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KEY POINTS

- About 7.6 million children died globally in 2010 before reaching their 5th birthday; an improvement from 9.6 million in the year 2000.
- Newborn deaths are an increasing proportion of the under-5 deaths: 43% in 2011 up from 37% in 1990.
- The major causes of neonatal deaths are complications of prematurity, intrapartum-related deaths ('birth asphyxia') and severe neonatal infections (pneumonia, sepsis or meningitis).
- Most deaths in post-neonatal, under-5 children are due to infectious causes with the three major killers being diarrhoea, pneumonia and malaria.
- Effective interventions exist to address all of the main causes of child deaths, but the infrastructure required to make these available on a timely basis is not present.
- A holistic approach to provide a continuum of care from conception to adulthood is needed to ensure that the progress is made towards the millennium development goals.
- Ending preventable child deaths requires global commitments to ambitious and achievable targets through evidence-based country plans, expanding country/stakeholder engagement, creating transparency and accountability and devising new approaches when needed.

Introduction

Unlike more industrialized countries, developing countries continue to carry a large childhood mortality burden due to preventable causes. The highest risk of death is at the youngest ages, with neonatal deaths accounting for a greater proportion of deaths in all regions of the world, reflecting an urgent need to focus resources not only on the young child, but also on the pregnancy and peripartum period. To address the goals of health, equity and development, 189 heads of state signed the Millennium Declaration consisting of eight Millennium Development Goals (MDGs) in 2000.¹ The goals defined included specific targets eradicating extreme poverty and hunger; achieving universal primary education; promoting gender equality and empowering women; reducing child mortality rates; improving maternal health; combating HIV/AIDS, malaria and other diseases; ensuring environmental sustainability; and developing a global partnership for development, all by the target date of 2015. These MDGs form a blueprint agreed to by all the world's countries and leading development institutions.

They have galvanized unprecedented efforts to meet the needs of the world's poorest people. The MDGs break down into 21 targets that are measured by 60 indicators. Working together, governments, the UN and partners, the private sector and civil society have succeeded in saving many lives and improving conditions for many more, but with the deadline approaching rapidly, it is essential to monitor both achievements and progress towards the MDGs in order to map which indicators need additional efforts.

Since specific diseases are covered in other chapters, the aim here is to focus on child health in tropical countries by reviewing two of the MDGs in some detail.

- MDG 4: Reduce by two-thirds, between 1990 and 2015, the under-5 mortality rate
- MDG 5: Reduce by three-quarters, between 1990 and 2015, the maternal mortality ratio.

Summarizing the progress in over 130 countries is difficult because a good assessment of progress towards MDGs must go beyond averages and aggregates, to consider strategies, implementation and pace of change in indicators. A discussion of child survival also requires consideration of two other MDGs, because of their impact on child health.

- MDG 1: Reduce by half the proportion of people living in extreme poverty and people who suffer from hunger, by 2015.
- MDG 7: Reduce by half the proportion of people without sustainable access to safe drinking water and basic sanitation and achieve a significant improvement in the lives of at least 100 million slum dwellers by 2015.

The MDG 7 of environmental sustainability has far-reaching consequences towards climate change, agricultural productivity and food security, the latter being important in preventing hunger and malnutrition and thus safe-guarding two other vital goals, i.e. MDG 4 and MDG 5, effectively reducing both child and maternal mortality. In essence, the scope of one goal reaches beyond its own effect and provides solutions, which impact other goals. By investing in national programmes that provide dignified access to facilities for the poor and the marginalized, a link between MDG 1 and MDGs 4 and 5 can be established wherein the fulfilment of the former goal can effectively serve to deliver the latter two goals. Essentially, simple interventions at the policy level can serve more complex tasks at the level of implementation.

Global Burden and Trends

Aspirational goals were set at the Millennium Summit for reducing child and maternal mortality. Numerous policies have been influenced to meet these goals by directing the focus to neglected global health challenges. However, even with major accelerated efforts, most countries are unlikely to achieve the

targets for MDGs 4 and 5. This might be seen as a failure, but it is worthwhile to view the pace of progress. Most countries are progressing on reducing maternal and child mortality but will take many years past 2015 to achieve the targets of MDGs 4 and 5. Immediate determined action is needed for a large number of countries to achieve MDG 4 and MDG 5 by 2015 or as shortly as possible thereafter.²

The data from 74 *Countdown* countries shows that 23 are on track to achieve MDG 4. Bangladesh, Brazil, Egypt and Peru reduced the under-5 mortality rate 66% or more and China, Lao People's Democratic Republic, Madagascar, Mexico and Nepal reduced it 60–65%, 13 countries made no progress and 38 made insufficient progress. Therefore, much remains to be done.

Since 2000, there has been an increased focus on neonatal deaths.³ Rapid policy changes have been driven after recent assessments demonstrating that an increasing proportion of under-5 deaths were neonatal, coupled with evidence that effective measures were possible even in low-resource settings. From 1990–2011, the early neonatal, late neonatal, post-neonatal and childhood (ages 1–4 years) death rates declined annually by 1.7%, 2.7%, 2.5% and 2.4%, respectively. Globally, 43% of under-5 deaths happen in the first 28 days of life. The pace of reduction for neonatal mortality is a third slower than for older children, limiting progress to MDG 4. Newborn deaths comprise an increasing proportion of under-5 deaths – 43% in 2011 up from 37% in 1990.^{4,5} The trends show that of the 3.07 million deaths annually in the newborn period, 1.08 million of these are attributable to pre-term birth complications and 0.72 million to intrapartum complications. The chief preventable causes of post-neonatal deaths among children are pneumonia (1.07 million deaths annually), diarrhoea (0.75 million deaths) and malaria (0.56 million deaths).⁶

Maternal deaths, which significantly impact morbidity in children, declined at 1.9% per year on average, from 1990 to 2011, dropping from 409 000 in 1990 to 274 000 in 2011. The subset due to direct and indirect obstetric causes seemed to decline steadily at an annual pace of 2.8% from 1990 to 2011; from 393 000 to 218 000. Over the same timeframe, the number of HIV-related deaths during pregnancy rose to a peak of 81 000 in 2003 and has since declined to 56 000 in 2011, because of the scale-up of antiretroviral drugs and the epidemic curve for HIV. From 2005 to 2011, 28.6% (21 000 of 74 000) of the decrease in maternal deaths was in India, whereas Ethiopia, Pakistan, Nigeria, Indonesia, China and Afghanistan accounted for a further 32.1% (24 000 of 74 000) (Figure 80.1). To achieve MDG-5, the annual rate of decrease in maternal mortality must be 5.5%, much greater than the rate of 1.9% since 1990. Furthermore, one in eight births in low-income settings is in girls aged 15–19 years old, who account for a large proportion of unsafe abortions and therefore, high mortality rates. Overall, only three countries (Equatorial Guinea, Nepal and Vietnam) reduced the maternal mortality ratio 75% or more from 1990 to 2010, though Cambodia, Bangladesh, Egypt, Eritrea and Lao People's Democratic Republic came close, reducing it 70–74%.

NEONATAL MORTALITY

Estimates from 2010 show 3.1 million newborn deaths compared with the nearly 4 million neonatal deaths in 2000 (17% reduction). Over half of under-5 deaths are newborns in all regions except sub-Saharan Africa and Oceania. More than three-quarters of the world's newborn deaths occur in South Asia and sub-Saharan Africa. Ten countries alone make up for 65% of the total 2 955 000 annual newborn deaths in 2011. In

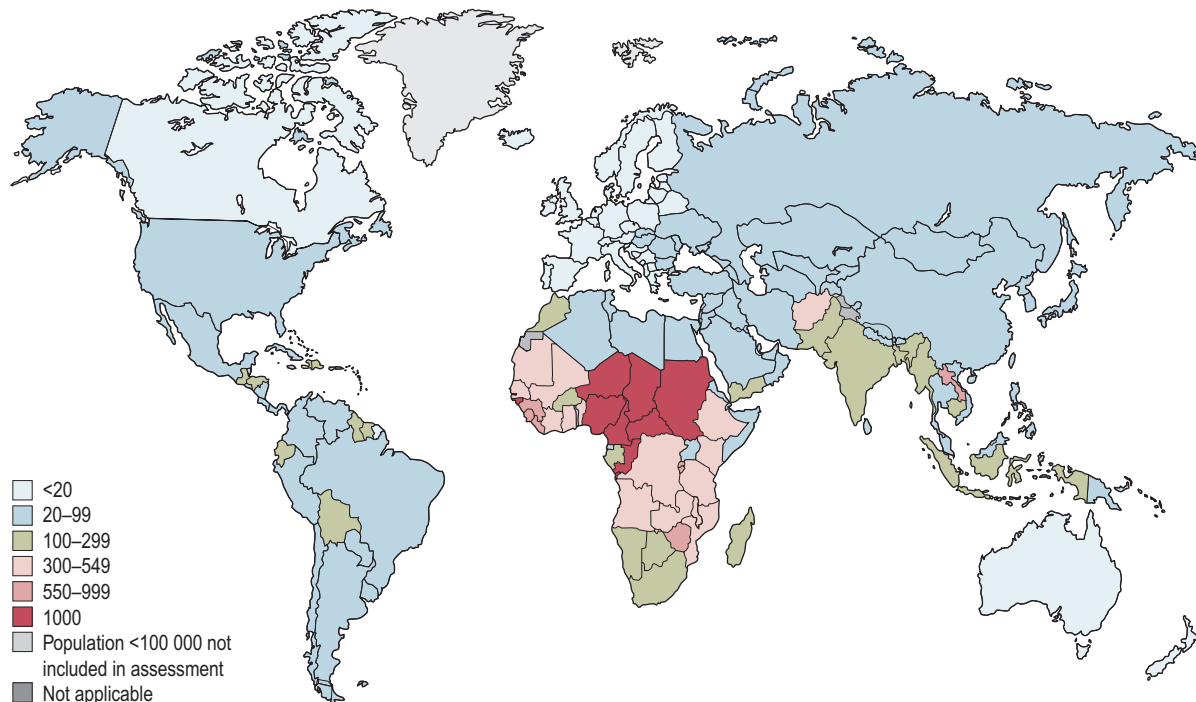


Figure 80.1 Global map for Maternal Mortality Ratio (MMR, deaths per 100 000 live births), 2010. (Source: Adapted from WHO, UNICEF, UNFPA and the World Bank, *Trends in Maternal Mortality: 1990 to 2010*. Geneva: WHO; 2012.)

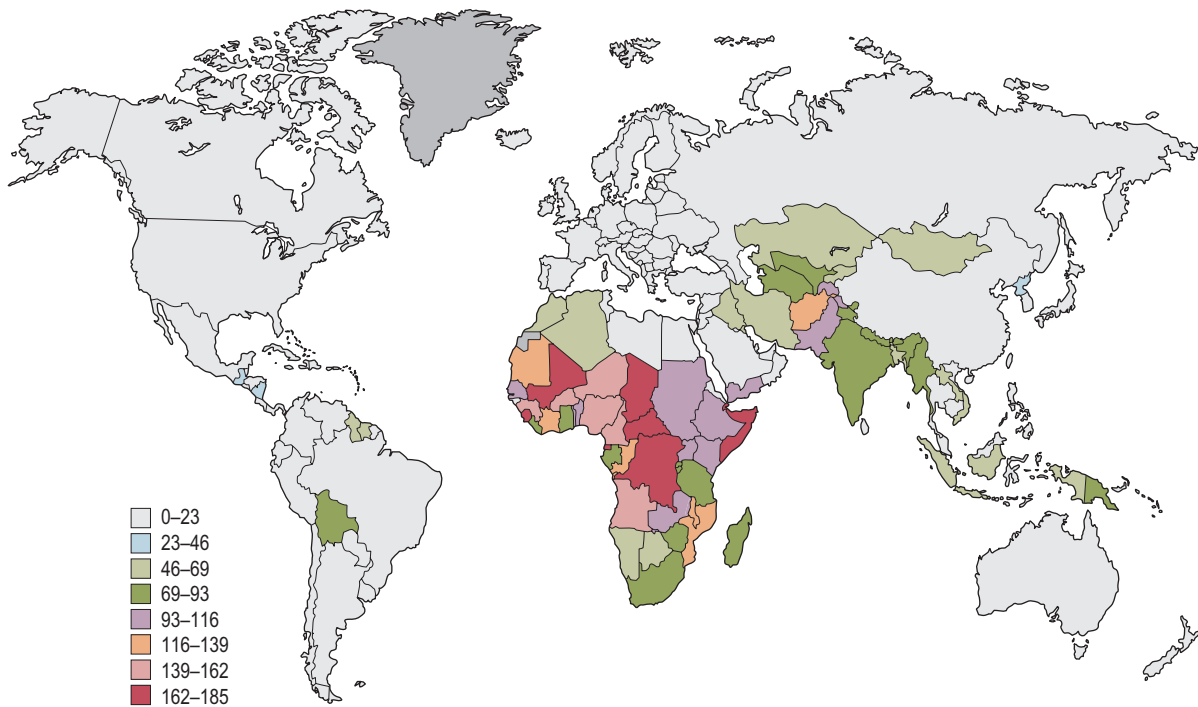


Figure 80.2 Global map for Under-5 Mortality Rate (probability of dying under age 5 per 1000 live births) 2011. (Source: Adapted from UNICEF, *Levels and Trends in Child Mortality Report 2012*.)

sub-Saharan Africa alone, an estimated 1 122 000 babies die before they reach 1 month of age.⁷ Some countries have achieved notable progress in reducing neonatal mortality. Five countries have been able to more than halve their neonatal mortality rates between 2000 and 2010 (Turkey, Oman, Greece, Belarus and Estonia). Sub-Saharan Africa was the region with the least progress, which has had, on average, no significant change in neonatal mortality rate during the last decade.

