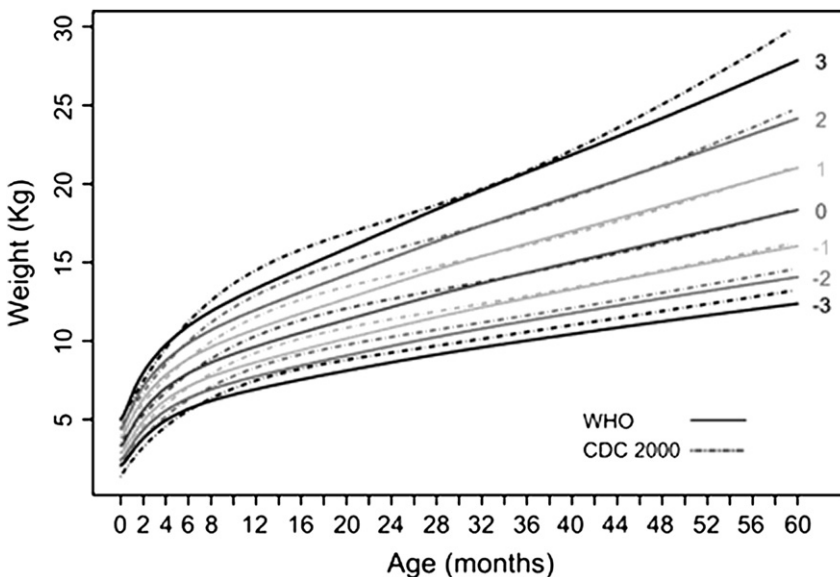
were based on a limited sample of children living in the United States, most of whom had been fed formula rather than breast milk.

The new WHO growth charts were compared with the ones developed by the Centers for Disease Control and Prevention (CDC) in 2000, based on United States children; a revised version of the 1977 NCHS charts [61]. The WHO charts show a mean weight for age above that in the CDC charts during the first 6 months, crossing it at 6 months, and remaining below it until 32 months. The CDC charts revealed a heavier and shorter sample, resulting in the body mass index (BMI)-for-age curves (BMI calculated as the weight in kilograms divided by height in meters squared) on the WHO charts depicting a higher rate of overweight and obesity than seen on the CDC charts [62,63]. Likewise, the WHO curves result in lower estimates of undernutrition (Fig. 10).

The new WHO growth curves represent *how all children should grow* rather than *how children did grow in a specific time and place*.

### Poverty and child health

UNICEF estimates that poverty is responsible for the deaths of 25,000 to 30,000 children younger than 5 years who die *each day*. Many of these children are dying in small villages far away from adequate medical care. These deaths are invisible to the industrialized nations. Of the 1.9 billion children living in the developing world, 1 in 3 is without adequate shelter, 1 in 5 has no access



**Fig. 10.** Comparison of the WHO and CDC weight-for-age Z-score curves for boys. (From de Onis M, Garza C, Onyango, et al. Comparison of the WHO child growth standards and the CDC 2000 growth charts. *J Nutr* 2007;137:144–8; with permission.)



to safe water, 1 in 7 has no access to health services, and 2.2 million children die each year from illnesses that could have been prevented, but were not. These 2.2 million children would be alive if only they had received the recommended immunizations and had been afforded adequate health care. A civilized world cannot/should not accept this appalling situation.

In 2005, 12% of the world's citizens were living on US\$1 per day and almost half of all the children on this planet were living below the poverty line. Twenty percent were living on less than \$2 per day and over 3 billion were trying to survive on less than \$2.50 per day. Eighty percent or 5.1 billion of the 6 billion of all the earth's inhabitants earned less than \$10 per day [64].

### **SOCIAL RISK FACTORS AND CHILD SURVIVAL IN THE UNITED STATES**

There is much to do both at home and abroad. Larson and colleagues examined the effects of 8 social risk factors on a child's general health in the United States (ie, dental health, socio-emotional health, and overweight) [65]. Their study emphasized some of the disparities in the United States and the need to address multiple levels of social problems if the health of children here in the United States is to be improved.

These investigators used data from the 2003 National Survey of Children's Health, a telephone survey of 102,353 parents of children between birth and 17 years of age. The 8 risk factors included no education beyond high school of any household member, uninsured children, a family income less than 200% of the federal poverty level, not a 2-parent household, race/ethnicity, family conflicts, low maternal mental health, and living in an unsafe neighborhood. More than half of the children had 2 or more risk factors and one-quarter had 4 or more risk factors. Low maternal mental health, black or Hispanic race/ethnicity, less than 200% below the federal poverty line, low household education, living in an unsafe neighborhood, and lack of health insurance increased the odds for poor health.

