

# A financial road map to scaling up essential child health interventions in 75 countries

Karin Stenberg,<sup>a</sup> Benjamin Johns,<sup>b</sup> Robert W Scherpbier<sup>a</sup> & Tessa Tan-Torres Edejer<sup>c</sup>

**Objective** To estimate the additional resources required to scale up interventions to reduce child mortality and morbidity within the context of the fourth Millennium Development Goal's aim to reduce mortality among children aged < 5 years by two-thirds by 2015.

**Methods** A costing model was developed to estimate the financial resources needed in 75 countries to scale up priority interventions that address the major causes of mortality among children aged < 5 years, including malnutrition, pneumonia, diarrhoea, malaria and key newborn causes of death such as sepsis. Calculations were made using bottom-up and ingredients-based approaches; this allowed financial costs to be estimated for each intervention, country and year. Costs reflect WHO guidelines on inputs and delivery strategies and encompass the delivery of interventions at community and facility levels. These costs also include programme-specific investments needed at national level and district level.

**Findings** The scale-up scenario predicts that an additional US\$ 52.4 billion will be required for the period 2006–2015. This represents an increase in total per-capita health expenditure in the 75 countries of US\$ 0.47 in 2006; this is projected to increase to US\$ 1.46 in 2015. Projected costs in 2015 are equivalent to increasing the average total health expenditure from all financial sources in the 75 countries by 8% and raising general government health expenditure by 26% over 2002 levels. (The latest data available at the time of the study were for 2002.) The scale-up scenario indicates that countries with weak health systems may experience difficulties mobilizing enough domestic public funds.

**Conclusion** While the results are approximate estimates, they show a substantial investment gap that low- and middle-income countries and their development partners need to bridge to reach the fourth Millennium Development Goal.

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## Introduction

Global reductions in child mortality have stagnated, and annually almost 11 million children die before their fifth birthday, mainly from preventable illnesses.<sup>1</sup> In many countries, a reversal in progress highlights the failure to reach children and to provide known and effective interventions.

The fourth Millennium Development Goal – to reduce child mortality by two-thirds by 2015 – is ambitious but achievable.<sup>2</sup> The *World health report 2005* identifies technical strategies to improve the health of mothers, newborns and children.<sup>3</sup> With only a decade left to reach the Millennium Development Goal targets, policies more firmly related to implementation are needed. Budget assessments are a necessary step in mov-

ing from vision to implementation of strategic plans.

Previous attempts have been made to estimate the costs of scaling up delivery of child health interventions including the United Nations Millennium Project's needs assessments. Findings from case studies from five countries estimated the total investments in child health needed per capita in 2015: these ranged from US\$ 3.80 in Ghana to US\$ 6.80 in Uganda.<sup>4</sup> The Commission on Macroeconomics and Health estimated the economic costs of scaling up health interventions that address childhood-related illnesses in 83 countries, projecting as far as 2015. This commission found that an additional US\$ 11.9 billion would be needed

per year above current expenditures.<sup>5</sup> Further, members of the Bellagio Study Group on Child Survival assessed the running costs of providing 23 interventions to improve child survival in 42 countries; the cost was estimated to be US\$ 5.1 billion in new resources annually.<sup>6</sup>

Our study was conducted because none of the pre-existing cost estimates forecast the additional financial funds required year-by-year for scale-up. Estimates presented by the UN Millennium Project represent total rather than incremental costs. The estimates made by the Commission on Macroeconomics and Health reflect an economic perspective rather than financial expenditures. The price tag presented by members of the Bellagio group estimate the additional

<sup>a</sup> Department of Child and Adolescent Health and Development, World Health Organization, 20 avenue Appia, 1211 Geneva 27, Switzerland. Correspondence to Karin Stenberg (e-mail: stenbergk@who.int).

<sup>b</sup> Department of Health Systems Financing, WHO, Jakarta, Indonesia.

<sup>c</sup> Department of Health Systems Financing, WHO, Geneva, Switzerland.

