The Second Child Survival Revolution

In February 2003, researchers from several institutions met in Bellagio, Italy to define what can be done to save the lives of approximately 6 million children who are dying annually from preventable causes. The following is a summary of five articles forming a series on child survival that emerged from the work of this group and that appeared in *The Lancet* in June and July 2003. These articles are a critical call to action to save children's lives, and we applaud *The Lancet* for publishing them. The authors' vision is to create a second child survival revolution using *known* interventions to address *known* public health problems. Their vision includes better understanding child health epidemiology at country level and closing the equity gap in child mortality between the rich and the poor and between girls and boys. The cost of saving these 6 million children is estimated to be approximately US $7.5 billion per year for vaccinations, treatment of childhood illnesses, and malaria prevention and treatment. To overcome the obstacles to preventing these deaths, what is needed now is the commitment to take proven interventions to scale with adequate resources and to mobilize the political will globally and at national level. The authors feel that the tools needed to achieve the Millennium Development Goal of reducing child deaths by two thirds by 2015 (from a base year of 1990) are within our grasp, but only if the necessary commitment and resources are made available.

To access the complete articles, register on *The Lancet* Website at www.thelancet.com/home. This summary is available in seven languages on the BASICS II Website at www.basics.org. This Website also contains information and tools for operationalizing the child survival interventions that are mentioned in this series of articles.

WHERE AND WHY ARE 10 MILLION CHILDREN DYING EVERY YEAR?

ROBERT E. BLACK, SAUL S. MORRIS, AND JENNIFER BRYCE

Where do most deaths occur? Rates of decline in child mortality peaked around 1980. Child mortality varies among world regions and between countries within regions. In several African countries, mortality rates among poor children actually rose during the 1990s, even though they fell among better-off children. Approximately 10.8 million children still die unnecessarily each year: about 41% of these in sub-Saharan Africa and 34% in south Asia. In 2000, six countries accounted for 50% of global under-five deaths, and 42 countries for 90%. The African countries of these 42 account for 90% of child deaths in sub-Saharan Africa. Even within countries, spatial variation in mortality can be large and caused by many environmental and behavioral factors that are often proxied by broad geographical groupings. Different profiles have been created based on different country characteristics.

Table 1. Six countries account for 50% of global under-five deaths

Countries Ranked by Total Child Deaths	Number of Child Deaths (x1,000)
India	2,402
Nigeria	834
China	784
Pakistan	565
D.R. Congo	484
Ethiopia	472
Total under-five deaths	10,800

Risk factors for child mortality. Unhygienic and unsafe environments place children at risk. Ingestion of unsafe water, inadequate availability of water for hygiene, and lack of access to sanitation

contributes to about 1.5 million child deaths and is a risk factor for 88% of diarrhea mortality. Other health-related behaviors, such as birth spacing and poor breastfeeding practices, are also important risk factors for child mortality. For example, infants ages 0–5 months who are not breastfed have a significantly greater risk of dying from diarrhea and pneumonia compared to infants who are exclusively breastfed.

Underlying causes of death. In low- and middle-income countries, serious illnesses commonly occur sequentially or concurrently before death. For example, measles is commonly complicated by pneumonia or diarrhea. Underweight status and micronutrient deficiencies also cause decreases in immune and non-immune host defenses, and should be considered underlying causes of death if followed by infectious diseases that are the terminal associated causes.

Fetal malnutrition, as manifested in low birth weight, may contribute in a similar way to neonatal mortality. In children with vitamin A deficiency, the risk of dying from diarrhea, measles, and malaria is increased by 20 to 24%. Undernutrition is recognized as a contributing factor to the cause of death, but the fraction of these infectious-disease deaths attributable to nutritional deficiencies varies with the prevalence of deficiencies.