#### **What interventions work?**

There is a strong association between undernutrition and mortality. In addition, micronutrient deficiencies account for 10% of childhood deaths. Ninety percent of these children live in sub-Saharan Africa and South-Central Asia. It is estimated that worldwide, there are 178 million children who are stunted (height-for-age  $Z$  score more than 2 SD below the mean), 55 million who are wasted (weight for height  $Z$  score less than 2 SD below the mean), and 19 million who have severe wasting or severe acute malnutrition (weight for height  $Z$  score less than 3 SD below the mean). Bhutta and colleagues conducted an extensive review of 209 articles spanning the past 25 years, with the vast majority of the studies published after 2000. These investigators sought to determine whether food supplementation interventions actually improve maternal and childhood nutrition and survival [66]. Food supplementation can reduce the prevalence of stunting by one-third; reduce mortality

from birth to 36 months by one-fourth; reduce disability-adjusted life-years (DALYs) associated with stunting, severe wasting, intrauterine growth restriction, and child mortality associated with micronutrient by one-fourth; and with universal supplementation of calcium, iron, and folic acid during pregnancy can prevent almost one-fourth of all maternal deaths. The long-term effects of stunting on cognition and earning potential are other important considerations.

Because it is difficult to affect stunting after 36 months of age, interventions must be directed at pregnant women and at children from birth to 24 months. Supplemental feeding programs that focus on older children will not affect linear growth. Moreover, rapid weight gain from supplemental programs directed at older children may result in an increase in BMI with probable adverse long-term effects. Food supplementation programs like the one in Guatemala have shown beneficial long-term economic benefits [29,30].

Evidence-based intervention programs show beneficial outcomes. What is needed is the technical expertise to determine “which interventions should be given the highest priorities and ensure their effective implementation” and “the political will to combat undernutrition in the very countries that need it most” [66].

## Two solutions to combat poverty and improve health

*Conditional cash transfer programs: a “magic bullet for health”*

Conditional cash transfer (CCT) programs began in Mexico 10 years ago (1998) when Fernald and colleagues randomly assigned 506 low-income communities for either immediate enrollment (320 communities with 6311 households) or after a wait of 18 months, enrollment of 186 communities with 4029 households [67]. The families would receive a monthly fixed stipend, but the money transfer would occur only on the condition that the family would obtain preventive medical care and agree to use the funds to purchase more nutritious foods. A second type of transfer was through educational scholarships that were received by the family, but only if their children attended school a minimum of 85% of the time and did not repeat a grade more than twice. Only 1% of the families were denied cash transfers because of noncompliance. Nine years later, the total cost of the program was \$3.7 billion and had reached more than 5 million families, for an average expenditure of \$740 per family. The outcome of 2449 children aged between 24 and 38 months who had been enrolled in the program since birth was assessed. The results were encouraging: 70% of the cash transfer was spent on purchase of “better quality calories,” there was a lower prevalence of stunting and a lower prevalence of overweight, as determined by a decrease in BMI for age; language development; and an improvement in mental development in short-term or working memory, which is most sensitive to differences in socioeconomic status and is a measure of executive function.

A literature search by Lagarde and colleagues uncovered 28 articles on CCT, of which only 6 met their criteria for study design. There were 5 programs in

Latin America (Mexico, Honduras, Columbia, Nicaragua, and Brazil) and 1 in Africa (Malawi) [68]. In general, CCT programs resulted in an increased use of health services, improved nutritional and anthropometric outcomes, and preventive behaviors. The nutritional improvement was greatest in the younger children. Immunization rates varied. The “overall effect on health status was less clear.” The results were somewhat dependent on the size of the monetary transfers but, most importantly, on the availability and ease of access to primary health care services.

In 2007, New York City launched its own CCT pilot program, the first to be established in the United States. A third component (workforce-participation) was added to the 2 traditional components of health and education.