UNDER-5 MORTALITY

About 7.6 million children died globally in 2010, before reaching their 5th birthday, an improvement from 9.6 million in the year 2000 (Figure 80.2). The majority of the 7.6 million unacceptable child deaths that occur each year could be prevented using effective and affordable interventions.⁸ South Asia accounted for one-third of worldwide deaths of children younger than 5 years, with the proportion of deaths in sub-Saharan Africa increasing from 33% (3.9 million of 11.6 million) in 1990 to 49% (3.5 million of 7.2 million) in 2011, while the number of deaths in North Africa and the Middle East declined from 5.7% (0.66 million of 11.6 million) to 3.7% (0.27 million of 7.2 million).

Causes of Child Death

NEONATAL DEATHS

The distribution of direct causes of death shows the major causes of neonatal deaths are complications of: prematurity – 1 078 000; intrapartum-related deaths ('birth asphyxia') – 717 000; and severe neonatal infections (pneumonia, sepsis or meningitis) – 717 000 (Figure 80.3).

Prematurity

Pre-term birth is a syndrome with a variety of causes which can be classified into two broad subtypes: (1) *spontaneous* pre-term birth (spontaneous onset of labour or following pre-labour premature rupture of membranes) and (2) *provider-initiated* pre-term birth (defined as induction of labour or elective caesarean birth before 37 completed weeks' gestation for maternal or fetal indications (both 'urgent' or 'discretionary')) or other non-medical reasons.⁹

Approximately 29% of neonatal deaths globally are attributable to pre-term birth complications. Most pre-term infants are

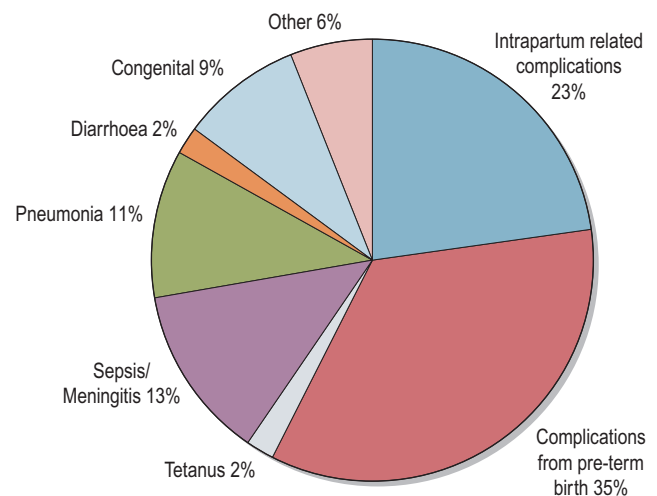


Figure 80.3 Estimated distribution of direct causes of newborn deaths. (Source: Liu L, Johnson H, Cousens S, et al. *Global, regional and national causes of child mortality: an updated systematic analysis. Lancet 2012;379(9832):2151–61.*)

born between 33 and 37 weeks' gestation. With careful attention to feeding, warmth and early treatment of problems, including breathing problems, infections and jaundice, these babies should be able to survive. Babies born before 33 weeks' gestation or with birth weight under 1500 g are more likely to need advanced care, especially for breathing problems and feeding. These babies should receive care in a referral hospital, if possible. Pre-term birth acts both as a risk factor for mortality as well as a direct cause of death.¹⁰ According to the International Classification of Disease, the direct cause of death is only attributed to pre-term birth if the death results from complications specific to pre-term birth or is in a severely pre-term baby. If a moderately pre-term baby has an infection and dies, the death is most appropriately attributed to infection and pre-term birth acts as a risk factor. Thus, many infants recorded as dying from infection are also pre-term.

An average of 14% of babies born worldwide are born with low birth weight (LBW), a weight at birth of <2500 g. LBW may be due to pre-term birth or growth restriction of full-term babies or a combination of the two causes. Pre-term infants are at 13 times greater risk of neonatal death than full-term infants. Furthermore, at least one-half of neonatal deaths are in pre-term babies. Babies who are both pre-term and growth-restricted have an even higher risk of death.

LBW infants in Africa are at greater risk of being born pre-term; around 12%. This is almost double the frequency of pre-term birth in European countries and probably related to infections, particularly sexually transmitted infections, malaria and HIV/AIDS. The situation in South Asia is markedly different. The LBW rate there is almost twice that in Africa but most LBW babies are term infants who are small for gestational age.

In any setting, co-infection during pregnancy with HIV and malaria is of major concern. These two infections act synergistically resulting in serious consequences for maternal and newborn health, especially increasing the LBW rate. To date, strategies to prevent LBW and pre-term birth have not resulted in significant progress and remain a critical discovery research gap for both high- and low-income countries. Identifying small infants and providing extra support for feeding, warmth and care, particularly kangaroo mother care, has great potential to reduce neonatal deaths in the short term.

Birth Asphyxia

Birth asphyxia is the fifth largest cause of under-5 child deaths (8.5%), after pneumonia, diarrhoea, neonatal infections and complications of pre-term birth. It is estimated that around 23% of all newborn deaths are caused by birth asphyxia, with a large proportion of these being stillbirths. The incidence of birth asphyxia has reduced significantly following improvements in primary and obstetric care in most industrialized countries and accounts for less than 0.1% of newborn infant deaths. In developing countries, rates of birth asphyxia are much higher, ranging from 4.6/1000 in Cape Town to 7–26/1000 in Nigeria and case fatality rates may be 40% or higher. Exact epidemiological data are lacking and the precise burden of severe neurological disability in developing countries is unknown. According to the World Health Organization (WHO), between 4 and 9 million newborns develop birth asphyxia each year. Of those, an estimated 1.2 million die and at least the same number develop severe consequences, such as epilepsy, cerebral palsy and developmental delay. The numbers

of disability-adjusted life years (DALYs) for birth asphyxia estimated by WHO exceed those due to all childhood conditions preventable by immunization. Community-based data on disability in less developed settings are lacking and studies reliably assessing the cause are virtually non-existent. This makes the estimates essentially uncertain.

Epidemiological research is needed to accurately estimate the contribution of birth asphyxia to perinatal morbidity and mortality, especially in community settings where the burden of disease, due to the high proportion of unattended deliveries, is likely to be larger than in the hospital setting. One of the major difficulties in collecting accurate epidemiological data on birth asphyxia is the lack of a standard definition of the condition. This has added to the difficulties in assessing the true burden of the condition, especially at the community level. Historically, asphyxia was categorized into two grades of severity; asphyxia pallida and livida, signifying varying degrees of affliction. Infants with asphyxia pallida or pale asphyxia were generally regarded as more severely affected, requiring immediate resuscitation. This definition was, however, replaced by more objective measures such as the Apgar score, proposed in 1952.¹¹ The Apgar score is universally accepted on the basis that a low score, especially at 5 min, can predict survival. The Apgar score has come under criticism for its inability to correctly diagnose perinatal asphyxia and predict long-term neurodevelopmental disabilities.^{12,13} The seemingly weak relationship between low Apgar scores and several indicators of perinatal asphyxia is not surprising, since the Apgar score was not intended to be a measure of perinatal asphyxia. Just as the Apgar score alone is a poor predictor of outcome, metabolic acidosis in isolation has also proved to be a poor predictor of significant perinatal brain injury. Similarly, a combination of low Apgar score and acidosis at birth was found to have poor predictive value for neonatal neurological morbidity.¹⁴ According to the American College of Obstetricians and Gynecologists and the American Academy of Pediatrics, a neonate is labelled to be asphyxiated if the following conditions are satisfied: (1) Umbilical cord arterial pH <7; (2) Apgar score of 0–3 for longer than 5 min; (3) Neonatal neurological manifestations (e.g. seizures, coma or hypotonia); and (4) Multisystem organ dysfunction, e.g. cardiovascular, gastrointestinal, haematological, pulmonary or renal system. Thus, hypoxia or asphyxia should be labelled as a cause of disability and handicap only when the neonate demonstrates the four perinatal findings listed above and in whom other possible causes of neurological damage have been excluded. In the absence of such evidence, subsequent neurological deficiencies cannot be ascribed to perinatal asphyxia or hypoxia.

Birth asphyxia can be caused by events in the antepartum, the intrapartum or the postpartum periods or combinations of all three.¹⁵ A recent review suggests that asphyxia is probably primarily antepartum in 50% of cases, intrapartum in 40% and postpartum in the remaining 10% of cases. In developed countries where intrapartum complications are rare events, cases of perinatal asphyxia are more commonly related to antepartum causes or to the superimposition of intrapartum insults over an already at-risk situation. Given the higher incidence of serious complications in labour and reduced availability of skilled care during delivery, intrapartum causes account for a larger proportion of cases in developing countries. The consequences of asphyxia range from no ill effects to multi-organ complications and death. This huge variation in

the outcome diverges with the severity and duration of asphyxia. Despite identification of many possible predictors of outcome, little is known of the long-term developmental outcome of asphyxiated term neonates.¹⁶ Furthermore, the evaluation of long-term outcome is stalled by the lack of a consensus on standard case definitions of birth asphyxia, difficulties in assessing asphyxia in non-hospital births and in measuring disabilities, especially among young children and the difficulty of attributing aetiology in the wake of malnutrition and disease.¹⁷

Although neonatal encephalopathy is the most commonly accepted marker of birth asphyxia, studies show that over 75% of the cases of neonatal encephalopathy have no clinical signs of intrapartum hypoxia. Assessing the proportion of neonatal encephalopathy that is due to birth asphyxia is difficult because of problems in defining both asphyxia and neonatal encephalopathy and in recognizing the cause of neonatal neurological illness.^{18,19} It was previously believed that birth asphyxia is a primary cause for one to two cases of cerebral palsy per 1000 live births. Cerebral palsy is a chronic non-progressive neuromuscular condition that results in muscular spasticity or paralysis and may have associated mental retardation. Earlier studies concluded that up to 50% of cerebral palsy was attributable to birth asphyxia. Further studies reduced this figure to under 10% of cases. Clinical epidemiological studies also show that in most cases, the events leading to cerebral palsy occur in the fetus before the onset of labour or in the newborn after delivery.²⁰ With the importance ascribed in the past to hypoxia in asphyxia and the role of oxygen in resuscitation, the relationship of asphyxia to cerebral palsy may also be related to aggressive and inappropriate treatment strategies.

Neonatal Infections

Infections, including sepsis, pneumonia, tetanus and diarrhoea, are estimated to be the most common causes of neonatal mortality.²¹ The early neonatal period, which includes the period from birth to the 7th day of life, is the most dangerous period for a neonate, with increased risk of morbidity and mortality from perinatal causes, including birth asphyxia, prematurity and infection. Three-quarters of neonatal deaths occur during this period; early-onset neonatal sepsis (EONS) is typically defined as sepsis occurring within the first 3 or 7 days after birth. Seven days is typically used for Group B streptococcal (GBS) sepsis; 3 days is more commonly used in epidemiological studies.²²

Determining the true burden of EONS in the developing world is not an easy task. Most births and deaths in developing countries take place at home and are unrecorded. Limited community-based surveillance and inadequate laboratory resources to identify EONS hinder assessment of the burden of disease.²³ Most of the available information comes from Demographic and Health Surveys, which are believed to underreport early neonatal deaths. Precise diagnosis of EONS and EONS-related deaths is further complicated by the uncertainties involved in distinguishing the clinical syndrome of sepsis from those of birth asphyxia and prematurity in the early neonatal period. Because hospitals in developing countries with high neonatal mortality capture only a small proportion of all cases of neonatal sepsis, the data do not reflect population-based incidence estimates. Other factors responsible for uncertainty in the data, include the lack of standardization of case

ascertainment, limited laboratory facilities for blood culture, problems with sensitivity of blood cultures in detecting true bacteraemia in neonates and inherent limitations of verbal autopsy tools, which make the cause of death unclear for most neonatal deaths in developing countries. Three studies reported incidence of culture-confirmed EONS, which ranged from 2.2 to 9.8 per 1000 live births. The fourth study reported the incidence of clinical EONS of 20.7 per 1000 live births.^{24–27} A more recent study from Bangladesh reported the incidence of EONS observed during a home-based newborn surveillance programme. The rate of clinical EONS was 50 per 1000 live births and blood culture-confirmed EONS was 2.9 per 1000 live births. All of these studies were from the South Asian region. Two of the studies also reported case fatality rates for EONS in the range of 18–19%.