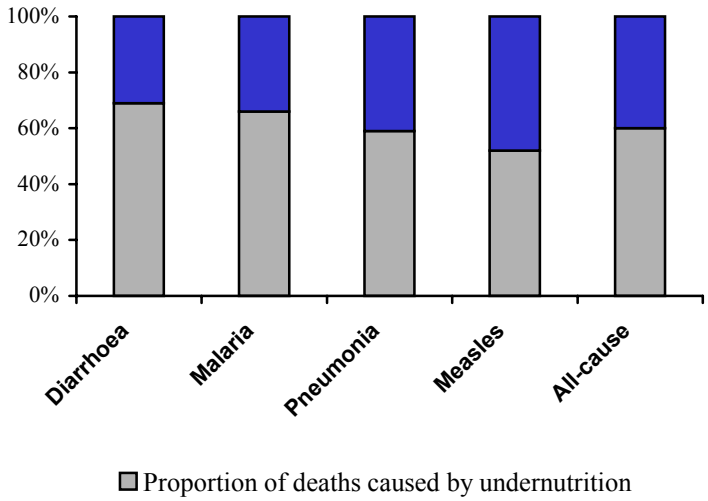
Table 2. Distribution of global child deaths by cause using a predication model in 42 countries with 90% of child mortality (2000)

DISEASE OR CONDITION	Preventable deaths
Neonatal	33%
Diarrhea	22%
Pneumonia	21%
Malaria	9%
Measles	1%
AIDS	3%
Other	9%

Of the 10.8 million child deaths each year, 3.9 million occur in the first 28 days of life, i.e., the neonatal period. It is estimated that 24% of these deaths are caused by severe infections, 29% by birth asphyxia, 24% by complications of prematurity, and 7% by tetanus. Malaria plays a more important role in child mortality in many countries in sub-Saharan Africa than AIDS, which accounts for more than 10% of deaths in only 3 of these 42 countries**.**

The identification of risk factors, the detection of underlying and associated causes of death, and the recognition of co-morbidity can lead to a selection of effective and affordable interventions that are appropriate for a given national delivery system. It is important, however, to understand child health epidemiology in order to select the appropriate number and type of interventions for a given country's characteristics and epidemiological profile.

Figure 1. Malnutrition contributes to about 60% of avoidable child deaths



HOW MANY CHILD DEATHS CAN WE PREVENT THIS YEAR?

GARETH JONES, RICHARD W. STEKETEE, ROBERT E. BLACK, ZULFIQAR A. BHUTTA, SAUL S. MORRIS, AND THE BELLAGIO CHILD SURVIVAL STUDY GROUP

In the 42 countries with 90% of global child deaths, 9.7 million children under five years of age died in 2000. An estimated 6.4 million (66%) of these deaths could have been prevented through full implementation of selected interventions. This is a conservative estimate. Mounting evidence suggests that remarkable progress could be made in all countries by the use of interventions that are available today and feasible for implementation in low-income countries.

Identifying proven child survival interventions. These papers focused on "proven" interventions—those that address the more proximal determinants of child mortality and those that can be delivered mainly through the health sector—that can prevent many of the above deaths. Interventions include preventive approaches that may reduce exposure to the infection or condition or reduce likelihood of exposure that leads to disease, as well as preventive and treatment approaches that reduce the likelihood that the disease or condition will lead to death. Breastfeeding and oral rehydration therapy (ORT) alone are estimated to be able to prevent 13% and 15% of all under-five deaths, respectively. Six other interventions could each further prevent a significant percentage of under-five deaths: insecticide-treated materials (7%), complementary feeding (6%), antibiotics for sepsis (6%), antibiotics for pneumonia (6%), antimalarials (5%), and zinc to reduce diarrhea and pneumonia deaths (5%). Unfortunately, existing coverage of these interventions is low in most of these 42 countries, ranging from a high of 90% for breastfeeding to a low of 1% for antimalarial intermittent preventive treatment during pregnancy.