#### *Microenterprise or Microcredit*

Muhammad Yunus received the 2006 Nobel Peace Prize for his innovation of microcredit for the poorest of the poor. Realizing that the poor have no collateral and hence no way to secure loans from commercial banks, he established a different kind of bank: the Grameen Bank. The Bank offered small loans of 30 to 40 US dollars to individuals using the only collateral they had; their word that they would repay the loan. The Bank felt women would use the funds more wisely than men and were more responsible, as their lives and the lives of their children were in the balance. These loans enabled families to start small businesses. A global movement of microcredit was launched. Thousands of institutions have now adopted this strategy, and it is present in 43 different countries. More than 100 million poor people have taken advantage of microloans and many are escaping poverty. The loans are paid back at a rate of greater than 98%. Dr Yunus is extending the program from starting businesses to helping people pay for education and housing. His goal over the next 10 years is to extend the loans to half a billion people who are living in poverty [69,70].

#### **MDG #8: A global partnership for development**

Data 2007 is the second annual report on the progress of commitments made by the Group of Eight (G8) in Gleneagles in 2005; “the year of Africa” and the Global Call to Action Against Poverty [71]. The G8 is composed of the 8 richest industrialized countries: France, Germany, Italy, Japan, the United Kingdom, the United States, Canada, and Russia. Some important gains have been achieved. Debt cancellation for some African nations and targeted aid has helped 20 million African children enter school. In 2002, only 50,000 or 1% of Africans in need of antiretroviral treatment had access to it but by 2006, the number had increased to 1.34 million, yet was reaching only 26% of those in need of treatment. More effective aid has improved economic growth and decreased poverty; for example, in Mozambique, from 2002 to 2004 aid increased from \$49 to \$63 per capita and the country’s annual GDP growth rate increased from 2% to 8%, while the under-5 mortality rate dropped from 178 to 152 per 1000 live births. The Lubombo region of South Africa has used this aid to buy insecticide-treated bed nets, resulting

in a 90% reduction of malaria prevalence with a potential of further decreasing the 3000 daily malaria-related deaths in Africa.

Individual G8 nations are keeping their promise in specific areas: Japan and the United Kingdom have increased aid; the United Kingdom and Canada have invested in education; The United States has made good on its promises for aid in the fight against HIV/AIDS and malaria; Germany, France, and Italy have invested in water and sanitation. However, all is not positive. Total G8 assistance increased only \$2.3 billion, less than half of the \$5.4 billion promised; the United Kingdom and Japan have kept to their deal but the United States, Canada, Germany, and France have not, and Italy has actually cut its aid. Only small increases in aid were scheduled for 2007 and 2008. A lack of global agreement on trade and failure to focus on Africa will prevent even well-governed African countries from succeeding in their efforts to reduce poverty. The way the G8 decided to account for debt relief masks the real picture of development assistance. Piecemeal progress on specific issues will not lead to the overall results promised by the G8 countries.

## 2. Improving the levels of education and the numbers of educated females (partially addressed earlier under female education, MDG #2, #3, and #5)

### *Economic discrepancies related to maternal and child health*

Health outcomes are directly related to household income, as are educational levels, particularly of women. Houweling and colleagues examined the inequalities among 4 economic groups (the urban rich, the urban poor, the rural rich, and the rural poor) living in 45 developing countries [72]. Assignment to these 4 wealth-related groups was done by using household ownership of durable goods, housing quality, and water and sanitation facilities. Five indicators were used to estimate the level of health care; professional delivery attendance, professional antenatal care, fully immunized children, and childhood treatment of diarrhea and of acute respiratory infections. No discrepancies were seen in respect to these child care indicators. However, wealth and maternity care are linked; the less wealth, the less care with the poor-rich inequalities, looming larger in respect of deliveries by professional trained care providers than provision of antenatal care. Professional delivery attendance is higher in urban than in rural areas, but in most countries the urban poor and the rural rich have very similar levels. The percentage of poor mothers who receive antenatal care is high, but the percentage being delivered by professional trained providers is very low. Relative inequalities tend to be larger in the countries where there are lower overall levels of health care use. Cultural differences may partially explain some of the discrepancies: poor women may favor traditional birth attendants or family members to assist in the deliveries and may favor home deliveries; women in richer families are often better educated and have a more “modern view;” and some families may be less willing to spend money on women’s health (perhaps particularly true in South East Asia). Availability of resources are implicated in explaining the difference in health outcome for maternal and child health services: there are serious

insufficiencies of well-trained personnel who are trained to recognize danger signs in the pregnant woman; there is a lack of 24-hour easy accessible delivery service facilities equipped with the supplies and personnel to handle emergencies; there is a serious lack of available timely transportation for the woman in labor who is experiencing problems; and then there is the expense, as adequate and appropriate physical infrastructure is more costly for deliveries than for the child care indicators. A few countries have addressed these barriers. Indonesia has concentrated on improving the availability of a narrow range of maternity care services whereas Honduras, Cuba, Sri Lanka, and the Kerala State in India have improved a broader range of health services that include maternity services.