Reviews have shown that the bacteriological profiles of organisms responsible for EONS have evolved over time, highlighting the need for constant surveillance to identify predominant organisms. Knowledge of pathogens that are likely to cause sepsis guides empiric therapy while awaiting culture and antimicrobial susceptibility results.^{28,29}

The longest running database on neonatal sepsis in the developed world has been maintained by the Yale-New Haven Hospital. Published findings for a 75-year period, from 1928 to 2003 showed that *Streptococcus pneumoniae* and group A streptococci account for almost half the cases from 1933 to 1943.³⁰ The incidences of infections due to *S. pneumoniae* or group A streptococci have shown a steady decrease and have been replaced by GBS and *Escherichia coli*. The recommendation of intrapartum use of antibiotics, since the 1990s, to reduce vertical transmission of GBS, has significantly contributed to a decline in the percentage of EONS secondary to GBS in recent years.³¹

Aetiological information on causes of EONS in developing countries is again limited. A recent review shows 44 studies that reported the causes of EONS in developing countries. Only four focused on community-acquired infections, the rest were facility-based studies not representative of home environments with high neonatal mortality rates. The limited data available in the review showed that 25% of all episodes of EONS were caused by *Klebsiella*; 15% were caused by *E. coli*; 18% were caused by *Staphylococcus aureus*; 7% were caused by GBS; and 12% were caused collectively by *Acinetobacter* and *Pseudomonas* (Table 80.1).

In the global dataset, the overall ratio of Gram-negative organisms to Gram-positive organisms was 2:1. In African countries, the ratio of Gram-positive organisms to Gram-negative organisms was equal, due to a larger proportion of infections caused by *Staphylococcus aureus* and GBS, as compared with other regions of the world. *Pseudomonas* and *Acinetobacter* were more common in East Asia, Pacific and South Asian countries and *S. aureus* was uncommon in East Asia and Latin America, as compared with other regions. Although GBS is one of the predominant organisms causing EONS in developed countries, it was uncommon in developing countries. In developing countries, South Asia had the lowest rates of GBS. The reason for this difference in distribution of GBS between developed and developing countries is not clearly understood. Stoll and Schuchat³¹ reviewed 34 studies published between 1980 and 1996 that evaluated GBS colonization rates in women in developing countries. Studies using adequate culture methods found differences in the prevalence of colonization in different

TABLE 80.1 Causes of Sepsis in Neonates up to 7 Days of Age in Developing Countries

Organisms Isolated	≤3 Days of Life (%)	≤7 Days of Life (%)
Total	100	100
<i>S. aureus</i>	17.3	17.5
<i>S. pyogenes</i>	0.4	1
GBS	13.1	6.5
Group D streptococci	5.3	2.5
Group G streptococci		0.03
<i>Viridans</i> streptococci	0.04	0.2
<i>S. pneumoniae</i>	1.1	1.5
Other <i>Streptococcus</i> species	2.3	1.1
ALL GRAM POSITIVES	40.2	32.4
<i>Klebsiella</i> species	26.4	25.3
<i>E. coli</i>	12.6	15.3
<i>Pseudomonas</i> species	5.9	7.0
<i>Enterobacter</i> species	3.6	4.4
<i>Serratia</i> species	0.5	0.3
<i>Proteus</i> species	0.6	0.8
<i>Salmonella</i> species	0.7	1.2
<i>Citrobacter</i> species	0.4	1.3

Source: Zaidi AK, Thaver D, Ali SA, et al. Pathogens associated with sepsis in newborns and young infants in developing countries. *Pediatr Infect Dis J* 2009;28(Suppl 1):S10–18.

regions (Middle East/North Africa, 22%; Asia/Pacific, 19%; sub-Saharan Africa, 19%; Americas, 14%; and India/Pakistan, 12%). Other factors contributing to observed differences in GBS rates in different populations include strain virulence, maternally derived antibody levels or cultural practices. Another reason for lack of information could be that in developing countries GBS is a very early-onset illness causing death within a few hours of birth, it is possible that data miss the vast majority of GBS cases.

A number of factors contribute to the high incidence of infections and mortality. These include: immediate causes such as lack of antenatal care; unsupervised or poorly supervised home deliveries; unhygienic and unsafe delivery practices and cord care; prematurity; low birth weight; lack of exclusive breast-feeding and delays in recognition of danger signs in both mother and baby.³² Furthermore, underlying factors such as health system inefficiencies, infrastructural, logistic or economic constraints also contribute to high rates of infection and infection-associated mortality. In addition, wide inequities exist in health service provision, such that the lowest coverage rates of known effective maternal and child interventions are in the poorest income groups.

In developing countries, blood cultures and adjunct laboratory tests are often not possible, so the diagnosis of neonatal sepsis is often based solely on clinical signs. The signs of sepsis in the neonate are often nonspecific and include lethargy or irritability, poor feeding, vomiting, jaundice, respiratory distress, apnoea, fever or hypothermia. These symptoms overlap with those of perinatal asphyxia and with normal findings in pre-term infants, further complicating the diagnosis. Neonatal pneumonia and meningitis may be included within the term, neonatal sepsis, particularly in the developing world where microbiology laboratories are not available. In addition, the clinical syndromes overlap and pneumonia and meningitis are variably accompanied by bacteremia.

There are a number of factors that put newborns in developing countries at an even greater risk for developing sepsis compared with the newborns in industrialized countries. These can be categorized into intrinsic and extrinsic factors in the antenatal, intrapartum and the early neonatal period. Intrinsic factors in the developing world include higher rates of prematurity, intrauterine growth restriction, birth asphyxia, premature and prolonged rupture of membranes and maternal peripartum infections. The most important extrinsic factors contributing to the high risk of sepsis are the lack of antenatal care and unhygienic birth practices. According to WHO estimates, only 35% of births in least developed countries are attended by a skilled health professional.

THE UNDER-5 CHILD

Diarrhoea and pneumonia are responsible for 29% of under-5 deaths globally. This is greater than the mortality caused by measles (1%), meningitis (2%), malaria (7%) and AIDS (2%) combined (Figure 80.4). Successful vaccination programmes have reduced the worldwide total for deaths caused by measles and tetanus, but each of these diseases was still responsible for about 1% of deaths worldwide in 2008. Other causes of death such as vector-borne diseases (e.g. malaria, dengue and Japanese B encephalitis), meningitis and HIV/AIDS are relatively small. AIDS, however, remains a substantial threat since so many HIV-infected people remain undiagnosed. It is remarkably striking that all-cause child deaths and deaths due to some specific causes, such as diarrhoea, pneumonia, malaria and AIDS are heavily concentrated in some countries. This is partly related to the large populations of children younger than 5 years in these countries, but also due to the concentration of diseases in these settings because of epidemiological and social conditions. Success in disease control efforts in these countries is essential if MDG 4 goals are to be achieved.

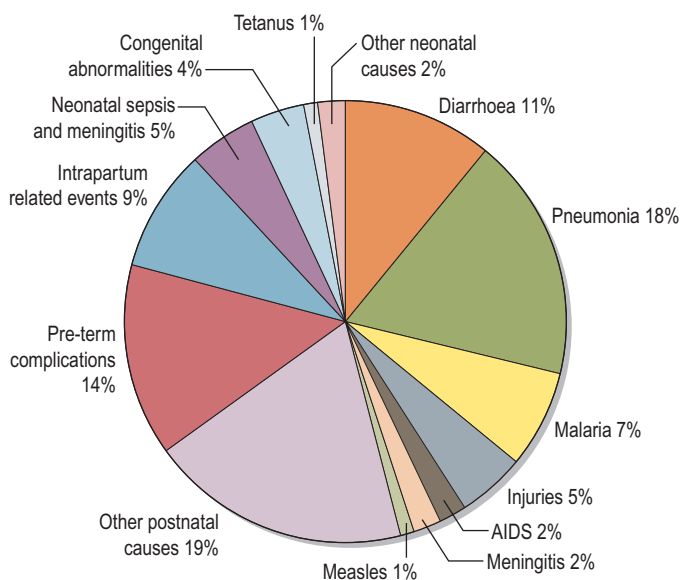


Figure 80.4 Causes of under-5 mortality worldwide. (Source: Liu, et al. *Child Health Epidemiology Reference Group of WHO and UNICEF. Global, regional and national causes of child mortality: an updated systematic analysis for 2010 with time trends since 2000. Lancet* 2012;379(9832):2151–61.)

TABLE
80.2

The 15 Countries with the Highest Estimated Number of Deaths due to Clinical Pneumonia and Diarrhoea

Country	Predicted No. of Deaths (Thousands)	Total No. of Annual Deaths due to Diarrhoea
India	408	386 600
Nigeria	204	151 700
Democratic Republic of the Congo	126	89 900
Ethiopia	112	73 700
Pakistan	91	53 300
Afghanistan	87	82 100
China	74	40 000
Bangladesh	50	50 800
Angola	47	19 700
Niger	46	151 700
Uganda	38	29 300
United Republic of Tanzania	36	23 900
Mali	32	20 900
Kenya	30	27 400
Burkina Faso	25	24 300

Source: World Health Organization, Global Burden of Disease estimates. (The totals were calculated by applying the WHO cause of death estimates to the most recent estimates for the total number of under-5 deaths, 2007 and Liu et al. 2012.)

A total of 95% of disease deaths preventable by the Expanded Programme on Immunization (EPI) vaccines are caused by measles (67%) and tetanus (28%); protection is higher for diphtheria and pertussis, as deaths from these diseases are rare. The low rate overall of deaths from vaccine-preventable diseases relates to the high rates of EPI coverage, measuring 80–95% in most countries. However, EPI coverage continues to be a problem in some countries, particularly those with poor public health infrastructure and in settings with difficult-to-reach populations such as indigenous groups.

Malnutrition is a major contributor to child deaths, in 61% of diarrhoea, 57% of malaria, 53% of pneumonia and 45% of measles deaths. Overall, 53% of all deaths may not have occurred in the under-5 age group if the child was well nourished.³³

To summarize, pneumonia and diarrhoea are the leading killers of children and each year more than 2 million children die due to these illnesses. This toll is highly concentrated in low-income countries (Table 80.2). The persistent importance of these infections as immediate causes of death relates to predisposing factors: a lack of access to basic health facilities, unsafe and unhealthy environments. Unsafe water for drinking and food preparation, inadequate availability of water for hygiene and lack of access to sanitation contributes to around 88% of deaths from diarrhoea. Indoor air pollution is implicated in over 50% of deaths of children 0–4 years old, largely related to pneumonia and bronchitis.

Pneumonia

Pneumonia kills more children under the age of 5 than any other illness, yet it is a forgotten pandemic. Around 18% of deaths in children under the age of 5 are caused by pneumonia, 20% in low-income countries and only about 4% in high-income countries. Among these, 14% occur in the postnatal period, whereas 4% occur in the neonatal period. The relative

importance of the causes differ among different regions, however, pneumonia remains a major killer of children under the age of 5 worldwide. Two-thirds of these deaths are concentrated in just 15 countries.

About 156 million new cases of pneumonia occur worldwide every year, with 74% of these new cases in just 15 countries and more than half in just six countries: India, China, Pakistan, Bangladesh, Indonesia and Nigeria. This can be attributed to high rates of malnutrition, poverty and inadequate access to health care.

Region-specific data indicate that about 50% of worldwide deaths from pneumonia in children under the age of 5 occur within the African region; less than 2% occur in the European region; and less than 3% in the region of the Americas. Figure 80.5 represents the trends in global mortality from pneumonia in children under 5 years of age over the last 2 decades. Although there has been some reduction in mortality rates, the global burden of pneumonia has remained unchanged since these composite figures hide the significant differences that exist in pneumonia mortality rates between various socioeconomic groups and countries.

Many low-income countries have introduced new vaccines against the common agents of pneumonia in children. These include the *Haemophilus influenzae* b vaccine and pneumococcal conjugate vaccine. By 2011, nearly all GAVI-eligible countries had introduced Hib vaccines with GAVI support, immunizing a cumulative 124 million children and preventing an estimated 697 000 future deaths.

Once children develop pneumonia, prompt and effective treatment saves lives. Data from a subset of countries with comparable data for around 2000 and 2010, indicate that progress in appropriate care seeking for suspected childhood pneumonia has been limited, with appropriate care seeking rising from 54% to 61%. Sub-Saharan Africa showed the most progress, although it still has the lowest level of appropriate care seeking.

It is therefore important that developing countries look at a combination of strategies for reducing the burden and mortality from pneumonia. These include the important role of preventive strategies such as control of environmental factors (e.g. indoor air pollution) dealing with prevalent micronutrient deficiencies such as zinc and vitamin A deficiencies and promotion of household behaviors such as exclusive breast-feeding and hand washing. Many of these preventive strategies have health

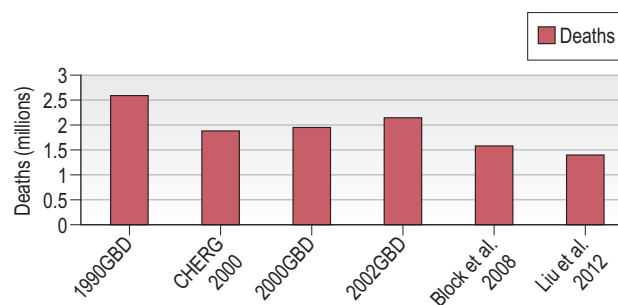


Figure 80.5 Trends in mortality from pneumonia. (Source: Bhutta et al. 2007; Black et al. 2008; Liu et al. 2012; GBD, Global Burden of Disease; CHERG, Childhood Epidemiology Reference Group.)