Table 3. Under-five deaths that could be prevented in the 42 countries with 90% of worldwide child deaths in 2000 through achievement of universal coverage with individual interventions

INTERVENTIONS	Number of deaths (in 000s)	Proportion of all deaths
Preventive Interventions		
Breastfeeding	1301	13%
Insecticide-treated materials	691	7%
Complementary feeding	587	6%
Zinc	459	5%
Clean delivery	411	4%
Hib vaccine	403	4%
Water/sanitation/hygiene	326	3%
Antenatal steroids	264	3%
Newborn temperature management	227	2%
Vitamin A	225	2%
Tetanus toxoid	161	2%
Nevirapine & replacement feeding	150	2%
Antibiotics for premature rupture of membranes	133	1%
Measles vaccine	103	1%
Antimalarial intermittent preventive treatment in pregnancy	22	<1%
Treatment Interventions		
Oral rehydration therapy (ORT)	1477	15%
Antibiotics for sepsis	583	6%
Antibiotics for pneumonia	577	6%
Antimalarials	467	5%
Zinc	394	4%
Newborn resuscitation	359	4%
Antibiotics for dysentery	310	3%
Vitamin A	8	<1%

Maintaining existing effective interventions at high coverage, such as measles vaccination, must continue to be supported. Amid the plethora of new and newly validated interventions, there are signs that the child survival effort has lost its focus. For example, a focus on AIDS, the cause of only 3% of under-five deaths, may divert attention to saving many more lives using known and less costly interventions. More deaths would be prevented by focusing on what we know works rather than being sidetracked by new interventions or new programs. For the 6 million children who will die this year, there is no need to wait for new vaccines, new drugs, or new technology, although all these should remain on the agenda as a basis for improving our efficiency and effectiveness in the future.

It is important to note that some of the most promising interventions may be delivered at the household level, with limited need for external material inputs; these include promotion of breastfeeding, ORT, education on complementary feeding, and insecticide-treated materials. These interventions could cumulatively prevent over one-third of all deaths.

REDUCING CHILD MORTALITY: CAN PUBLIC HEALTH DELIVER?

JENNIFER BRYCE, SHAMS EL ARIFEEN, GEORGE PARIYO, CLAUDIO F. LANATA, DAVIDSON GWATKIN, JEAN-PIERRE HABICHT, AND THE MULTI-COUNTRY EVALUATION OF IMCI STUDY GROUP

Despite improved interventions, increased overall resources, and a history of success, the gap between what can be done to reduce child mortality and what is actually being done is growing. Child survival interventions are not reaching the children who need them most. Coverage of known interventions is low, yet we know that high coverage is possible by the simple fact that higher levels of coverage have been achieved in the past. Poor coverage is the result of weaknesses both in the provision of and demand for services, and is a consequence of malfunctioning health systems. Understanding the reasons for our inability to increase coverage, especially among the poorest people, is a first step towards recouping what we have lost and moving towards universal coverage. The Integrated Management of Childhood Illness (IMCI) multi-country evaluation provides evidence of barriers to implementation. The evaluation provides insight into why efforts to develop and implement activities to improve key family practices related to child mortality were limited, and into why those efforts attempted took far longer and achieved much lower coverage than anticipated.

Successful case studies do exist in Brazil, Tanzania, Uganda, and Guatemala, among other countries. They show that there is no *one* way to achieve high coverage and reduce child deaths. Very different approaches can be effective, efficient, and sustainable when they fit well within the settings in which they are implemented and when they are managed by capable and motivated people. These case studies, however, indicate that there are five fundamental directions for improving service delivery:

1. Planning requires relevant data at sub-national level to assess local epidemiological profiles, health system capacity, and community preferences. Monitoring of provision and quality of services and inequities is essential.

2. Interventions should be selected based on the local epidemiological data provided and other locally defined key criteria. Improved integration of child survival and reproductive health services will probably help increase effectiveness.

3. Alternative delivery strategies need to be assessed. Analytical work is underway to understand how best to combine interventions to achieve maximum effect, and how to build capacity for making these decisions at country level and below.

4. Supply must be tailored to meet demand and must respond to needs. Monitoring coverage is needed to see who is being reached and to help assess progress on the intermediate determinants of child mortality.