This study provides important insights into why there has been so little progress in decreasing the unacceptably high maternal mortality rates in many countries and with the different populations within countries. We are far from reaching the MDG #5 of reducing maternal mortality by 75% by 2015, with just 7 years left. Pediatricians are very much aware of this issue, as a maternal death is a death toll for her infant. Mortality within the first 28 days of life accounts for 27% of all childhood deaths. Reducing maternal deaths will in turn help reduce childhood mortality.

#### Maternal mortality and safe motherhood strategies (MDG #5)

Compared with the gains made in infant and under-5 mortality over the past 25 years, there has been little change in maternal mortality. Saving the mother's life not only averts the death of her newborn infant, it also prevents emotional trauma to her other children and the likelihood of their ill health and starvation. Each year, half a million women die a maternal death; a death during pregnancy, at the time of labor, or during the 42 days following delivery. Ninety-nine percent of these deaths occur in the developing world. The lifetime risk of a woman dying a maternal death in industrialized countries is 1 in 8000, but for a woman living in sub-Saharan Africa the risk is 1 in 22 [11]. Hemorrhage is responsible for approximately 25% of the deaths, infections and eclampsia each another 13%, and obstructed labor 8%. All of these complications demand early recognition and prompt referral to a facility equipped to deal with the emergency.

Safe motherhood practices have been instituted in only a relative few areas. One such area is Nepal. Freedman and colleagues stress the importance of strengthening the capacity of the district health system to implement integrated "functioning services that are accessible to and used by all segments of the population" [73]. Isolated changes are not enough. The focus must be a broad-based multisectorial change. Establishing such a system will also have a positive effect on other emergency and referral services. Practical lessons can be learned from the 4 major global safe motherhood initiatives of the past decade. Three key elements are crucial: family planning, skilled care for all deliveries, and access to emergency obstetric care for women who are identified as having life-threatening complications. What to do is known, but how to do it will

vary with the local situation. Geographic distribution, skilled personnel, the high cost of keeping adequate obstetric facilities open 24 hours a day, and transportation all present challenging problems. The ultimate goal is for every birth to be attended by a skilled health professional, one who can recognize risks and complications and initiate an appropriate referral to a center where the women can receive appropriate obstetric care. A needs assessment is fundamental to identify how to proceed in implementing the most important positive changes. Such an assessment allows the building blocks of the health care system to be put in place.

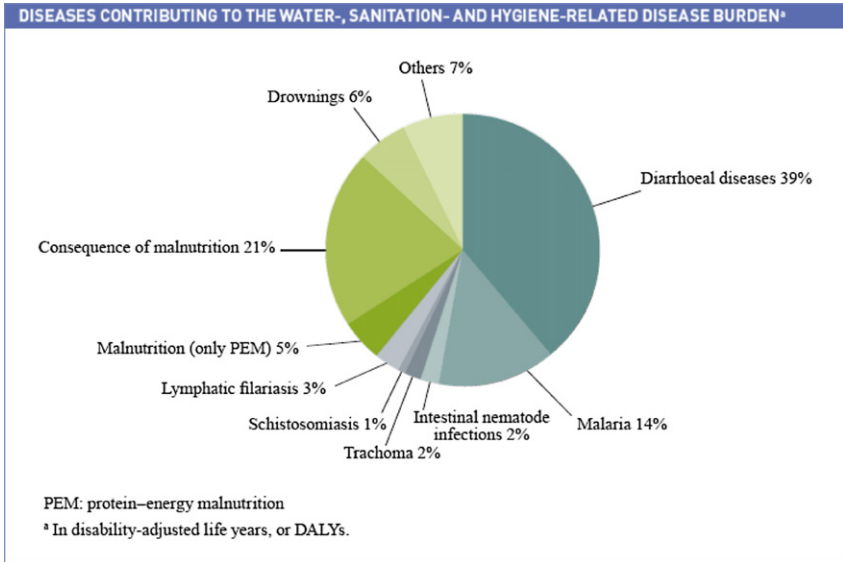
Maternal mortality rates over a 30-year period in 2 adjacent areas in Bangladesh with different levels of care have been compared [74]. In 2002, the population in these areas was 220,000 and the 2 areas were similar in socio-economic criteria. One area was served by the International Center for Diarrhoeal Disease Research (ICDDR). There, maternal and child health services were introduced in the late 1970s and a safe motherhood program was piloted in 1987. The health centers were staffed by trained midwives and transportation was provided to a referral hospital when necessary. The other area received routine government services.