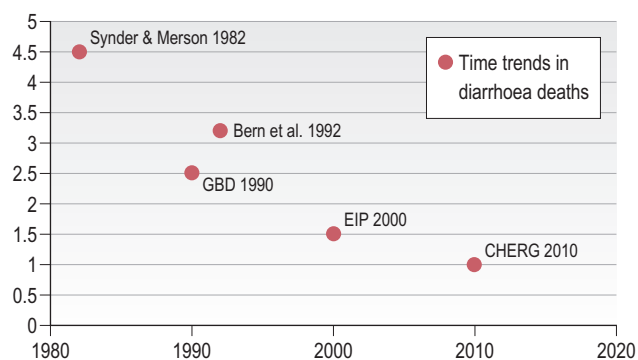


Figure 80.6 Time trends in diarrhoea deaths. (Source: Snyder and Merson 1982 4 3; Bern et al, 1992; GBD 1990 2; EIP 2000 1; CHERG 2010 0 1975 1980 1985 1990 1995 2000 2005 2010. Source: Boschi-Pinto C, Tomaskovic L. For CHERG (2006) and Fischer-Walker et al. (2013).

benefits that far exceed mere reduction in respiratory infections, such as reduction in diarrhoea burden and improvement in nutrition indices.³⁴

More than 1 million lives could be saved if both prevention and treatment interventions for pneumonia were implemented universally. Around 600 000 children's lives could be saved each year through universal treatment with antibiotics alone, costing around \$600 million.

Diarrhoea

About 2.5 billion episodes of diarrhoea occur per year across the world in children under 5 years of age. Every year, nearly 1 in 5 child deaths – about 1.5 million child deaths each year – are due to diarrhoea. Although mortality from diarrhoea has declined over the past three decades (Figure 80.6), it still remains the second most common cause of death among children under the age of 5, globally.

Diarrhoea incidence rates have not changed substantially over the years. Incidence rates in sub-Saharan Africa and Latin America are greater than in Asia or the Western Pacific (Figure 80.7). Walker et al. in 2012, estimated that diarrhoea incidence

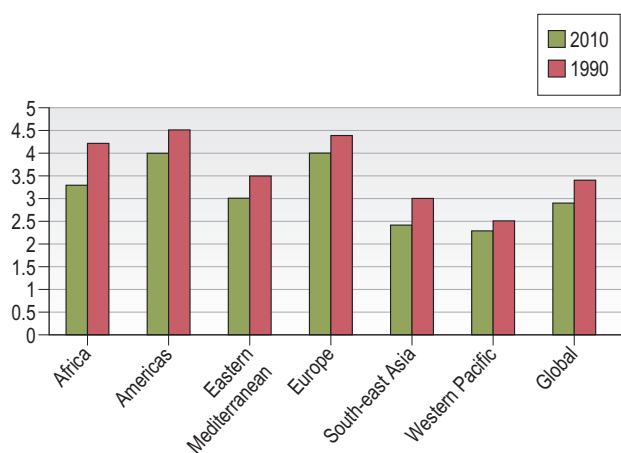


Figure 80.7 Trends in diarrhoea incidence rates in under-5 children by WHO region in low- and middle-income countries (1990–2010). (Source: Walker et al. 2012.)

in children under 5 years of age has declined from 3.4 episodes/child year in 1990, to 2.9 episodes/child year in 2010, with the highest incidence rate of 4.5 episodes/child year in the age group 6–11 months.³⁵

Diarrhoea is more prevalent in the developing world due, in large part, to the lack of safe drinking water, sanitation and hygiene, as well as poorer overall health and nutritional status. A total of 783 million people still do not use an improved drinking water source and 2.5 billion do not use an improved sanitation facility, mostly in the poorest households and rural areas; 90% of people who practice open defecation live in rural areas. Another important cause is the reduced rates of optimal breastfeeding. Only about 40% of children under 6 months of age are exclusively breast-fed. Malnutrition has a bidirectional relationship with diarrhoea. It reduces the immunity and makes children susceptible to infections, including diarrhoea and can also be caused as a result of persistent or severe diarrhoea.³⁶ Childhood malnutrition is prevalent in low- and middle-income countries. According to an estimate, 20% of children <5 years of age in these countries are underweight (weight for age Z score <−2). The prevalence of both underweight is highest in Africa and South-Central Asia. Most children with diarrhoea are not managed appropriately, with only around one-third of them given oral rehydration solution (ORS). Moreover, despite the evidence of benefit, widespread introduction of zinc for diarrhoea treatment has been limited. UNICEF's zinc procurement began in 2006 and has increased substantially. Despite this progress, global zinc supply is dismally low compared with global need.

Rotavirus, responsible for at least one-third of severe and potentially fatal episodes of diarrhoea, is potentially preventable through rotavirus vaccine. In developing countries, around 440 000 deaths occur every year due to vaccine-preventable rotavirus infection.³⁷ Thus, cost-effectiveness and increase in access to the vaccine can potentially lead to remarkable reduction in diarrhoea mortality in developing countries.

Social Determinants of Health

Social conditions and circumstances are major determinants of health. Social factors affect health and risk behaviours, environmental exposures and access to resources that protect good health. It is generally seen that there is an inverse relationship between social position and health status of people. Developing a better understanding of the social determinants of health is essential to reduce health disparities and to design policies to address social and economic factors associated with poor health.³⁸ Statisticians use the term socioeconomic position (SEP) to describe the social and fiscal resources available to individuals. There is clear evidence to suggest that health indicators are inferior in lower SEP groups as compared with higher SEP groups, and this classification could be used to target resources.

EDUCATION

Education is a lifelong process starting at birth and increase in formal educational attainment is an important social goal. A causal link has been established between education and a range of health outcomes. One of the most consistent and powerful findings in public health is the strong association between mothers' education and child mortality. Results of studies show

that a 1-year increment in the mother's education is associated with a 7–9% reduction in mortality in children younger than 5 years and that child mortality rates among mothers with at least 7 years of schooling were 58% lower than among those without any education. Increases in educational attainment have also been linked to reductions in fertility, which in turn contributes to reduced child and maternal mortality rates.

Considerable progress has been made in education in the past 40 years, especially in developing countries, where the mean number of years of education has increased in men and women aged 15 years and older between 1970 and 2009. For women of reproductive age (15–44 years) in developing countries, the increase is much greater. This rapid advancement in educational attainment in women has resulted in significant reductions in the gender gap in education. The impact on child health has been enormous, with an increase in women's education estimated to avert 4.2 million deaths. The expansion of women's education will have serious implications for global health in the next few decades. Increases in educational attainment will probably lead to more rapid reductions in the total fertility rate, even in sub-Saharan Africa. Research shows that education is associated with a reduction in the demand for children and thus increased demand for family planning services.

Early childhood offers huge opportunities to reduce health inequities within a generation. The importance of early child development and education for health across the lifespan provides a strong imperative to start action at the grass-roots level.³⁹ Inaction will have detrimental effects that can last more than a lifetime. A new approach is needed that embraces a more comprehensive understanding of early child development and includes not just physical survival but also social, emotional and cognitive development.

INEQUITY

Inequities in intervention coverage are generally unfair, yet avoidable. Within-country inequities in the health of mothers and children in low-income and middle-income countries are

generally indiscernible from the global medical literature. The assumption has been that all mothers and children in low-income and middle-income countries were equally poor and that there was no need to account for subnational inequalities when strategies were designed for the scaling-up of health interventions. Practical difficulties in the stratification of health status by socioeconomic position contributed to this lack of visibility. The most inequitable indicators are skilled birth attendant, followed by four or more antenatal care visits, whereas the most equitable was early initiation of breast-feeding. These analyses confirm previous findings that, unlike in high-income countries, in many low-income countries, breast-feeding is more prevalent in poor than in rich individuals.

Interventions that are usually delivered in fixed health facilities, particularly those that need constant access to secondary-level or tertiary-level care, tend to be the most inequitably distributed in the population (e.g. skilled birth attendant and four or more antenatal care visits). Interventions that are often delivered at community level (e.g. vaccinations or vitamin A supplementation) tend to be much more equitable than are those delivered in health facilities (Figure 80.8). Cost might also be a factor. Some interventions are usually provided free of charge, such as vaccinations and vitamin A, but others might need out-of-pocket spending by families, either for services or because families need to travel to a health facility. For example, in Uzbekistan, Kyrgyzstan and Brazil, where maternity hospitals are accessible and free of charge, coverage for skilled birth attendant is almost universal.⁴⁰ Cultural perceptions might affect care-seeking patterns and the choice of whether to adopt specific interventions, such as contraceptives or breast-feeding, despite counselling or information campaigns.

SOCIAL SECURITY

Lack of basic and social security is an important determinant of health. Extending social protection to all people will eventually pave the way towards securing health equity. This is not just a matter of social justice; it is also the key to social protection

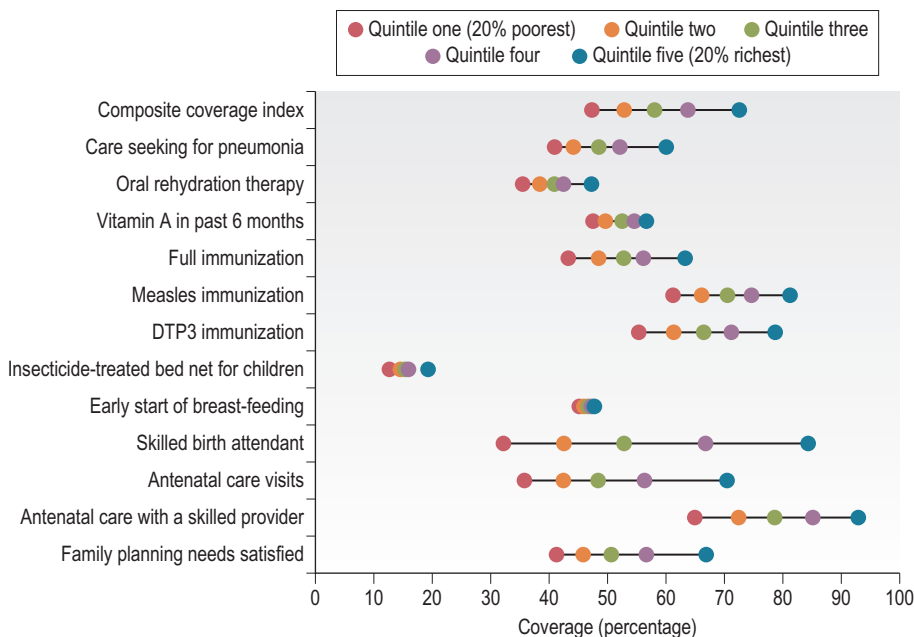


Figure 80.8 Mean coverage in respective wealth quintile for studied interventions in the 54 Countdown countries. Coloured dots show the average coverage in each of the respective wealth quintile. Q1 is the 20% poorest quintile; Q5 is the 20% richest quintile. The distance between quintiles 1 and 5 represents absolute inequality. (Source: Adapted from Barros et al, *Lancet* 2012.)

and can be instrumental in realizing developmental goals. Social protection can cover a broad range of services and benefits, including: basic income security; entitlements to non-income-based benefits such as food and other basic needs; services such as health care and education; and labour protection and benefits such as maternity leave, paid leave, childcare and health insurance. Countries with more generous social protection systems tend to have better population health outcomes. Data on the association between the magnitude of health inequities within countries and social protection policies remain scarce, however, and more investment in comparable data sources and methods is needed. The existing data from high-income countries show that while relative mortality inequities are not smaller in states with more generous, universal, social protection systems, absolute mortality levels among disadvantaged groups are lower.

Universal social protection systems should safeguard the health and rights of all people across their lifespan – as children, in working life and in old age. Women and children are among the most vulnerable in terms of the population, especially when it comes to health and diseases. Women do most of the household work, have a reproductive role as well and more often than not, assist their male counterparts in work outside the home, especially those from lower-income groups. Their work is not subject to maternity leave or benefits. A national strategy to eradicate child poverty needs to be enacted upon, which should ideally encompass as least financial security, employment support and security, housing security and opportunities to avail public amenities.

Addressing health equity through a social determinants framework is a long-term investment. Low- and middle-income countries cannot be expected to implement a fully comprehensive suite of universal social protection policies overnight. It is, however, feasible gradually to develop these systems by developing and implementing pilot projects. Many low- and middle-income countries are starting to experiment with social protection programmes. These include social pension schemes and cash transfer programmes. Administrative and institutional capacity remains a critical barrier in many poor countries. Nevertheless, poor countries can progressively expand such systems by starting pilot projects and by gradually increasing the system's generosity, where necessary, with help from donors.

POVERTY

Poverty and low living standards are powerful determinants of ill-health and health inequity. They have significant consequences towards determining health-related behaviours and poor health outcomes. Crowded living conditions, lack of basic amenities, unsafe neighbourhoods, parental stress and lack of food security are all contributors towards ill health. Child poverty and transmission of poverty from generation to generation are major obstacles to improving population health and reducing health inequity. The influence of living standards on healthcare behaviour is a process that begins from even before a child is conceived and continues until he or she becomes the cause of another birth.

LACK OF EMPOWERMENT

Any serious effort to reduce health inequities will involve political empowerment, as in changing the distribution of power within society from the leaders and community stakeholders to

people themselves. Health equity depends vitally on the empowerment of individuals and groups to represent their needs and interests and also to challenge and change the inequitable and skewed distribution of social resources and material resources. It is important to have the freedom to participate in economic, social, political and cultural opportunities. Restriction in participation can result in deprivation of fundamental human capacities, setting the grounds for unequal distribution of employment, education and health care.

A special mention should be made of the indigenous population, the lives of whom continue to be governed by specific and particular laws, regulations and conditions that apply to no other members of civil states. They continue to live on bounded or segregated lands and are often at the heart of jurisdictional divides between levels of governments, particularly in areas concerning access to financial allocations, programmes and services. The enactment of legal changes to recognize and support community empowerment initiatives will ensure the comprehensive inclusion of disadvantaged groups in action at global, national and local levels concerned with improving health and health equity.