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running costs once interventions have been successfully scaled up to full coverage rather than the increasing costs of scaling up health service delivery over time. We believe that yearly estimates of financial needs are essential to guide the advocacy for raising funds to reach the fourth Millennium Development Goal. This study provides the first estimate of the incremental financial resources required over 10 years to scale up child health interventions to universal coverage by 2015, and it includes programme investments as well as running costs.

We acknowledge that child survival depends on maternal survival and pregnancy care as well as factors outside the health sector (e.g. women's education, access to clean air and water, and improvements in infrastructure). However, for this study, we limited the list of interventions to those generally falling under the responsibility of what are known as "child health programmes". As such, these estimates are intended to provide a financial road map that is useful for child health practitioners, managers of national and international organizations and programmes providing interventions that are key to children's survival, and donors considering funding interventions to attain this goal.

## Methods, assumptions and data sources

This section summarizes the methods used. For greater detail on the key assumptions underlying the models, please see the relevant technical working paper.<sup>7</sup>

The development of a financial road map for scaling up essential child health interventions required us to select countries for the analysis, to identify priority interventions, to estimate the population in need of each service, to define current and target coverage of interventions, and to collect country-specific costs associated with the delivery of interventions.

For interventions that have an impact on the major causes of mortality among children aged < 5 years (malnutrition, pneumonia, diarrhoea and conditions affecting neonates), a model was constructed that incorporated all inputs. Pre-existing models developed by WHO's Department of Immunization, Vaccines and Biologicals<sup>8</sup> and the Roll Back Malaria Partnership<sup>9</sup> were used to assess costs for immunization and interventions to prevent and treat

malaria among children aged < 5 years. The models use similar methods and data sources. In addition, costs for anti-retroviral prophylaxis and replacement feeding were assessed using the resource needs model developed by Constella Futures (formerly known as the Futures Group).<sup>10</sup> The models were applied to 75 countries and harmonized for delivery strategies and target coverage.

The projected costs cover the incremental scale-up required in order to close the coverage gap from current coverage levels to 95% coverage. Given the short time frame, the modelling assumed that no major changes to the health system were made, and we used a simplified implementation model that allowed for the delivery of interventions within existing (non-financial) constraints. Ongoing care provided to children aged < 5 years was assumed to continue at current rates using current practices; this assumption was also made for other interventions not included in our cost estimate.

## Countries included

Countries were selected in parallel with another WHO costing exercise for scaling up care for mothers and newborns.<sup>11</sup> The main selection criterion for countries was that they have high mortality among mothers and children, both in terms of rates and gross numbers of maternal deaths, neonatal deaths and deaths among children. Efforts were made to include low-income countries from all regions. All countries where the mortality rate for children aged < 5 years is  $\geq 100$  are represented, as well as all countries experiencing reversal or stagnation in the reduction of mortality rates among this age group. The 75 countries included have a total population of 4.6 billion and account for 94% of global deaths among children in this age group. The countries included are listed in Annex 1 (available at <http://www.who.int/bulletin>).

## Health services included Interventions

There is sound evidence that high-impact, low-cost interventions could lead to a major reduction in child mortality. Table 1 lists the 16 key intervention sets that were costed; these were selected on the basis of their potential impacts on mortality and morbidity and the feasibility of delivery.<sup>1,12</sup> The estimates presented here cover only those interventions delivered directly to the child.

Costs for other essential interventions addressing neonatal mortality, in particular those having an impact on asphyxia and prematurity, are estimated in the parallel exercise for maternal and newborn care. The two projects were carefully coordinated to prevent double-counting. Interventions delivered during pregnancy and at birth, and interventions linked to complications resulting from pregnancy and birth, have been assigned to maternal and newborn health costs, whereas the treatment of neonatal infections is included in the costs of providing child health care.