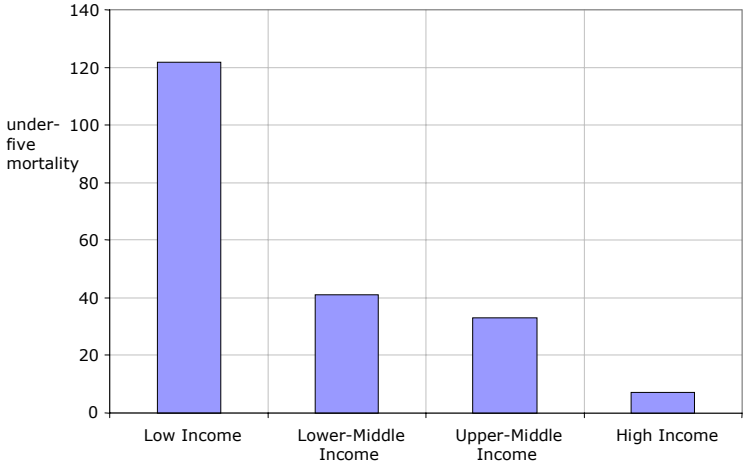
5. Strengthening national health systems is a medium- to long-term aim. Without adequate manpower, drug and vaccine management and supply, information systems, and functioning referral, child health programs cannot be sustained. Community-based and private sector strategies need to be linked to health systems. Continuing problems with incentive structures and staffing policies must be addressed, and the effects of reform policies must be monitored and used as the basis for improving intervention delivery.

APPLYING AN EQUITY LENS TO CHILD HEALTH AND MORTALITY: MORE OF THE SAME IS NOT ENOUGH

CESAR G. VICTORA, ADAM WAGSTAFF, JOANNA ARMSTRONG SCHELLENBERG, DAVIDSON GWATKIN, MARIAM CLAESON, AND JEAN-PIERRE HABICHT

Gaps in child mortality between rich and poor countries are unacceptably wide and in some areas are becoming wider, as are the gaps between wealthy and poor children within most countries. Poor children are more likely than their better-off peers to be exposed to health risks, and they have less resistance to disease because of undernutrition and other hazards typical in poor communities. Poverty increases exposure and reduces resistance to disease, a synergy that contributes to the wide inequities in child survival described here. The poor are also least likely to receive preventive and curative

Figure 2. Under-five mortality by country income



Under-five mortality rate	
In high-income countries	6
In developing world	88
In poorest countries	120

Source: Based on data from UNICEF and the World Bank.

interventions, and, once sick, are least likely to receive appropriate care. The life-saving potential of improving equity is far greater than that of any new technology or combination of technologies that may be introduced in the near future. A policy intervention that eliminated inequalities in child health—by bringing rates among the poorest 80% down to those prevailing among the richest 20%—would prevent about 2.28 million under-five deaths.

Can policymakers reduce child survival gaps? These damaging effects of poverty on child health can be reduced by well-designed policies. Several different—and generally complementary—approaches are possible and address the deprivations of poverty that go beyond income. Improving knowledge and changing behavior among poor mothers has been achieved in many settings. Social marketing entails adapting commercial sector marketing approaches for a public health gain, and has been effective for various items including soap and mosquito nets. Micro-credit has helped empower women. In some countries, diseases of the poor have been given priority in budget allocations. Health care can be made affordable to the poor through cash transfers, fee waiver schemes, and health insurance and made more accessible through road improvements, outreach, or deployment of services in poor areas. Interventions in water and sanitation can be designed to assist the poor.

The quality and quantity of the evidence available to support each of the approaches are variable. Ideally, one would like to know how well every program is targeted to poor people, and how large the health effect is on poor communities. There is an urgent need to improve the evidence base on child health and poverty and to build capacity in measurement of equity indicators. Despite these limitations, however, we do know enough now to move ahead in reducing health inequities among children. Unfortunately, few if any of these approaches have been implemented on a large scale—scale being the next big challenge. Surmounting that challenge will require adoption of suitable health strategies, the creation of an appropriate policy environment, and more equitable targeting of interventions.