DEFICIENT AUTONOMY

The global growth in precarious employment and child and bonded labour both reflects and reinforces a disempowerment of workers and their industrial and political representatives. Such a system jeopardizes the autonomy of people to exercise control and their free will in decisions regarding health, education and living conditions.

Autonomy of women for decision-making and resource utilization needs to be recognized. The support of women's efforts to coordinate through resourcing via private donors and government is very important for ensuring gender equity. For instance, building their own organizations has been one of the ways that women have chosen to promote solidarity, offer support and collectively work for change. These organizations are of various sizes, from small village-based or neighbourhood groups to large movements. It is imperative to support and encourage such organizations and movements in a way that preserves and protects their autonomy and promotes their long-term sustainability, and self-reliance.

CONFLICT AND ANARCHY

Nations that are undergoing rapid power shifts and are entrenched in conflicts provide poor security to individuals. In conflict settings, people suffer a variety of physical and social deprivations, including lack of social security, displacement and loss of social networks and family structure, loss of livelihood, food insecurity, work insecurity, and poor physical and social environments. As a whole, conflict disempowers individuals, communities and even countries and cripples the social and political infrastructure leading to a multitude of health concerns. While it is critical that community members share control over processes that affect their lives, without political commitment and leadership and allocation of resources such initiatives can be short-lived.

Evidence-based Solutions

Priorities across the continuum of care need to be emphasized to move the agenda of the MDGs forward. Current

recommendations target reproductive health (contraceptive information and services, sexual health and safe abortion services); maternal health (skilled birth attendants; facility-based delivery, emergency obstetric care and postpartum care); stillbirths (addressing the complications of childbirth, maternal infections and diseases and maternal undernutrition); newborn health (addressing the complications of pre-term birth), child health (targeting pneumonia, diarrhoea and malaria); and adolescent health (sexuality education and universal access to reproductive health services).

Across the world, many children from the most deprived and impoverished groups are still dying of easily preventable diseases due to poor access to quality health services. Effective interventions exist to address all of the main causes of child deaths, yet the infrastructure required to make these available on a timely basis is not present.⁴¹ Enhancing access to and use of life-saving commodities is essential, as is investing in neonatal and maternal health and nutrition. At the moment, it is an essential need to focus on those simple and cost-effective intervention issues that will bring about the greatest morbidity and mortality benefit, particularly those due to pneumonia, diarrhoea and malaria. Urgent efforts are needed in health system capacity to take care of newborns, particularly in the field of human resources, such as training nurses and midwives for newborn and premature baby care and ensuring reliable supplies of commodities and equipment.

INTERVENTIONS IN THE NEWBORN

About 60 million of the world's 130 million births occur at home. Many more take place in facilities without adequate resources to prevent stillbirth. [Figure 80.9](#) shows the estimates of the global number of babies undergoing resuscitation at birth. Thus, we need to focus on ways to improve healthcare systems to increase coverage of key, life-saving perinatal interventions. The components of such systems include facilities, equipment and supplies, but also involve various healthcare

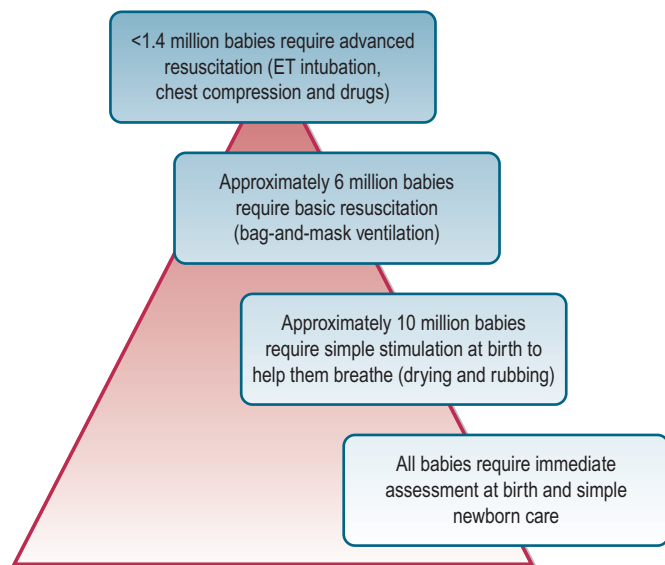


Figure 80.9 Estimates of global number of babies undergoing resuscitation at birth. (Source: Wall SN, et al. *Int J Gynecol Obstet* 2009;107(S47–64).

providers. Studies show that the linking of community birth attendants to referral systems and facility-based clinical care is beneficial.⁴² Evidence also indicates that the mobilization and empowerment of communities to increase demand for and implement improvements in pregnancy-related care can facilitate reductions in the large stillbirth burden in low-income and middle-income countries.

At the level of the international community, several steps can be taken to reduce stillbirths.⁴³ To enumerate, stillbirth reduction should be included in all relevant maternal and neonatal health initiatives and international health reports. Reporting of accurate stillbirth rates and cause-of-death data should be established. Furthermore, a universal classification system and implementation of an effective business model to reduce stillbirths is necessary. Key actions at the level of individual countries should include: empowerment for women and families; setting-up pregnancy improvement committees; providing birth plans and transportation; reducing the stigma associated with stillbirths; and provision of bereavement support.

Strengthening family-community and outreach services, including health education to improve homecare practices and preventive services such as tetanus immunization, can be done relatively quickly and can reduce neonatal deaths by 20–40%. High coverage of clinical care, which includes skilled maternal and immediate newborn care, emergency obstetric care and emergency newborn care, is needed to achieve the larger reductions in child mortality required to meet MDG 4. Postnatal care and intrapartum care both have the potential to save 20–40% of newborn lives, but postnatal care costs about half the amount of skilled care during childbirth. Postnatal care for mothers and newborns has not received much emphasis in public health programmes. Care at birth and in the first days of life can not only save the lives of mothers and newborns, but also reduces serious long-term complications.⁴⁴ Progress is slow, especially in reaching poor families. Currently, only about half of women worldwide deliver with a skilled attendant. The variation between countries is extreme, ranging from 5% to 99%. Skilled attendance and institutional delivery rates are lowest in countries with the highest neonatal mortality rates.

Simple immediate newborn care should be provided to newborns in all settings as part of essential newborn care. These include warming, drying, stimulation, hygiene and thermal care. These are the first and immediate steps in neonatal resuscitation and can even be performed by family members. Training in essential newborn care, either before or concurrent with training in basic and advanced neonatal resuscitation should be ensured at all levels.⁴⁵ Basic neonatal resuscitation training can be performed by a wide range of health providers (from traditional birth attendants (TBAs), community health workers (CHWs), nurses and midwives to physicians), resulting in reductions in intrapartum-related mortality in both the facility and home settings ([Table 80.3](#)).

There is evidence from India and Indonesia that community-based neonatal resuscitation may be both feasible and effective in reducing intrapartum-related mortality in settings with high rates of home birth and delivery attendance by community cadres, ranging from TBAs and CHWs to midwives.⁴⁶ Training for community-level neonatal resuscitation should not occur in isolation. It should be paralleled with efforts to strengthen health systems and the quality of, and linkages to, facility-based skilled emergency obstetric care.

Several key considerations are required for an effective and sustainable programme, including:

TABLE 80.3 Interventions to Save Newborn Lives

Interventions	
Immediate essential newborn care – at the time of birth	Promotion and provision of thermal care for all newborns to prevent hypothermia (immediate drying, warming, skin to skin, delayed bathing) Promotion and support for early initiation and exclusive breast-feeding (within the first hour) Promotion and provision of hygienic cord and skin care Neonatal resuscitation with bag and mask for babies who do not breathe at birth Newborn immunization
Neonatal infection management	Presumptive antibiotic therapy for the newborns at risk of bacterial infection Case management of neonatal sepsis, meningitis and pneumonia Initiation of ART in babies born to HIV-infected mother
Small and ill babies	Kangaroo mother care for pre-term and for <2000 g babies Extra support for feeding the small and pre-term baby Prophylactic and therapeutic use of surfactant to prevent respiratory distress syndrome in pre-term babies Continuous positive airway pressure (CPAP) to manage pre-term babies with respiratory distress syndrome Management of newborns with jaundice

Source: The Partnership for Maternal, Newborn & Child Health. A Global Review of the Key Interventions Related to Reproductive, Maternal, Newborn and Child Health (RMNCH). Geneva: PMNCH; 2011.

1. A trained attendant must be present at birth, to recognize and assist a baby who does not breathe and attend an adequate number of cases to maintain skills
2. Training should focus on essential newborn care first
3. Adequate systems should be in place for equipment procurement, cleaning/maintenance, resupply
4. Systems are required for supervision, refresher training and monitoring of skills retention
5. Functional referral systems should exist for post-resuscitation care and to follow-up resuscitated newborns.

A range of preventive strategies can reduce the burden of neonatal infections in community settings and must be implemented at scale. Preventive strategies can be implemented in all cases and in at-risk populations (Figure 80.10). However, the key to treating neonatal infections successfully in community settings is the appropriate rapid diagnosis and triage to therapy. The onset of illness and course of progression is much more rapid in newborns, thus both clinical diagnosis, as well as empirical therapy are the mainstay for management of neonatal sepsis.⁴⁷ Appropriate strategies are needed for prevention of infections, as well as interventions for the domiciliary care and referral of newborn infants who develop bacterial infections. In several resource-poor situations, where prompt referral to a facility is not possible, health workers may have no alternative but to provide domiciliary care, which entails visiting households to provide care for the treatment of serious neonatal

bacterial infections (Table 80.4). To prevent EONS in low-resource settings, cost-effective interventions must be introduced at the community level, with prevention strategies applied during the antenatal, intrapartum and early neonatal period. It is estimated that implementation of these interventions with coverage of 99% can prevent 41–72% of neonatal deaths globally. The knowledge and implementation of these interventions, however, is lacking in the poorest countries, where they are most needed.

The benefits of breast milk in preventing neonatal infections and infection-related neonatal mortality are well established. Early and exclusive breast-feeding should be encouraged in developing country settings, since it is perhaps the most important postnatal intervention to prevent EONS.⁴⁸ Hygienic newborn care also needs to be encouraged to prevent infections in the early neonatal period. This includes sanitary disposal of waste, provision of clean water in homes and hand washing by care providers. Appropriate cord and skin care is also essential with recent trials showing the benefit of cord and skin cleansing with chlorhexidine. Similarly, massage of newborns with topical sunflower oil, a traditional practice in some communities, has been shown to produce substantial reductions in hospital-acquired neonatal infections among pre-term infants in randomized controlled trials in developing countries. Kangaroo care by mothers is another intervention that can decrease EONS. Kangaroo care involves skin-to-skin contact between mother and infant in a strict vertical position between a

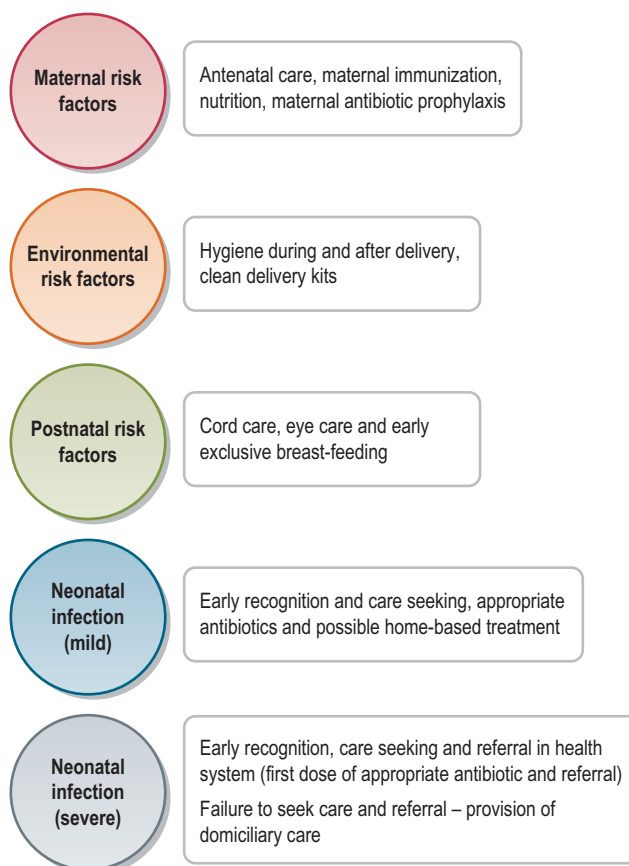


Figure 80.10 Risk factors and intervention strategies for serious neonatal infections. (Source: Bhutta ZA, et al. *Pediatr Infect Dis J* 2009;28:S22–30.)