## Delivery strategies

The costs presented here reflect the perspective of a public health system and represent a continuum of care running from the household, community and facility levels up to the national programme-management level. Intervention-specific delivery strategies are based on WHO's guidelines for prevention and care. The Integrated Management of Childhood Illness (IMCI) strategy has proven to be an excellent delivery channel for many of the interventions included in this costing exercise.<sup>13-15</sup> Otherwise, data on delivery channels is sparse, and the models utilize assumptions as to where the incremental scale up of interventions would be most feasible within a short time frame (Table 1).

We assumed that it is possible to reach high coverage in all countries by 2015 through a combination of extending existing health-care networks, stepping up outreach and relying on trained community health workers. We further assumed that rapid scale-up will require a greater deployment of community health workers in rural settings compared with urban settings, owing to the poor availability and utilization of formal health-care systems in many rural environments.

## Estimating populations in need

Three parameters were used to calculate the incremental population in need of each intervention.

- *Population data on children aged < 5 years and the expected number of births per country and year.* These data were gathered from the UN Population Division's 2002 medium variant projections and were adjusted for the number of lives saved as interventions are scaled up.

Table 1. Sixteen core interventions to improve child survival and their major point(s) of delivery, as costed in the model

Interventions	Population in need		Current coverage		Delivery channels used to apportion incremental delivery			
	Source of data	Range of estimates used	Source of data	Range of estimates used	National	First referral	Primary facility	Community
<b>Preventive interventions</b>								
Counselling for promotion of exclusive and continued breastfeeding	Expert opinion	100% of infants	Expert opinion	5–20%		X	X	X
Counselling for improved complementary feeding	Expert opinion	100% of infants	Expert opinion	2%			X	X
Implementation of the International Code of Marketing of Breast Milk Substitutes	Expert opinion	All 75 countries are in need of additional investments at programme level	International Baby Food Action Network, expert opinion	None (additional costs were included for all countries)	X			
Immunizations (Bacille Calmette–Guérin, diphtheria–tetanus–pertussis, measles, yellow fever, polio, <i>Haemophilus influenzae</i> type b, hepatitis B) <sup>a</sup>	Expert opinion	100% of children	WHO	0–100%			X	X
Insecticide treated bednets <sup>b</sup>	By country, the proportion of people in endemic areas was determined using climatic and environmental modelling or clinical reporting of incidence	0–100% of children	Demographic and Health Surveys, regional averages	Demographic and Health Surveys 0–23%			X	X
Routine vitamin A supplementation to children aged < 5 years	Expert opinion	100% of children aged > 6 months	WHO	0–100%			X	X
Universal salt iodization	WHO data on iodine deficiency	0–100% of children	WHO	0–98%	X			
Prevention of mother-to-child HIV transmission by antiretroviral prophylaxis and infant feeding and counselling	Refer to assumptions in the Constella Futures resource needs model <sup>10</sup>						X	
<b>Treatment interventions</b>								
Case management of diarrhoea	Demographic and Health Surveys, regional averages	2.4–6.0 episodes per child/year	Demographic and Health Surveys, regional averages	12–81%		X	X	X
Antibiotic treatment for dysentery	Demographic and Health Surveys, regional averages and expert opinion	5% of diarrhoea incidence	Diarrhoea coverage used as proxy indicator	12–81%			X	
Case management of pneumonia	Demographic and Health Surveys, regional averages	0.22–0.34 episodes per child/year	Demographic and Health Surveys, regional averages	16–75%		X	X	X

(Table 1, cont.)

Interventions	Population in need		Current coverage		Delivery channels used to apportion incremental delivery			
	Source of data	Range of estimates used	Source of data	Range of estimates used	National	First referral	Primary facility	Community
Case management of severe malnutrition	WHO Global Database on Child Growth and Malnutrition	0.2–4.3 per 100 children/year with weight-for-height <3 SD	Expert opinion	5%		X		X
Case-management of neonatal infections	Expert opinion	6.5/100 newborns	Bellagio group <sup>1</sup>	10%				X
Case management of malaria <sup>b</sup>	Demographic and Health Surveys, regional averages	0–4 episodes per child/year	Demographic and Health Surveys, regional averages	Assume switch to artemisinin-based combination therapies (nearly 0% coverage except a few countries reporting their use in 2005)			X	X
Treatment of measles and measles complications	WHO data on measles cases per year	0–0.63 per birth cohort	WHO data on measles cases per year (for complicated measles, pneumonia coverage is used as proxy indicator)	16–75%		X	X	
Regular deworming	Expert opinion	100% of children aged ≥ 12 months	Estimated from WHO data	0–94%			X	X

<sup>a</sup> Following assumptions in the model produced by WHO's Department of Immunization, Vaccines and Biologicals.