Increasing coverage in poor communities. Two basic approaches can increase coverage among poor population groups: targeting and universal coverage. Targeting can be direct or indirect. *Direct* targeting involves identification of poor households or individuals and developing ways of getting services specifically to them. *Indirect* targeting can focus program efforts on geographic areas that are particularly poor, or on population subgroups in special need.

Rapid, universal coverage is the second approach and seeks program saturation, without worrying unduly about which groups are covered first. When universal coverage is achieved, poor people receive the same benefits as those with more resources. Achieving high coverage levels with a few interventions is more equitable—and may be administratively simpler—than achieving mediocre coverage levels with several interventions.

Improving accountability. Poverty-oriented approaches are much more likely to be accepted in environments characterized by a strong commitment to equity among policymakers and program managers. Developing and maintaining such a commitment to equity is more probable if policymakers, program managers, and communities are involved in policy formulation. Several types of monitoring and reporting can provide useful information for policymaking. One type is the simple measurement of health status and program use disaggregated by socioeconomic status, gender, or ethnic group. Another is the establishment and monitoring of health objectives in terms of health status or service use among disadvantaged groups. A third is the establishment of monitoring mechanisms to track progress among those groups.

At the national level, there are several potential audiences for such information: the public at large, particularly poor populations who are most affected; and the community of non-governmental organizations, which are often highly motivated and well placed to use the information to advocate for equity. Another audience is health professionals and decision-makers, many of whom are still ignorant of or oblivious to equity matters.

The challenge at international level. Approaches are available to reduce inequities; the challenge is to ensure that they are widely implemented. International and bilateral agencies must build on current efforts to address equity by building knowledge and competency among their staff on poverty and equity issues, by advising governments on what can be done to tackle child health inequalities, and by systematically presenting health data not only as national averages but also as stratifications by socioeconomic, gender, and geographic categories. Multilateral and bilateral agencies must ensure that equity considerations are an essential part of the design of all new projects, must address equity issues in dialogue with countries, and must ensure that impact evaluations provide data on equity. International foundations involved in child health must build upon initiatives such as the Rockefeller Foundation's Equity Gauge.

International momentum toward achieving the Millennium Development Goals must be tapped to address equity issues. The first goal, on poverty reduction, should be brought together with the goal of reducing child mortality. It is neither sufficient nor fair to make progress towards child health outcomes at a population level and to leave the poor behind. Special efforts based on the approaches mentioned in

this paper must be made to reach the poorest, and progress towards the goals should be monitored by socioeconomic strata.

KNOWLEDGE INTO ACTION FOR CHILD SURVIVAL

THE BELLAGIO STUDY GROUP ON CHILD SURVIVAL

Translating current knowledge into effective action for child survival will require leadership, strong health systems, and targeted human and financial resources to ensure that poor children and mothers benefit. The momentum that Jim Grant, then executive director of UNICEF, was able to achieve in the 15 years following the 1982 Child Survival Revolution has been lost, and gains achieved in child survival have been slowed or reversed. The child summit goal for the 1990s—reducing child mortality by a third or to less than 70 per 1,000, whichever was lower—is far from being achieved. There is large variation in under-five mortality rates within African countries, and poor children everywhere bear more than their share of the mortality. There are no new epidemiological challenges. The killers of the past are the killers of the present: diarrhea, pneumonia, and malaria, just as they were in 1980. Birth asphyxia and neonatal sepsis remain responsible for most neonatal deaths, and undernutrition remains an underlying cause of death. The differences in the health and development environment today, however, are that there are better ways to respond to these deaths, that global international partnerships focused on specific disease conditions (HIV/AIDS, malaria, TB, etc.) have been created, and that there is a focus on poverty reduction that previously did not exist.