TABLE
80.4

Factors Determining Approaches to Community Management of Neonatal Sepsis

Overarching Considerations	Health System Preparedness	Availability of Community Healthcare Providers	Family and Household Factors	Information Determining Antibiotic Choice and Route of Therapy
Development of an overall strategic plan for managing serious neonatal infections	Outreach services capable of supporting community health workers	Community health workers available for household visits and case detection	Care-seeking practices for newborns and gender-related behaviours	Local microbiology and antimicrobial resistance patterns
Epidemiological data suggestive of high burden of neonatal sepsis in domiciliary settings	Linkages with various tiers of the health services for referral and effective care	Community health workers trained to detect serious neonatal infections	Access to health services and emergency transport	Availability of common antibiotics effective for above pathogens
Patterns of care seeking and access suggestive of the need for community-based care	Health information systems capable of supporting community care strategies	Community health workers trained in recognition of serious infections in newborns and young infants	Willingness to sustain regular access and supervised treatment in community clinics/health centres	Availability of antibiotics for daily delivery, preferably once-daily dosages in suitable form (e.g. Uniject)
		Community health workers authorized to treat with oral or injectable antibiotics	Acceptance of home care	

Source: Bhutta ZA, et al., *Pediatr Infect Dis J* 2009;28:S22–S30.

mother's breasts and frequent and exclusive breast-feeding. Kangaroo care provides the benefits of increasing body temperature and weight of the child and reducing the stress level of the infant. These factors, combined with the increased rate of exclusive breast-feeding, might be responsible for the lower rates of infections in neonates receiving kangaroo care.

In developed countries, the standard of care for management of EONS is in-patient administration of parenteral antibiotics and supportive care, often in an intensive care unit setting. Hospitalization provides supportive care, such as intravenous fluids; oxygen therapy, when needed; and a controlled thermal environment. The WHO recommends the same standard of care for newborns in developing countries. Unfortunately, most newborns with severe illness in developing countries never reach a healthcare facility. Treatment strategies, therefore, in developing countries, need to be tailored to deliver care at the community level (home or primary care facility), with close interaction between the community health workers, mothers and other family members and linkages with the formal health system. WHO and United Nations Children's Fund (UNICEF) have developed the Integrated Management of Neonatal and Childhood Illnesses (IMNCI) programme, which trains community health workers to identify severely ill infants and provide treatment and referral.⁴⁹

A recent review on the management of neonatal sepsis in primary care settings shows that there is a deficiency of data on community-based management options. However, the use of parenteral antibiotics integrated into home- or community-based packages is an effective option. There is a lack of aetiological data for EONS from community settings, which makes it difficult to design empiric antibiotic regimens. Among the various parenteral antibiotic options, penicillins, cephalosporins and aminoglycosides are most commonly used in health-facility settings of developed and developing countries. For many families in the developing world, living in remote communities, even injectable antibiotic therapy is not easily accessible. Administration of oral antibiotics is preferred in such situations as an alternative in affected neonates and is superior

to no therapy. Furthermore, added information on antimicrobial resistance patterns of pathogens causing EONS in the community in different regions of the world is needed to devise appropriate empiric treatment regimens.

INTERVENTIONS IN THE UNDER-5 CHILD

Effective interventions to reduce pneumonia and diarrhoea and the morbidity and mortality associated with them includes primary prevention by reduction of environmental risk factors, as well as immunization and secondary prevention by effective case management once the infection has been acquired. These strategies could save the lives of innumerable children that die of preventable causes of pneumonia and diarrhoea each year.⁵⁰ There is an overlap between many of the prevention and treatment strategies of diarrhoea and pneumonia (Figure 80.11).

Pneumonia

Adopting strategies to achieve targets for effective immunization against measles and pertussis via national immunization programmes is central to prevention of preventable causes of pneumonia. Vaccinations against other pathogens such as *Streptococcus pneumoniae* and *Haemophilus influenzae* type b have only recently been introduced. The latter has been integrated into the national immunization programme of many countries but the integration of the former is still just a recommendation in most countries. Progress in this area is expected, especially in the least developed countries.⁵¹ However, introducing a vaccine does not necessarily translate into high and equitable coverage within countries and inequities in uptake greatly reduce the impact of vaccines.

Simple measures for primary prevention basically include exclusive breast-feeding and zinc supplementation.⁵² These strategies reduce rates of low birth weight and undernutrition, which helps prevent pneumonia. Indoor air pollution is a well-known risk factor for pneumonia in children under 5 because of special susceptibility factors that place children at particular risk – their lungs and immune systems are not fully mature,

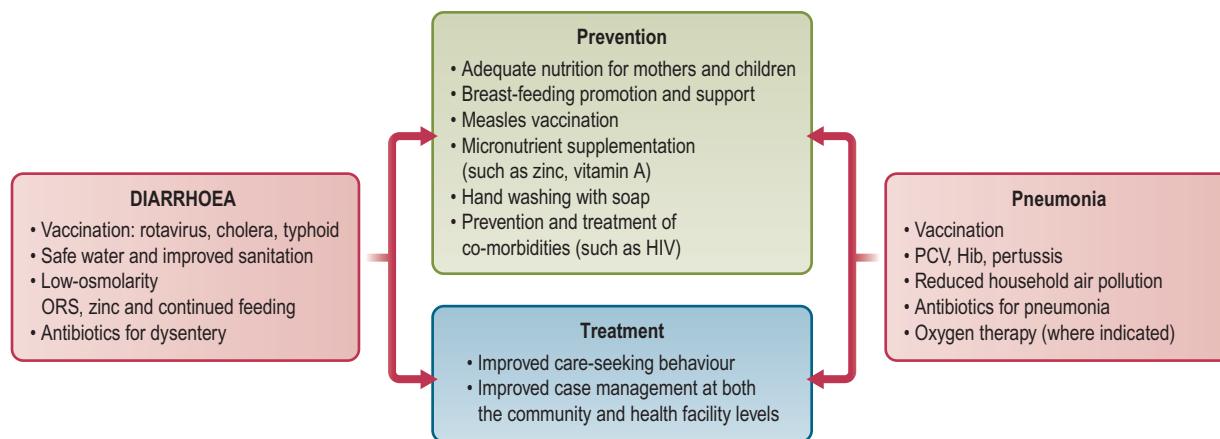


Figure 80.11 Prevention and treatment strategies for diarrhoea and pneumonia are identical. (Source: Gupta GR. *Tackling pneumonia and diarrhoea: the deadliest diseases for the world's poorest children*. *Lancet* 2012;379(9832):2123–4.)

they breathe more in proportion to their body size and they spend most of their time inside the home. Indoor air pollution in developing countries is due largely to the use of solid fuels for cooking or heating purposes in poorly ventilated and closed home units. Material used most often for fuels to light fires and stoves in most rural and many urban areas include wood, crop waste, animal dung and coal. Statistics show that around 3 billion people worldwide use solid fuels as their main cooking fuel and more recent studies show that the use of this solid fuel contributes to as many as 2 million premature and preventable deaths, with as many as half of them attributable to childhood pneumonia alone. The use of these solid fuels is disproportionately higher in rural areas as compared with urban households. Now, with increased spending in research, newer technologies have become available that can reduce indoor air pollution that may help prevent pneumonia. In addition to this, allocation of funds for additional research is needed to demonstrate the health benefits of these interventions.

Overcrowding in homes is also associated with increased risk of childhood pneumonia because disease-causing pathogens can spread to more people faster in the small vicinity of a house. Houses in rural areas and urban slums are typically devoid of shutters and windows. This leads to entrapment of indoor pollutants and bacteria that in turn make the inhabitants of the house more susceptible to both upper and lower respiratory tract infections.

Once infection has been acquired, case management following the appropriate guidelines is imperative. Countries with a high under-5 mortality rate should strive to implement strategies to ensure adequate pneumonia case-management at hospitals, healthcare facilities and community levels, to achieve sufficient coverage within a predetermined timeframe. In low-income settings, elaborate laboratory investigations such as chest radiographs, blood sampling and sputum analysis and culture are not easily available to confirm diagnosis, identify the underlying pathogen and determine the severity of illness or direct treatment guidelines.⁵³ Even without these tools, pneumonia can be easily classified and treated based on symptoms and physical examinations according to IMNCI guidelines. Based on these guidelines, pneumonia can be classified by a fast respiratory rate counted by a trained healthcare worker. Children diagnosed with pneumonia should receive a full course of effective antibiotics because most severe cases have a bacterial

cause. WHO recommends amoxicillin given twice daily for 3–5 days. In cases of severe pneumonia and if infrastructure for a healthcare setup more advanced than the very basic is available, then pulse oximetry to improve the diagnostic specificity for pneumonia, oxygen systems for providing as needed oxygen as an emergency measure, injectable antibiotics and other supportive measures for continued care may help children with severe acute respiratory syndromes.

Diarrhoea

Primary preventive strategies are both simple and effective for the prevention of diarrhoea. A clean home and surrounding environment are indispensable to reduce disease. Access to safe and clean drinking water and adequate sanitation are necessary to prevent diarrhoea. Improving home and personal hygiene helps prevent diarrhoea. Nearly 90% of deaths due to diarrhoea worldwide have been attributed to unsafe water, inadequate sanitation and poor hygiene. Water, sanitation and hygiene programs include several interventions including promoting safe disposal of human faeces, encouraging hand washing with soap, improving water quality and advancing household water treatment and safe storage.⁵⁴ Supply of potable water is again an equity-based issue and requires an equity-based solution in that poor households and marginalized areas require more attention.

Hand washing with water and soap is the most cost-effective health intervention for reducing the incidence of not only diarrhoea in children under age 5 but also other diseases like pneumonia. There is consistent and dependable evidence to suggest that hand washing with soap at necessary times such as before eating a meal, before preparing food and feeding a child and after using the lavatory can effectively reduce the risk of diarrhoea. Monitoring of correct hand washing techniques by supervised healthcare personnel in the community can help in the assessment of community behaviour with respect to hand washing, and thus serve as an effective preventive strategy in the defence against diarrhoeal pathogens.⁵⁵

Maternal and child malnutrition is also a contributing factor to the morbidity and mortality associated with diarrhoea. While all undernourished children are at higher risk of death, severely under-weight, wasted and stunted children are at greatest risk. Undernutrition generally weakens the immune system, that itself requires adequate protein for antibody and interferon

formation in addition to energy, vitamins and minerals for proper functioning. For diarrhoea, undernutrition places children at higher risk of more severe frequent and prolonged illness. Undernutrition is also a consequence of repeated bouts of illness such as diarrhoea itself and in effect malnutrition and diarrhoea are linked to one another by a vicious cycle that further worsens a child's crippling nutritional status at a time when they have higher caloric requirement. Beliefs associated with diarrhoea, that if feeding is stopped then it might actually improve the diarrhoea, need to be dispelled.

Repeated diarrhoeal episodes in young children lead to stunting and hence adequate and effective control of diarrhoea in the first few months of life reduces the prevalence of stunting among children. Undernutrition and infection interact to create a potentially lethal cycle of worsening illness and deteriorating nutritional status. Critical nutrition interventions to break this cycle include encouraging optimum breast-feeding practices such as early initiation, exclusive breast-feeding for the first 6 months of life and continued breast-feeding to age ≥ 2 , encouraging micronutrient supplementation and also reducing the incidence of low-birth-weight newborns through interventions to improve maternal health and nutrition. Infants who are cared for in this manner develop fewer infections and suffer less severe illness. Underlying the inculcation of this health-conscious behaviour are other interventions such as improving maternal education, provision of healthcare workers and improving empowerment through policy-making and implementation.

In addition, micronutrient supplementation such as zinc and vitamin A are critical for normal growth and development in young children. However, the coverage remains low. Zinc deficiency places children at greater risk of illness and death due to pneumonia and diarrhoea, particularly in low-income countries. There is evidence that zinc is beneficial in managing acute or persistent diarrhoea in children under 5, especially with respect to reduction in duration of illness.⁵⁶ In addition, vitamin A supplementation reduces all-cause and diarrhoea-related mortality among children less than 5 years. Vitamin A therapy during an episode of measles has also been demonstrated to reduce the child's risk of post-measles diarrhoea and other measles-associated complications. Coverage for these two supplements, although not ideal at the moment does show a promising trend towards increasing coverage in developing countries.

Rotavirus results in higher diarrhoea-related death in children less than 5 years of age, than any other single agent. This is especially true of low- and middle-income countries. Although the vaccine is available, it is not yet part of the National Immunization Programme in many countries. The number of countries planning to introduce vaccination, however, is increasing.

Once diarrhoea has occurred, prompt recognition and treatment are essential. The UNICEF/WHO joint recommendation for the treatment of diarrhoea under the IMNCI strategy includes encouraging universal access and provision of the oral rehydration solution, continued feeding, recommended home-made fluids and zinc treatment for children with acute diarrhoea. A recent change has been the modification of the original high-osmolarity ORS to the new low-osmolarity solution, which reduces stool output and the overall duration of diarrhoea. Zinc treatment for 10–14 days, in addition to low-osmolarity ORS, is an adjunct therapy that reduces the duration

and severity of a diarrhoea episode and the likelihood of subsequent infections in the 2–3 months following treatment. At the policy level, many strategies have been implemented, yet at the implementation level, many gaps still need to be filled.

The role of probiotics needs emphasis. Daily intake of a probiotic drink can play a role in prevention of acute diarrhoea in young children, as shown in community-based trials.⁵⁷

Delivery Strategies

The comprehensive goal of child health interventions is to improve child survival and reduce the overall burden of childhood diseases. Policies that govern the improvement of child survival need periodic renewal and assessment, since changing geo-political situations put the continuity of implementation strategies at risk.

In this chapter, we aim to present the tasks or the core solutions required for the improvement of child survival and the implementation strategies that are required to channel a task on paper into a task in action. Beginning from the care of the expecting mother all the way to the adolescent child, solutions need to be focused around interventions and scaling-up those interventions to reach all sections of society equitably.