<sup>b</sup> Following assumptions in the model produced by the Roll Back Malaria Partnership.

- *Incidence or prevalence of a condition or risk:* These data were based on data from WHO or experts' opinions. (The expert committees were chosen from staff at WHO known to be specialists in the area of focus, each of whom has access to a wider network of global experts.) The model assumes that epidemiological risk will remain constant up to 2015, apart from reductions in the incidence of measles and *Haemophilus influenzae* type b brought about by improved vaccine delivery.
- *Incremental scale-up of coverage required:* This was estimated using the universal coverage target of 95% minus current levels of coverage per

country and intervention. The current coverage of interventions is based on the best available estimates from 1995 or later. For countries without coverage data, average regional values were used. For interventions with little available coverage data, estimates are based on expert opinion.

### Scale-up rates

An index developed by the Commission on Macroeconomics and Health classifies countries' health systems into four different levels of strength based on constraints other than lack of finance, such as those related to demand and care-seeking, health sector policy, and

broader economic and political factors.<sup>16</sup> This classification is used here in two ways: (i) to model country-specific and intervention-specific scale-up curves based on current coverage and growth-rate scenarios applied to each group in the index, and (ii) to determine the need for additional investment required to strengthen the health system's capacity to deliver interventions. Countries with a low index (those rated 1) are seen as having greater need for incremental investments at the health system level, as well as facing a slow start-up before rapid scale-up in the end phase. Countries with a high index (rated 4) are expected to be able to reach full coverage for most interventions by 2010.

Table 2. Components of patient costs and programme costs for child health interventions.<sup>7</sup>

Category	Costs included	
<b>Patient costs</b>		
Commodities	Drugs, vaccines, laboratory tests, medical supplies	
Service delivery costs	Costs for consultation time include salaries of multipurpose health workers and locally procured goods, such as overhead costs for electricity, running water and buildings	
<b>Programme costs</b>		
	Activities	Costs included <sup>a</sup>
Community health workers	Honoraria and equipment for community health workers delivering child health interventions	E, H, S
Programme management	Deployment of national-level and provincial-level programme staff; review of policy; development of strategic plans; coordination work; development of district plans; recruitment and management of community health workers	CD, MC, PD, PM, S, SS, TC
Training	Upgrading pre-service training programmes: Implementing introductory training for community health workers; implementing in-service training for staff at first-level facilities (IMCI training) and first referral level (specialized training for management of severely ill children); training programme managers on children's rights and the UN <i>Convention on the rights of the child</i>	CD, MC, PD, PM, S, SS, TC
Supportive supervision	Supervision at district level, first referral care-level hospitals, primary-level health centres, and of community health workers	CD, MC, PD, S, SE, SS, TC
Externally funded technical assistance/capacity building	Consultants' fees	CD
Information, education and communication	Hiring of social mobilization officers; formative research and development of information, education and communication materials; community mobilization to raise awareness through media (radio, TV) and printed material (posters, fliers)	E, PD, PM, S, SS, TC
Monitoring and evaluation	Hiring of staff (epidemiology and data entry); strategic review meetings; maintenance of information technology infrastructure; community-based and facility-based surveys	CD, E, M, MC, PD, SS, TC
Infrastructure	Existing hospitals – upgrade equipment to standards; existing health centres – upgrade equipment to standards, upgrade selected facilities to hospital standard in regions where there are no hospitals available (includes upgrading equipment and hiring additional staff); provide vehicles	E, M, SS
Advocacy	Development and review of advocacy strategy; provision of advocacy materials and implementation of advocacy activities	MC, PD, PM, S, TC
Laws, policy, regulation	Drafting relevant legislation and policies (including legislation and policy related to the International Code of Marketing of Breast Milk Substitutes, iodine fortification and the UN <i>Convention on the rights of the child</i> ) monitoring activities related to implementation of legislation and policy	MC, PD, S, TC
Programme costs for immunization	Supervision, provision and maintenance of cold chain, purchase and maintenance of vehicles	E, M, PD, S, SS, TC