The first four papers in *The Lancet* child survival series constitute sufficient grounds for renewed actions. These actions include:

- Epidemiology – Advances in epidemiology have provided evidence of the proportional distribution of child deaths and the cause-specific contribution of undernutrition. Inter-country variation and application of this knowledge to different heath systems mean that countries need to obtain and use information to support child survival programming.

- Child survival interventions – Existing, more effective interventions need to be aggressively applied and progress needs to be made on interventions not yet available, e.g., vaccines for pneumonia, diarrhea, and malaria.

- Delivery strategies – Child survival interventions are not reaching the children and mothers who need them. Delivery failures, and the recognition that a healthy child needs many and coordinated preventive and therapeutic interventions, demand renewed action.

- Inequities – Inequities have been documented and must be addressed.

Four prerequisites are required in order to transform knowledge into effective action to reduce child mortality.

1. *Leadership.* At present no institution or individual is taking the lead, pioneering responses to recognized failures and needs, influencing technical and political agendas, directing investments, and producing credible evidence that child mortality can be reduced. This leadership must be established.

2. *Strong health systems.* Improved health systems are required for success in reducing child mortality as well as for long-term sustained impact. Disease-specific interventions, a focus on the private sector, and programs independent of health systems may have short-term positive effects, but these effects can not be sustained without a specific focus on improving overall health systems.

3. *Adequate and targeted resources.* Adequate and targeted human and financial resources are required. The yearly costs of scaling up these known interventions, according to the Commission on Macroeconomics and Health for 2007, would be about U.S. $1 billion for vaccinations, $4 billion for treatment of childhood illnesses, and an additional $2.5 billion for malaria prevention and treatment for all age groups combined. This is less than the estimated $17 billion spent annually on pet food in North America and Europe. A substantial proportion of this amount could be mobilized from within the countries themselves.

   Despite repeated attempts, the Bellagio Study Group could not track investments for child survival over the past decade. Mechanisms are urgently needed to track such investments. Furthermore, general estimates of resource needs must be disaggregated in ways that define the needs for child survival and link investments to intermediate outcomes and mortality reduction.

4. *Awareness and a commitment to action.* The final prerequisite is awareness and a commitment to action that goes beyond the public health community to mobilize parents, teachers, village chiefs, rock stars, prominent sports people, and presidents. The actions needed are simple, clear, and can be communicated through multiple channels.

The way forward. The lessons of the child survival revolution of the 1980s provide a solid starting point for renewed efforts. They suggest that leadership is essential, and that to be effective the leadership must encompass United Nations (UN) agencies, worldwide initiatives, private foundations, and other non-governmental agencies, professional societies, and ministries of health, education, and finance. These alliances do not exist now and must be forged. A small group of institutions and individuals must lead the way.

A call to action. The Bellagio Study Group calls on WHO, UNICEF, the World Bank, the UN Development Program, and their other UN partners to act on behalf of children by putting child survival at the top of their list of priorities.

Commitment needs to be followed by:

- Establishing a process that leads to development of true leadership worldwide.
- Collaborating in programs to strengthen country capacity and health systems in general, with appropriate financial and technical support.
- Continuing to develop guidelines that put poor children and their mothers at the center of efforts to increase coverage of these known interventions and improve health systems.
- Developing systems for monitoring coverage, equity, and progress towards achieving the millennium development goal of child survival.

This group also calls on worldwide initiatives, including the Global Fund to Fight AIDS, TB and Malaria, Roll Back Malaria, and the EPI program and its progeny, to expand their strategies and guidelines for support. The same call goes out to all governments, ministries of health, and their bilateral and multilateral technical assistance partners to make child survival a priority, both in their own countries and in their work in low-income and middle-income countries. Countries where children continue to die at high rates must be helped to build capacity and strengthen health systems. Ministries of health in these countries must be able to prioritize the most cost-effective and equitable interventions,

and they must be supported. In doing so, they must take into account the current and future competence levels of available staff and volunteers and partner institutions, the epidemiological profile, the cultures of their populations and staff, and the feasibility of improving health-related behavior.