REDUCING POVERTY-ASSOCIATED BARRIERS

The structure of national health systems in many countries continues to direct most resources away from their poorest citizens. Unless the bottlenecks faced by poor and marginalized people in access to and use of health interventions and services are explicitly addressed, inequities will probably worsen, as more expensive and elaborate interventions are introduced. Expansion of coverage by empowering women, removing financial and social barriers to accessing basic services, developing innovations that make the supply of critical services more available to the poor and increasing local accountability of health systems are policy interventions that would allow health systems to improve equity and reduce mortality.⁵⁸

Reduction or elimination of user fees increases the use of curative services and facility-based deliveries, although the effect sizes vary depending on study site and outcome examined. Equity also seems to improve, with the greatest increases in access noted in households from the poorest quintiles. Legislation mandating universal access to maternal healthcare services and eliminating user fees in low- and middle-income countries also have been shown to be an important prerequisite to ensuring all women receive antenatal care. However, quality of care can be negatively affected by difficulties in meeting increased demand and in provision of drugs to more patients, poor staff morale, decreasing health service revenues and the creation of unofficial fees to replace user fees.

A programme that provides monetary transfers to households on the condition that they comply with a set of behavioural requirements can serve to bring equity-based health care to target disadvantaged groups. As low-income individuals usually face the greatest barriers to access, such conditional cash transfer mechanisms can also help redistribute resources to reduce health inequities. They can potentially increase the use of health services by low-income individuals, by providing funds to help overcome some financial barriers to access, including costs related to seeking health care or sending

children to school. Such programmes have been used effectively in Latin America to provide tangible benefits to marginalized groups. For instance, an incentive such as free provision of food supplements on the condition that children would be brought for preventive health examinations where they would have the opportunity to receive vaccinations, deworming agents, vitamins and supplements, is an excellent means to bring about a health-related behavioural change in a local community.⁵⁹ Other reasonable incentives can be cash transfers contingent on enrolment and regular attendance at primary school. This approach has the capacity to scale-up existing resources for measurable outcomes. However, success depends upon a working and effective infrastructure that can provide services.

COMMUNITY APPROACHES AND TASK SHIFTING

Robust evidence shows that delivery of several key interventions can be safely and effectively transferred from clinical services (i.e. provided by qualified health professionals) to community health workers. For example, training of TBAs and other CHWs to dispense simple immediate preventive and curative actions for neonatal care, including neonatal resuscitation and injectable antibiotics, is likely to reduce stillbirths and perinatal mortality in various settings. Additional evidence suggests that CHWs can effectively provide treatments and care to reduce morbidity and mortality prenatally and in children under 5. More recent evidence for the effect of community-based malaria treatment on child health outcomes suggests a reduction in malaria prevalence and a fall in under-5 mortality when combined with delivery of insecticide-treated nets and antimalarial chemoprophylaxis.

Subcontracting of services, such as obstetric care, maintenance of health services and administration, to private sector providers is another strategy that could reduce bottlenecks associated with geographical access, particularly for isolated districts.⁶⁰ More intensive and extensive use of outreach services is another strategy to change how interventions are delivered. Studies show that increasing the number of locations such as local health set-ups and schools offering immunization services can lead to moderate-to-high gains in coverage. Additionally, provision of specialist outreach services can substantially improve access without compromising the quality of care and might improve the skills and morale of the health workers in remote settings.

Transference of interventions that necessitate little optional action – such as immunization, vitamin A supplementation, insecticide-treated nets and deworming medicines – from clinical services to large-scale campaigns, is also an effective way to boost coverage. These campaigns are regularly used by low-income and middle-income countries to deliver key child survival interventions more efficiently, overcome coverage bottlenecks such as distance to health clinics, and improve equity of coverage by targeting groups most at risk of missing out on these services.

Evidence suggests that mass media campaigns can directly and indirectly produce positive changes or prevent negative changes in health-related behaviours across large populations and thereby substitute for individual care and attention. Social marketing has positive effects on promotion of awareness and use of insecticide-treated nets and adoption of recommended practices for dengue prevention.⁶¹

The establishment and enhancement of partnerships with councils, health organizations and non-governmental organizations as well as the private sector offers an opportunity to develop more effective tools to reach out to the indigenous population. Public support on regulatory issues can be enhanced through partnerships by increasing the understanding of the partner organizations and the regulatory process associated with the development and implementation of various policies.

MONITORING AND ACCOUNTABILITY

To maximize the impact of multiple initiatives in women and children's health and to ensure coordination and coherence in their implementation, a more formal global governance framework for women and children's health needs to be established. At present, there is a governance gap that must be filled by a mechanism that includes partner countries, multilateral agencies, donors, non-governmental organizations, health professionals, researchers, foundations and the private sector.

Scarcity of data is still a major obstacle for identifying where the real burden of disease rests. Medically certified vital registration data need to be made available for future health initiatives to progress. Where mortality rates and the need for data are the highest, resources and data are least available. Global, regional and national childhood cause-of-death estimates should enable the setting of priorities for scaling up child survival interventions and guide national and international resource allocation.⁶² The attainment of the MDGs is possible only if life-saving maternal, newborn and child health interventions are rapidly scaled-up in high-burden regions. Continued efforts to gather high-quality data are essential and require strengthening of national health information systems to enable better accountability. The potential for digital technology to accelerate improvements in women and children's health is great – notably, in supporting country civil registration and vital statistics systems.

POLICY AND EDUCATION

Workplace policies are important to promote healthy pregnancies and reduce the risk of pre-term birth, including regulations to protect pregnant women from physically demanding work. Studies have shown that carrying heavy workloads and working more than 5 days a week is associated with pre-term birth. Environmental policies to reduce exposure to potentially harmful pollutants, such as from traditional cook stoves and second-hand smoke are also necessary. Examples include time off for antenatal care visits, paid pregnancy leave and exemption from nightshifts and tasks requiring heavy lifting or standing for long periods of time.⁶³ Measures that can improve general working conditions are especially important for pregnant women in low- and middle-income countries, where they are more likely to be engaged in agricultural labour and other physically demanding tasks.

Human rights-based approaches have a crucial, but neglected part to play in the delivery of global strategy.⁶⁴ In 2011, the Committee on the Elimination of Discrimination against Women became the first UN human rights body to state that countries have an obligation to guarantee and take responsibility for women's timely and non-discriminatory access to maternal health services. Individual or group education or knowledge-transfer interventions (e.g. counselling, training

and education) applied to specific services or practices, such as breast-feeding and complementary feeding, can greatly improve coverage.

ALLOCATION OF FUNDS

Identification of a budget that would ensure the sustainability of existing and upcoming projects is critical. Allocation of funding in the right direction is an imperative through which implementation of policies can be accomplished.

Cash transfers are an effective way to increase use of health and nutrition services and have moderate effect sizes depending on the indicator. Cash transfers have clear effects on health outcomes, particularly morbidity and on some longer-term outcomes, such as stunting and anaemia. Despite the quality of some studies, reviewers noted that disentanglement of the effects of different programme components (especially non-cash components) was difficult. Some evidence suggests that vouchers, which are distributed free or at low cost, provide an entitlement to a good or service and then reimburse the facilities or providers, can substantially improve use and quality of services and reduce care-seeking delays.

IMCI, IMNCI (INTEGRATED STRATEGIES)

Globally, a limited number of childhood illnesses, such as pneumonia, diarrhoea, measles, malaria and malnutrition are the cause of children dying under the age of 5 years. Focusing specifically on these illnesses and training personnel in their specific management can help save innumerable lives. The WHO and UNICEF therefore came up with the idea of an integrated management of childhood illness (IMCI) strategy, which relied upon using simple clinical signs for case detection without the use of sophisticated laboratory investigations. As soon as a case is labelled, empirical treatment is started. Further, the 'integrated' approach entails the combination of major childhood illnesses with involvement of parents in provision of home-based care, prevention of disease through immunization, improved nutrition and breast-feeding.⁶⁵

Initially, the programme focused just on childhood illness, but now it has also integrated a neonatal component (IMNCI). This includes care of the newborn child in the first week of life. The implementation of this programme requires home visits to all newborns in the first week of life by the CHWs, for the promotion of optimal care practices and identification of severe illness and referral. Health workers assess the newborns, ensure breast-feeding, counsel on warmth and danger-signs, treat local infections and refer to appropriate facilities for possible serious bacterial infections.⁶⁶ In addition, the workers are expected to assess sick children, manage children with minor illness and refer severely ill children.

In addition, the programme has shifted focus from a facility-based healthcare service to a community-based workers' programme. The sustainability of this programme depends upon allocating reasonable funds and providing a framework for accountability to ensure transparent dealings and quality of care. As part of the programme, the community health workers receive training and are provided with basic drugs and supplies required for treating identified children. Their work is supervised and they are to be provided feedback.

A general observation has been that children presenting with one illness often suffer from more than that one condition and

the secondary disease is frequently the underlying cause of the illness that caused the child to present to the community health centre. As an example, a child presenting with diarrhoea may also be malnourished and may not have received immunization as per schedule. Thus, assessment of nutritional, as well as vaccination status of all children reporting to a community health facility, is indispensable. Any contact of the sick child with the health system is an incredible opportunity to complete unfinished tasks.

Conclusions

With only a short time left to achieve the MDG targets, extensive and evidence-based strategies are imperative to improve child survival. Unless addressed urgently, not only will the MDGs for women and children not be met, but also the gains that have been made so far will not be protected and secured for the future. The grounds for moving fast to implement recommendations are strong. Evidence is gradually growing to show that investing in adolescent, women's and children's health has important economic as well as health returns. This emerging evidence should give confidence to Ministries of Finance to invest in adolescents, women and children for long-term economic prosperity. The past few years have seen many new and welcome initiatives launched to accelerate progress towards improving women's and children's health, e.g. on child survival, family planning and life-saving commodities.

Since most of the MDGs are interlinked and dependent on one another, a holistic approach is necessary. For example, strategies targeting improvement in water and sanitation can potentially reduce the incidence of diarrhoea, thereby reducing child mortality. A child's full potential for survival, normal growth and development is predetermined by conditions in intrauterine life, beginning at conception and indirectly, it is also dependent on preconception care. Therefore, the approach that emphasizes pre-pregnancy and pregnancy care of women can potentially reduce many perinatal and newborn deaths. Other interventions that can reduce newborn deaths include antibiotics to combat neonatal sepsis, resuscitation with room air for a newborn who is not breathing and other measures to protect the newborn, including promotion of home-based neonatal care.

Most developing countries have high fertility rates, which indirectly has an adverse impact on maternal and child health. No programme will make sustainable progress without urging women to have later and fewer pregnancies with a birth interval of 3 years. This will mean contraceptives as public health interventions directed at young women and men.

Presently, the coverage of IMCI is lowest in poor countries and among poor and difficult-to-reach populations. In some countries, there are currently no specific programmes that tackle pneumonia and diarrhoea, since older programmes were integrated as part of the IMCI or discontinued. An approach that targets these two leading killers of children under the age of 5 should be implemented until the rate of IMCI training and coverage expands.

The lack of equity is a growing issue, particularly in those countries where a transition is occurring from planned to free-market economies.⁶⁷ Improved quality of care, starting with women- and child-friendly services; improved financial access to high-quality public services through social security

mechanisms; free education and subsidized water – all must be viewed by governments as public goods, where the benefit to one individual cannot be separated from the benefit of the whole society. The strategic focus must be on prevention more than cure, particularly for those populations that live outside areas with easy access to healthcare facilities. Because prevention demands fewer medical skills than cure, the focus will bring in new partners, many of them outside of the health system and Ministries of Health, in civil society, the NGO community, women's and youth groups, religious groups, etc. Hence, community-based programmes for outreach, monitoring, education and communication will need to be emphasized.⁶⁸ Health workers must extend outreach immunization activities to remote areas. These outreach programmes can use combined interventions to cover immunizations, vitamin A dosages as well as provide other micronutrients, family planning interventions, promotion of breast-feeding, water purification or test kits, general health examinations, counselling of pre-pregnant women and so on. They should always include communication materials in local language with illustrations, preferably those derived from community inputs.

In addition to the preventive approaches mentioned above, curative approaches are equally important for child survival. For diarrhoeal diseases this means use of oral rehydration therapy using a hypo-osmolar solution along with zinc. For respiratory infections, it means early diagnosis of respiratory difficulties and treatment with appropriate antibiotics. Where logistical as well as financial access to new vaccines exists, they can be used to reduce the mortality from diarrhoea (rotavirus vaccine) and respiratory infections (conjugate pneumococcal

and Hib vaccines). Governments should implement water, sanitation and hygiene (WASH) strategies where the burden of diarrhoea is high. The effectiveness of a 'Diarrhoea Pack' (comprising low-osmolarity ORS, zinc, water purification tablets and pictorial instruction sheet in a single pack) has been tested in a trial and was acceptable in the community for the treatment of diarrhoea.

Revision of curriculum of community workers, laying emphasis on the recognition of signs, appropriate management and counselling of caregivers for diarrhoea and pneumonia is required. Awareness regarding the recent guidelines for diarrhoea and pneumonia should also be increased and updated by refresher courses. Special emphasis should also be made to recognize the need to complete the duration of treatment.