Over the 30-year period, maternal mortality fell substantially. In the ICDDR area the decrease was 68%, from 412 to 131 per 100,000 live births. In the Government service area the decrease was 54%, from 451 to 206. From 1990 onward the decline was 7% and 4% per year, respectively. Introduction of the safe motherhood program did not produce a statistically significant difference. Nor was there a statistically significant difference with the shift from home births to facility-based births or the availability of antibiotics. The proportion of pregnant women with formal education increased 50%. Mortality was 3 times lower in women who had 8 or more years of education compared with women with no formal education, and abortion mortality was 11 times lower in the highly educated women. The number of pregnant women who lived in the lowest asset quintile decreased from one-third to less than 1%. The gap in mortality between the rich and the poor and between the educated and uneducated was striking.

Investment in trained birth attendants and the availability of emergency services are important in reaching the MDG #5, but female education and decrease in poverty are essential to sustain any of the success that was achieved in Bangladesh.

### 3. The provision of accessible potable water and adequate sanitation (MDG #7)

From 1990 to 2004, there has been considerable improvement in the provision of safe drinking water to developing world countries, from 71% to 80%, with a goal of 86% by 2015. The greatest strides were seen in South Asia (71% to 85%, with a goal of 86%), less in the East Asia/Pacific area (72% to 79%, with a goal of 86%), but far too little progress in sub-Saharan Africa (48% to 55%, with a goal of 74%) (Fig. 11).



**Fig. 11.** Diseases related to water and sanitation. (From Pruss-Ostun A, Bos R, Gore F, et al. Safe water, better health. Costs, benefits, and sustainability of interventions to protect and promote health. Geneva: World Health Organization; 2008; with permission.)

MDG #7 calls for decreasing the number of people without sustainable access to safe water by 50% from what it was in 2000. This MDG seeks to combat the impact of contaminated water on diarrheal disease that kills 2 million children every year. A critical review of 118 articles that assessed what works in fighting diarrheal diseases in developing countries noted that piped water and sanitation are vital in the fight to reduce childhood mortality, but 30% of those who live in the rural areas of the developing world lack a safe and accessible water supply [75]. Unfortunately, in poor rural areas piping water to every scattered household is expensive and currently not practical. Hence, the focus has been on providing community-level water infrastructure.

Several strategies work in preventing and treating diarrheal diseases: exclusive breast feeding works; the 2 new Rotavirus vaccines work; ORT works; micro-nutrient supplementation with zinc and vitamin A works; point-of-use water treatment systems work (chemical disinfection of water in the home with household bleach or use of flocculants, adsorption, filtration, boiling, or solar disinfection), reducing diarrheal disease by 20% to 30%; and increased hand washing works. A Cochrane review of 14 RCTs from different counties, across socioeconomic levels, and in both community and institutional settings evaluated the effectiveness of hand washing on the incidence of diarrhea. The target was children and if supplies were available, the outcome was good. Pooled analysis revealed that the incidence of diarrhea decreased 32% in the community setting

and 39% in the institutional setting [76]. Education by itself was the least cost-effective measure, particularly when maternal literacy was low.

### 2008 is the international year of sanitation

From 1990 to 2004, there has been considerable improvement in the provision of sanitation to developing world countries, from 35% to 50%, but well below the goal of 68% by 2015. The greatest strides were seen in the East Asia/Pacific area (30% to 51%, with a goal of 65%) and South Asia (17% to 37%, with a goal of 59%), but little progress is apparent in sub-Saharan Africa (22% to 27%, with a goal of 66%).

A longitudinal study determined the effect on diarrheal morbidity in children younger than 3 years following an intervention that improved sewage coverage from 26% to 80% in households in Salvador, Brazil. The intervention had a significant effect, with diarrhea days per child-year decreasing by 22% [77].