CD, consultant days; E, equipment; H, honoraria; IMCI, Integrated Management of Childhood Illness programme; M, maintenance; MC, meeting costs; PD, per diems; PM, printing materials; S, supplies; SE, supportive supervision expenses; SS, incremental staff salaries for additional recruited staff; TC, travel costs.

<sup>a</sup> All except PM and S are not considered fully tradable goods and are adjusted to country-specific prices.

### Estimating country-specific costs

All four models use a standardized WHO ingredients approach (cost = quantity \* price) to derive country-specific cost estimates. Costs are classified as “patient costs” or “programme costs” (Table 2). Patient costs refer to costs at the point of delivering services to the client; they include outpatient visits, inpatient bed days and the use of drugs, supplies and laboratory tests. Programme costs are expenses incurred at the administrative levels of the district, province or country.<sup>17</sup>

The quantities of inputs needed for patient care were defined according to WHO's treatment protocols and

guidelines for prevention. The inputs essential to strengthening programmes and delivery systems were based on experts' opinions of the minimum requirements for efficient programme management and related assumptions for health-system requirements. Estimates did not account for storage, loss or waste of drugs and supplies, for the construction of new facilities or for the “production” of incremental multipurpose health professionals to provide facility-based care.

The cost for community health workers' honoraria, equipment and support were included in programme costs because the need for community health workers was calculated from population

density rather than from the number of consultations with patients. Community health workers were assumed to be fully funded by the child health programme, with an estimated need for 1 community health worker per 1000 population in rural areas and 1 per 1500 population in urban areas. Based on experts' opinions, costs were adjusted for an attrition rate of community health workers of 25% per year.

Prices were derived from WHO's Choosing Interventions that are Cost Effective (WHO-CHOICE) database<sup>18</sup> and the Disease Control Priorities Project,<sup>19</sup> except for drugs, where the median prices reported by Management Sciences

for Health's *International drug price indicator guide* are used.<sup>20</sup> Catalogues were used to determine the prices of larger equipment.

Costs are presented in 2004 US dollars, include a 3% annual inflation rate and are estimated by input category, intervention, country and year. Costs reflect a supply-side perspective using public provider prices; they do not include households' costs related to health-seeking behaviour or accessing services.