A key element of any implementation strategy is the provision of an adequate supply of essential commodities for the community and for primary health facilities; for health care, nutrition (including essential vitamins and minerals), water and sanitation. Often the availability of these within the public sector can reduce out-of-pocket expenses to the family, reduce health-seeking behaviour that leads families to the unregulated private sector and improve utilization of public facilities. Distribution and supply, quality checks on medicines and equipment, referral systems and transport are all critical to ensure accessible equitable health care.

Thus, ending preventable child deaths requires global commitments to ambitious and achievable targets through evidence-based country plans, expanding country/stakeholder engagement, creating transparency and accountability and devising new approaches for countries that are lagging.

REFERENCES

4. Lozano R, Wang H, Foreman KJ, et al. Progress towards Millennium Development Goals 4 and 5 on maternal and child mortality: an updated systematic analysis. *Lancet* 2011;378(9797):1139–65.
6. Liu L, Johnson HL, Cousens S, et al; Child Health Epidemiology Reference Group of WHO and UNICEF. Global, regional and national causes of child mortality: an updated systematic analysis for 2010 with time trends since 2000. *Lancet* 2012;379(9832):2151–61.
33. Black RE, Allen LH, Bhutta ZA, et al. Maternal and child undernutrition: global and regional exposures and health consequences. *Lancet* 2008;371(9608):243–60.
47. Darmstadt GL, Bhutta ZA, Cousens S, et al. Evidence-based, cost-effective interventions: how many newborn babies can we save? *Lancet* 2005;365:977–88.
50. Gupta GR. Tackling pneumonia and diarrhoea: the deadliest diseases for the world's poorest children. *Lancet* 2012;379(9832):2123–4.

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REFERENCES

- United Nations General Assembly. United Nations Millennium Declaration. A/RES/55/2 edn. New York: United Nations; 2000.
- Bhutta ZA, Chopra M, Axelson H, et al. Countdown to 2015 decade report (2000–10): taking stock of maternal, newborn and child survival. *Lancet* 2010;375(9730):2032–44.
- Shiffman J. Issue attention in global health: the case of newborn survival. *Lancet* 2010;375:2045–9.
- Lozano R, Wang H, Foreman KJ, et al. Progress towards Millennium Development Goals 4 and 5 on maternal and child mortality: an updated systematic analysis. *Lancet* 2011;378(9797):1139–65.
- Bryce J, Boschi-Pinto C, Shibuya K, et al. WHO estimates of the causes of death in children. *Lancet* 2005;365:1147–52.
- Liu L, Johnson HL, Cousens S, et al; Child Health Epidemiology Reference Group of WHO and UNICEF. Global, regional and national causes of child mortality: an updated systematic analysis for 2010 with time trends since 2000. *Lancet* 2012;379(9832):2151–61.
- Lawn JE, Osrin D, Adler A, et al. Four million neonatal deaths: counting and attribution of cause of death. *Paediatr Perinat Epidemiol* 2008;22(5):410–16.
- Jones G, Steketee RW, Black RE, et al. How many child deaths can we prevent this year? *Lancet* 2003;362, 65–71.
- Goldenberg RL, Culhane JF, Iams JD, et al. Epidemiology and causes of pre-term birth. *Lancet* 2008;371(9606):75–84.
- Beck S, Wojdyla D, Say L, et al. The worldwide incidence of pre-term birth: a systematic review of maternal mortality and morbidity. *Bull World Health Org* 2010;88:31–8.
- Apgar V. A proposal for a new method of evaluation of the newborn infant. *Curr Res Anaesth Analges* 1953;32(4):260–7.
- Papile LA. The Apgar score in the 21st century. *N Engl J Med* 2001;344(7):519–20.
- Casey B, McIntyre D, Leveno KJ. The continuing value of the Apgar score for the assessment of newborn infants. *N Engl J Med* 2001;344(7):467–71.
- Dijxhoorn MJ, Visser GH, Fidler VJ, et al. Apgar score, meconium and acidaemia at birth in relation to neonatal neurological morbidity in term infants. *Br J Obstet Gynaecol* 1986; 93:217–22.
- Azra Haider B, Bhutta ZA. Birth asphyxia in developing countries: current status and public health implications. *Curr Probl Pediatr Adolesc Health Care* 2006;36:178–88.
- Dilenge ME, Majnemer A, Shevell MI. Long-term developmental outcome of asphyxiated term neonates. *J Child Neurol* 2001;16(11): 781–92.
- Young Infants Clinical Signs Study Group. Clinical signs that predict severe illness in children under age 2 months: a multicentre study. *Lancet* 2008;371(9607):135–42.
- Ellis M, de L Costello AM. Antepartum risk factors for newborn encephalopathy. Intrapartum risk factors are important in developing world. *BMJ* 1999;318:1414.
- Ellis M, Manandhar N, Manandhar DS, et al. Risk factors for neonatal encephalopathy in Kathmandu, Nepal, a developing country: unmatched case-control study. *BMJ* 2000;320: 1229–36.
- Hankins GD, Speer M. Defining the pathogenesis and pathophysiology of neonatal encephalopathy and cerebral palsy. *Obstet Gynecol* 2003;102:628–36.
- Stoll BJ. The global impact of neonatal infection. *Clin Perinatol* 1997;24(1):1–21.
- Schrag S, Gorwitz R, Fultz-Butts K, et al. Prevention of perinatal group B streptococcal disease. Revised guidelines from CDC. *MMWR* 2002; 51(RR-11):1–22.
- Edwards MS, Baker CJ. Bacterial infections in the neonate. In: Long SS, Pickering LK, Prober CG, editors. *Principles and Practice of Pediatric Infectious Disease*. New York: Churchill Livingstone; 2003. p. 536–42.
- Ganatra HA, Stoll BJ, Zaidi AKM. International Perspective on early-onset neonatal sepsis. *Clin Perinatol* 2010;37:501–23.
- Aurangzeb B, Hameed A. Neonatal sepsis in hospital-born babies: bacterial isolates and antibiotic susceptibility patterns. *J Coll Physicians Surg Pak* 2003;13(11):629–32.
- Chacko B, Sohi I. Early onset neonatal sepsis. *Indian J Pediatr* 2005;72(1):23–6.
- Kuruvilla KA, Pillai S, Jesudason M, et al. Bacterial profile of sepsis in a neonatal unit in south India. *Indian Pediatr* 1998;35(9):851–8.
- Karthikeyan G, Premkumar K. Neonatal sepsis: staphylococcus aureus as the predominant pathogen. *Indian J Pediatr* 2001;68(8):715–17.
- Zaidi AK, Thaver D, Ali SA, et al. Pathogens associated with sepsis in newborns and young infants in developing countries. *Pediatr Infect Dis J* 2009;28(Suppl 1):S10–18.
- Bizzarro MJ, Raskind C, Baltimore RS, et al. Seventy-five years of neonatal sepsis at Yale: 1928–2003. *Pediatrics* 2005;116(3):595–602.
- Stoll BJ, Schuchat A. Maternal carriage of group B streptococci in developing countries. *Pediatr Infect Dis J* 1998;17(6):499–503.
- Garner P, Lai D, Baea M, et al. Avoiding neonatal death: an intervention study of umbilical cord care. *J Trop Pediatr* 1994;40(1):24–8.
- Black RE, Allen LH, Bhutta ZA, et al. Maternal and child undernutrition: global and regional exposures and health consequences. *Lancet* 2008;371(9608):243–60.
- Black RE. Zinc deficiency, infectious disease and mortality in the developing world. *J Nutr* 2003;133(5):1485S–9S.
- Walker CLF, Perin J, Aryee MJ, et al. Diarrhoea incidence in low- and middle-income countries in 1990 and 2010: a systematic review. *BMC Public Health* 2012;12(1):220.
- Yasmin S, Osrin D, Paul E, et al. Neonatal mortality of low-birth-weight infants in Bangladesh. *Bull World Health Org* 2001;79:608–14.
- Parashar UD, Hummelman EG, Bresee JS, et al. Global illness and deaths caused by rotavirus disease in children. *Emerg Infect Dis* 2003;9: 565–72.
- CSDH. Closing the gap in a generation: health equity through action on the social determinants of health. Final Report of the Commission on Social Determinants of Health. Geneva: World Health Organization; 2008.
- Gwatkin D, Bhuiya B, Victora CG. Making health systems more equitable. *Lancet* 2004; 364:1273–80.
- Barros AJ, Santos IS, Bertoldi AD. Can mothers rely on the Brazilian health system for their deliveries? An assessment of use of the public system and out-of-pocket expenditure in the 2004 Pelotas Birth Cohort Study, Brazil. *BMC Health Serv Res* 2008;8:57.
- Simmons LE, Rubens CE, Darmstadt GL, et al. Preventing pre-term birth and neonatal mortality: exploring the epidemiology, causes and interventions. *Semin Perinatol* 2010;34:408–15.
- Lawn J, Shibuya K, Stein C. No cry at birth: global estimates of intrapartum stillbirths and intrapartum-related neonatal deaths. *Bull World Health Organ* 2005;83:409–17.
- Barros FC, Bhutta ZA, Batra M, et al. Global report on preterm birth and stillbirth (3 of 7): evidence for effectiveness of interventions. *BMC Pregnancy Childbirth* 2010;10(Suppl 1):S3.
- Lawn JE, Kerber K, Enweronu-Laryea C, et al. Newborn survival in low resource settings – are we delivering? *Br J Obstet Gynaecol* 2009;116 (Suppl 1):49–59.
- Knippenberg R, Lawn JE, Darmstadt GL, et al. Systematic scaling up of neonatal care in countries. *Lancet* 2005;365:1087–98.
- Bang AT, Bang RA, Baitule SB, et al. Effect of home-based neonatal care and management of sepsis on neonatal mortality: field trial in rural India. *Lancet* 1999;354:1955–61.
- Darmstadt GL, Bhutta ZA, Cousens S, et al. Evidence-based, cost-effective interventions: how many newborn babies can we save? *Lancet* 2005;365:977–88.
- Edmond KM, Zandoh C, Quigley MA, et al. Delayed breastfeeding initiation increases risk of neonatal mortality. *Pediatrics* 2006;117(3): e380–6.
- Gove S. Integrated management of childhood illnesses: technical basis and overview. The WHO Working Group on Guidelines for Integrated Management of the Sick Child. *Bull World Health Organ* 1997;75:7–24.
- Gupta GR. Tackling pneumonia and diarrhoea: the deadliest diseases for the world's poorest children. *Lancet* 2012;379(9832):2123–4.
- Greenwood B. A global action plan for the prevention and control of pneumonia. *Bull World Health Organ* 2008;86(5):322–322A.
- Duijts L, Ramadhani MK, Moll HA. Breastfeeding protects against infectious diseases during infancy in industrialized countries: a systematic review. *Matern Child Nutr* 2009;5(3):199–210.
- Bhutta ZA. Dealing with childhood pneumonia in developing countries: how can we make a difference? *Arch Dis Childh* 2007;92(4):286–8.
- Wardlaw T, Salama P, Brocklehurst C, et al. Diarrhoea: why children are still dying and what can be done. *Lancet* 2010;375(9718):870–2.
- Curtis VA, Danquah LO, Aunger RV. Planned, motivated and habitual hygiene behaviour: an eleven country review. *Health Edu Res* 2009;24(4):655–73.
- Bahl R, Baqui A, Bhan MK, et al. Effect of zinc supplementation on clinical course of acute diarrhoea. *J Health Pop Nutr* 2001;19(4): 338–46.
- Sur D, Manna B, Niyogi SK, et al. Role of probiotic in preventing acute diarrhoea in children: a community-based, randomized, double-blind placebo-controlled field trial in an urban slum. *Epidemiol Infect* 2011;139:919–26.
- Manandhar DS, Osrin D, Shrestha BP, et al. Effect of a participatory intervention with women's groups on birth outcomes in Nepal: cluster, randomized, controlled trial. *Lancet* 2004;364(9438):970–9.

59. Lagarde M, Haines A, Palmer N. Conditional cash transfers for improving uptake of health interventions in low- and middle-income countries: a systematic review. *JAMA* 2007;298(16):1900–10.
60. Liu X, Hotchkiss DR, Bose S. The effectiveness of contracting-out primary health care services in developing countries: a review of the evidence. *Health Policy Plan* 2008;23:1–13.
61. Gordon R, McDermott L, Stead M, et al. The effectiveness of social marketing interventions for health improvement: what's the evidence? *Public Health* 2006;120:1133–9.
62. Kakwani N, Wagstaff A, van Doorslaer E. Socio-economic inequalities in health: measurement, computation and statistical inference. *J Econ* 1997;77:87–103.
63. Houweling TA, Ronsmans C, Campbell OM, et al. Huge poor-rich inequalities in maternity care: an international comparative study of maternity and child care in developing countries. *Bull World Health Organ* 2007;85:745–54.
64. Mohan P, Kishore B, Singh S, et al. Assessment of implementation of integrated management of neonatal and childhood illness in India. *J Health Popul Nutr* 2011;29(6):629–38.
65. Ramji S. Integrated management of neonatal and childhood illness (IMNCI): implementation challenges in India. *Indian Pediatr* 2006;43:1029–31.
66. Segall M, Tipping G, Lucas H, et al. Economic transition should come with a health warning: The case of Vietnam. *J Epidemiol Comm Health* 2002;56(7):497–505.
67. Farmer P. Pathologies of power: rethinking health and human rights. *Am J Public Health* 1999;89:486–1496.
68. Bhutta ZA, Lassi ZS, Blanc A, et al. Empowering communities for maternal and newborn health. *Lancet* 2010;375:1142–4.