Data on the economic status, level of childhood underweight, availability of clean water, and type of sanitation and indoor air pollution from household fuels from 52 countries in Latin America, the Caribbean, South Asia, and sub-Saharan Africa was used to estimate what reduction would occur in child mortality if child nutrition was improved and if clean water, sanitation, and clean fuels were provided [78]. The effects of the interventions were related to the economic status of those receiving the interventions. If these strategies reached all the children who needed them, the predicted result would reduce child deaths each year by 49,700 (14%) in Latin America and the Caribbean, by 0.8 million (24%) in South Asia, and by 1.47 million (31%) in sub-Saharan Africa. As expected, the poor were at greatest risk for all the factors assessed. If the strategies targeted the poor first, the reductions would be 30% to 75% larger than if the same 50% coverage reached the wealthier households before the poor households. Targeting the poor first would have the greatest impact and would help close the disparity in child mortality between the poor and the wealthy.

Large-scale investments in water and sanitation infrastructure can have a strong positive impact on child mortality. In the United States, filtration and chlorination technology was responsible for one-half of the decline in child mortality. An increase of 10% of the homes with improved water and sanitation on Native American Reservations in the United States resulted in a 4% decrease of child mortality. Community water sources often do not have a significant health impact, particularly if the source is surface water, as it is often contaminated with pathogens and, unfortunately, wells often fall into disrepair due to poor maintenance. Nearly half of the borehole wells in Kenya are in disrepair. One-quarter of India's water infrastructure is in need of repair. More than one-third of the rural water infrastructure in South Asia is not functional. There is a high degree of recontamination of water in transport or in storage. Sanitation and hygiene is as important or more important than water quality.



The ultimate goal is piped water to all households, but until then emphasis should be on: (1) concentrating efforts on point-of-use water treatment programs; (2) encouraging village councils headed by women as they are more likely to invest in public infrastructure for drinking water; (3) giving communities direct control or ownership over key decisions.

Access to safe water and basic sanitation would result in 200 million fewer episodes of diarrhea each year and prevent 2.1 million deaths each year. Improving water supply, sanitation, hygiene, and management of water resources could reduce the global disease burden by 10% [79].

The rapid growth of slums has slowed reaching the MDG #7 target

The quality of available water and the adequacy of sanitary facilities are even worse in the sprawling slums of the major cities in the developing world. A cross-sectional study assessed the effect of overcrowding and resultant proximity of water supply and pit latrines in an urban slum in Eldoret, Kenya [80]. Forty percent of the pit latrines were less than the recommended 15 m from the water source, and 30% of children did not use latrines but defecated in the field. Most people (91%) used wells for their water supply, but the wells were highly contaminated with fecal matter. Shallow wells were used by 89% of the population and *Escherichia coli* was found in all samples taken from these shallow wells. The shallow wells lacked concrete slabs, often the opening was not covered at all, and none met the WHO requirements for drinking water. Deep wells had a pipe system but were used by only 2% of the population, and 3 of 4 samples taken from these deep wells were contaminated with coliform organisms. Only 42% of those using well water boiled the water used for drinking.

In Kenya, the number of people living in slums nearly doubled in the 18 years from 1980 to 1998. Slums are home to 70% of all urban residents in sub-Saharan Africa. Many governments either do not accept any responsibility for the health of squatting slum dwellers or do not have sufficient funds to provide clean water, drainage, sewerage, and rubbish removal. The percentage of people living in the urban slums who lack these vital services is already high, and the numbers are growing. The prevalence of diarrhea among slum dwellers was double what it was for the city and for the national average. Moreover, the under-5 mortality in slum residents in Nairobi is 35% higher than in the city or among rural populations.

There are many factors that lure rural farmers from the land to the city. The size of family plots has decreased due to governmental acquisition and to division among the children. "Fair trade" practices of foreign governments and the subsidies given to in-country farmers make it difficult for the local farmers to compete in the market place. It is increasingly difficult for farmers to make a living in the rural areas. All of this plus the lure of the city and the dream of getting rich has driven many to urban areas. Municipal governments have not prepared for this influx. The sprawl begins, but the usual vital utilities are not there. Poverty and disease infuse the area and crime rises. The problem

is huge and growing. In Ethiopia and Chad, 99.4% of the urban populations live in slums. The next highest percentage of slum dwellers is in Afghanistan (98.5%) and Nepal (92%). Ten to 12 million people live in the slums of Mumbai, and 9 to 10 million live in the slums of Mexico City [81].