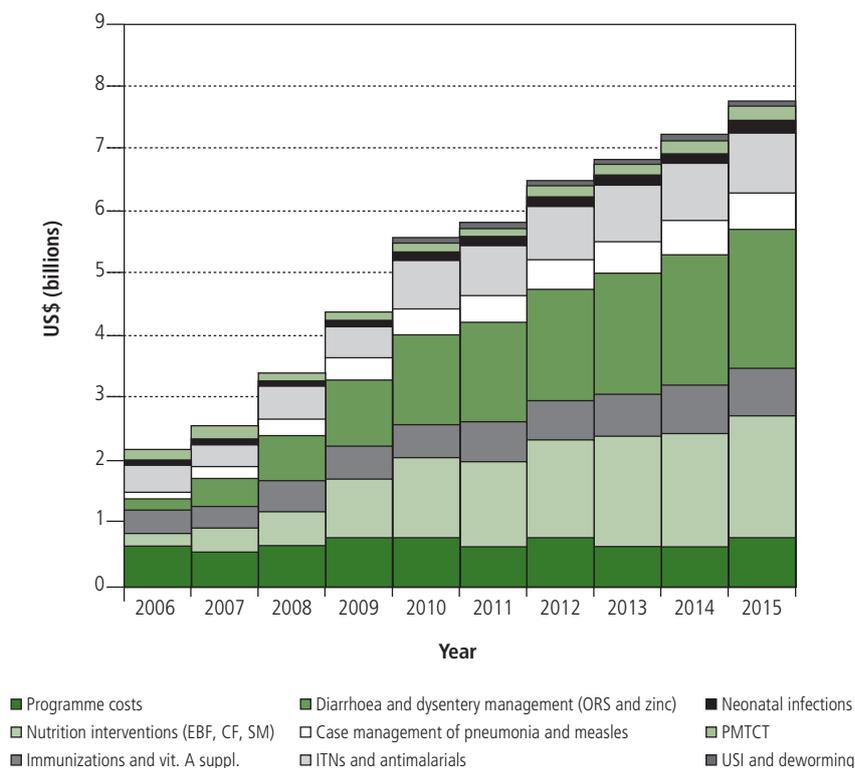
## Findings

The total additional cost for implementing the scale-up scenarios was estimated to be US\$ 52.4 billion. Fig. 1 shows the breakdown of costs for each set of interventions by year. We estimated the need in 2006 at US\$ 2.2 billion, which would increase to US\$ 7.8 billion by 2015. While the costs for immunization, preventing mother-to-child transmission of HIV, treating and preventing malaria and programme support activities remain relatively stable, the cost of scaling up nutrition interventions, and the case management of neonatal infections, pneumonia and diarrhoea increase sharply over time. This reflects the relatively higher current levels of investment for some of the former interventions (immunization and treating and preventing malaria) and poor initial coverage for some of the latter interventions (such as nutritional counselling and case management of neonatal illness). The relatively high cost of diarrhoea case management compared with pneumonia is explained by the liberal distribution of oral rehydration salts and zinc in the model versus the more restricted inclusion of oxygen costs for treating pneumonia. Programmatic investments remain relatively stable throughout the period, illustrating the economies of scale of using an integrated approach.

The average additional cost per capita for all 75 countries was US\$ 0.47 in 2006; this rises to US\$ 1.46 in 2015. The average investment required per child in 2015 at full coverage is an extra US\$ 12.31 (range: US\$ 10.35–17.78 for all index categories).

The 13 countries in the group with the most favourable environment for scale-up (those classified as index category 4) account for half the global

Fig. 1. Yearly breakdown of additional costs of increasing the coverage of child health interventions to reach universal coverage by 2015



CF, counselling for improved complementary feeding; EBF, counselling for promotion of exclusive and continued breastfeeding; ITNs, insecticide treated bednets; ORS = Oral Rehydration salts; PMTCT, prevention of mother-to-child transmission of HIV by antiretroviral prophylaxis and infant feeding and counseling; SM, case management of severe malnutrition; USI, universal salt iodization.

price tag (Table 3). This group includes countries with large populations, such as China and India. Yet on a population basis, the incremental investment needed is less than half that of countries in index category 1 (Fig. 2). The more developed health systems, which occur in many middle-income countries, need to spend a relatively larger proportion of their additional expenditures on human resources. (Note that the salary costs for health workers for all countries are likely to be underestimated, given that no adjustments were made for the need to raise salaries in low-income countries to recruit and retain the necessary human resources.)

In index categories 1 and 2, where conditions currently are the most challenging, an additional US\$ 21 billion is required. These are low-income countries with high mortality rates, low health-care coverage and relatively weak health systems. However, in these countries the prices of labour and supplies are comparatively low. Considerable investments will need to be made not only in commodities but also to expand human resources.