Academic and resource institutions, professional and scientific associations, and educators must also contribute. The power and credibility of these groups must be firmly and publicly placed behind the child survival agenda.

The Bellagio Study Group on Child Survival wrote these five papers as individuals. They now call on and shall work with their individual institutions to see that these general prescriptions are translated into effective action. However, this group commits themselves to ensuring that there is an overall mechanism for improving accountability, re-energizing commitment, and recognizing accomplishments in child survival. They commit themselves to convening a series of meetings, held every two years and hosted by rotating institutions. Participants will be those who support child survival, who monitor interventions and delivery strategies, and other concerned individuals and organizations. The meetings will provide regular opportunities for the world to take stock of progress in preventing child deaths, and to hold countries and their partners accountable. The Bellagio Study Group hopes readers will respond to this call to action by advocating for change within their institutions, countries, and communities.

THE BELLAGIO STUDY GROUP ON CHILD SURVIVAL

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COUNTRIES RANKED BY TOTAL CHILD (UNDER 5 YEARS) DEATHS OR BY UNDER 5 YEAR MORTALITY RATES*

Countries Ranked by Total Child Deaths	Number of Child Deaths (x1,000)	Under 5 Year Mortality Rank		Countries Ranked by Under 5 Year Mortality Rate	Under 5 Year Mortality Rate (per 1,000 births)	Number of Child Deaths Rank
India	2402	54		Sierra Leone	316	36
Nigeria	834	17		Niger	270	12
China	784	88		Angola	260	11
Pakistan	565	43		Afghanistan	257	8
D.R. Congo	484	9		Liberia	235	51
Ethiopia	472	21		Mali	233	16
Bangladesh	343	57.5		Somalia	225	22
Afghanistan	251	4		Guinea-Bissau	215	70
Tanzania	223	23		D.R. Congo	205	5
Indonesia	218	76.5		Zambia	202	27
Angola	169	3		Chad	200	33
Niger	156	2		Mozambique	200	13

Countries Ranked by Total Child Deaths	Number of Child Deaths (x1,000)	Under 5 Year Mortality Rank		Countries Ranked by Under 5 Year Mortality Rate	Under 5 Year Mortality Rate (per 1,000 births)	Number of Child Deaths Rank
Mozambique	155	11.5		Burkina Faso	198	20
Uganda	195	36		Burundi	190	44
Myanmar	132	43		Malawi	188	25
Mali	128	6		Rwanda	187	42
Brazil	127	92		Nigeria	184	2
Kenya	125	39		Mauritania	183	59
Sudan	116	45.5		Central African Republic	180	54
Burkina Faso	104	13		Guinea	175	41
Iraq	104	34		Ethiopia	174	6
Somalia	100	7		Côte d'Ivoire	173	24
Yemen	97	43		Tanzania	165	9
Côte d'Ivoire	97	22		Benin	160	46
Malawi	96	15		Equatorial Guinea	156	89
Madagascar	93	30.5		Cameroon	154	28
Zambia	88	10		Djibouti	146	88
Cameroon	83	26		Swaziland	142	85
Philippines	82	88		Togo	142	55
South Africa	77	66.5		Senegal	139	45
Nepal	76	54		Madagascar	139	26
Egypt	76	80		Cambodia	135	39
Chad	73	11.5		Lesotho	133	73
Iran	71	82.5		Iraq	130	21
Mexico	70	101.5		Gambia	128	79
Sierra Leone	69	1		Uganda	127	14
Turkey	66	80		Haiti	125	52
Ghana	65	49		East Timor	124	90
Cambodia	63	32		Kenya	120	18
Vietnam	63	91		Zimbabwe	117	43
Guinea	62	20		Eritrea	114	63
Rwanda	54	16		Yemen	110	23

*Number of deaths estimated by multiplying the number of live births by the under five year mortality rate and by a life-table based adjustment factor that slightly reduces the number of deaths when the annual number of births has been increasing over the previous quinquennium and slightly increases it when births have been decreasing.