### **GLOBAL CLIMATE CHANGE AND CHILDREN'S HEALTH**

The American Academy of Pediatrics (AAP) statement on climate change emphasizes the fact that children are a particularly vulnerable group that "is likely to suffer disproportionately from both direct and indirect adverse health effects of climate change." The AAP cites several adverse examples that the anticipated climate change will cause: reduction in the availability of food resulting in an increase in malnutrition; water availability will become less in some regions, potentiating dehydration in children; flooding will occur in other areas; and people living in coastal areas will be displaced. Greater adverse effects will be seen on the less mobile and more dependent citizens, the children. The AAP makes a series of recommendations to pediatricians and to governments to mitigate the effects of climate change [82].

A UNICEF report focused on what affect climate change may have on the MDGs, and concluded that climate change will likely reduce any likelihood that several of the 8 goals will be met [83]. As the world warms and rains fail, crops will wither and livestock will die. A lack of food will result in an increase in malnutrition and childhood mortality. Malnutrition will also have an adverse affect on pregnant women, and their fetuses will suffer. The WHO estimates that in 2000, climate change was responsible for 2.4% of worldwide episodes of diarrhea and 6% of malaria in some middle-income countries. As the world warms, water shortages will increase; by 2020 an estimated 75 million people in Africa alone will experience water stress. Weather-related events like hurricanes and flooding will intensify, coastal areas will be inundated, and millions will be displaced. Children are more affected, and more will die of starvation while many will become orphans. In the first half of the 20th century, 12 natural disasters occurred annually. In 2004, the number was 350.

There is already some response to this impending problem. In Niger, community gardens are encouraged and are nourishing hope. Conservation through tree planting is increasing; the Ethiopian Government has set a goal of planting 20 million trees and the United Nations Environment Program launched the "Plant for the Planet: Billion Tree Campaign" with the goal of planting 1 billion trees by 2007. Community-based advocacy programs are involving youth in planning and decision making. The United Nations Environment Program and UNICEF are developing an Environmental Education Resource Pack for Child-Friendly Schools offering comprehensive solutions to empower children.

### **INTERNATIONAL HEALTH TRAINING IN PEDIATRIC RESIDENCY PROGRAMS**

Ten years ago, the AAP's Section on International Child Health surveyed pediatric residency programs in the United States to document the interest in

international electives [84]. Nelson and colleagues recently conducted a similar survey of 201 accredited pediatric residency programs in the United States, Puerto Rico, and the Caribbean. More than half of the responding programs offer a “global health” elective as compared with just 25% from the survey done 10 years earlier [85]. Half of these programs had a global health curriculum including didactic lectures and case reports. Six percent had a formal global health track, and another 7% said they were intending to initiate one within the next 2 years. Only 36% of the programs provided prerequisite clinical training or cultural orientation as recommended by the AAP, but the majority offered pretravel briefing, faculty mentorship, and debriefing sessions. A quarter of the programs reported that “at least half” of their residents had had an international health experience before beginning residency training. The majority of the residents take the elective during their third year, and the programs reported a mean total of 3 participating residents from their program. The programs listed several potential barriers to establishing a global health elective, including call-free time and funding. (The Residency Travel Grants of \$500 offered by the AAP’s Section on International Child Health were established to assist with the expense.)

The growing interest in international health should encourage programs to incorporate the opportunity for a global health elective for their residents. Barriers are there but are not insurmountable. A short-term international experience has the potential to improve the lives of children and give a broader

### **What Would You Like to be When You Grow Up?**



**Fig. 12.** Yes, you can help. (Copyright UNICEF; reproduced with permission.)

perspective and understanding of the way the majority of the world lives. A word of caution: such a venture has the potential of altering the way a physician views the world and just might influence life-changing decisions.

It is inappropriate for pediatricians from the “developed” world to even try to make or even suggest policy changes without involving the local pediatricians, and they will invariably fail if they try to do so. However, the “guests” are in a unique position to assist their colleagues who live this reality every day, pushing their governments to put children higher on the priority scale and fulfill the contracts they agreed to when they signed the World Declaration on the Survival, Protection and Development of Children, the Plans of Action, and the Convention of the Rights of the Child. Only by realigning governmental priorities will the MDGs stand a chance of being met.

## SUMMARY

Perhaps this article can be best summed up by the UNICEF poster (Fig. 12).

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