The additional resources needed in 2015 correspond to a mean 2% increase and a (population-weighted) average 8% increase in total expenditures on health in the 75 countries from all financial sources (range 0–168%). Similarly, projected costs in 2015 are equivalent to raising (population-weighted average) general government health expenditure by 26% over 2002 levels.<sup>21</sup> (The latest data available at the time of the study were for 2002.) Although the total resource requirements are highest in countries in index category 4, the implications for financing are less severe for these countries. The average additional cost (weighted by population) per capita in these countries (US\$ 1.00) is less than a third of that needed in countries in index category 1 (US\$ 3.40); Fig. 3 illustrates that this is a manageable increase in current expenditures for higher index countries 3 and 4, but that countries with weaker health systems may experience difficulties in mobilizing domestic public funds for scaling up child health services, given the large relative increase in expenditure required (21% in category 2 countries; 74% in category 1 countries).

Table 3. Estimated cost of scaling up child-health interventions, 2006–2015 (US\$)

Index category <sup>a</sup>	No. of countries	Estimated additional cost (millions of US\$)	% of total costs	% of children < 5 years included	% of global mortality among children < 5 years	Average total health expenditure per capita <sup>b,c</sup>	Average general government health expenditure per capita <sup>b,c</sup>	Weighted average incremental cost per capita <sup>c</sup> in 2015	Average incremental cost per child < 5 years in 2015
1	22	11 667	22	17	32	14.62	4.60	3.41	17.78
2	19	8 994	17	18	20	41.09	9.51	2.01	12.77
3	20	5 537	11	10	8	35.49	15.54	1.51	11.83
4	14	26 241	50	55	35	73.01	27.82	1.01	10.35
All 75 countries	75	52 440	100	100	94	59.93	22.17	1.46	12.31

<sup>a</sup> The Commission on Macroeconomics and Health's index classifies countries' health systems into four different levels of strength, with lower numbers indicating greater need for incremental investments. See text for further details.

<sup>b</sup> For data on total health expenditure and general government health expenditure, refer to the tables on National Health Accounts in the annexes to the *World health report 2005: make every mother and child count*.<sup>3</sup> Data here are from 2002, which was the latest data set available at the time of this study.

<sup>c</sup> Average health expenditure per capita and average incremental cost per capita and per child were weighted by the year-specific population for each country.

## Discussion

The numbers presented here are intended to be approximate estimates for donors, multilateral agencies and countries to help them determine the financial resources needed to scale up child health programmes with the aim of reaching the fourth Millennium Development Goal by 2015. Members of the Bellagio group estimated that scaling up health services for children, mothers and newborns in 42 countries would reduce mortality among children aged < 5 years by two-thirds.<sup>1</sup> The cost estimate presented here for child health interventions includes 41 of those 42 countries – accounting for 92% of the estimated costs – plus an additional 34 countries – accounting for 8% of the estimated costs. The impact of scaling up the interventions presented here as calculated by the Bellagio group corresponds to a 50% reduction in global deaths among children aged < 5 years.

Our objective is to provide order of magnitude projections based on the available data. While the estimates provide a basis for obtaining additional resources, this study has not been validated by consultation with countries, and the limitations outlined below should be kept in mind.

## Limitations

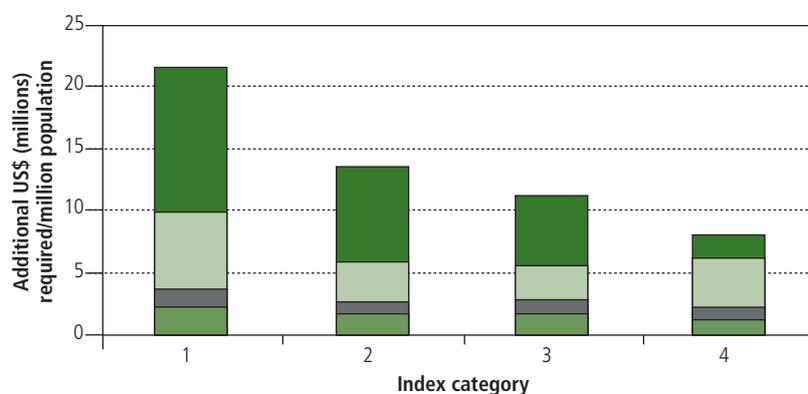
These estimates reflect WHO's recommended treatment protocols, which in reality are subject to different degrees of compliance. The effect of delivery assumptions is considerable, in particular the reliance on community-based delivery for rapid scale-up. Costs will

increase if countries place less emphasis on delivery at the community level and more on investments at facility level. To assess the impact of delivery assumptions on costs, two alternative scenarios were developed that placed a much greater emphasis on community-based or facility-based delivery. Applying the two alternative scenarios resulted in a range of total costs from US\$ 49 billion to US\$ 113 billion. The high-end estimate occurs when 80% of the interventions are delivered at the facility level. The greatest increase in resource needs is the cost of managing suspected sepsis at the first referral level inpatient

department rather than at community level. (More information on coverage assumptions is available from the corresponding author.)

No uncertainty analysis or sensitivity analysis was undertaken for this study since such assessments are better performed at the national level, where scenarios can be adapted to local contexts. We recognize the need for countries to make their own estimates for purposes of local planning for delivery of child health services; WHO is developing a national cost estimation tool for child health that will be ready for use by countries later in 2007.

Fig. 2. Incremental expenditures required for each Commission on Macroeconomics and Health index category, by cost category, 2006–2015 (simple averages, no population weighting)



■ Commodities (lab tests, drugs and supplies)<sup>a</sup>

■ Salaries (professional health workers)<sup>b</sup>

■ Community health workers<sup>c</sup>

■ Programme costs<sup>b</sup>

<sup>a</sup> Cost components are considered fully tradable. International prices have been used.

<sup>b</sup> Cost components are partially tradable. Salary costs have been adjusted to country-specific prices.

<sup>c</sup> Cost components (salaries) are not considered fully tradable in the short term. Costs have been adjusted to country-specific prices.

The limited information available on incidence, coverage and delivery strategies necessitates dependence on assumptions, expert opinion and proxy indicators. Information gaps are a cause for concern when developing global or national strategies to reach the fourth Millennium Development Goal; these data limitations will be specified in a subsequent publication.

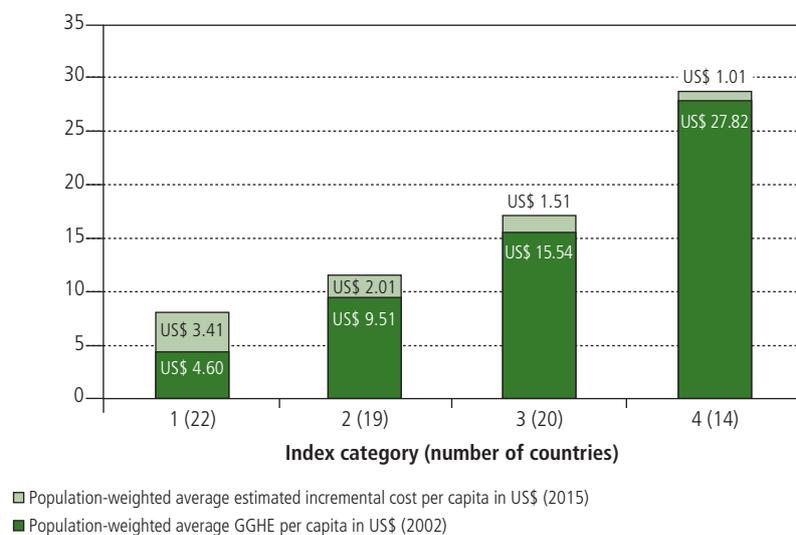
The utilization of four different models to assess intervention-specific costs is less of a concern, since the models use similar approaches and care was taken to ensure there was minimal overlap of programme support costs. The restricted possibilities of adjusting for multiple diagnoses remain a problem. Better evidence on co-diagnosis and co-treatment is required to adjust the costs of human resources to reflect integrated management in future cost assessments.

Moreover, the models are not able to fully account for interactions between prevention and treatment. Over a longer time frame, the interaction of different interventions and their impact on disease epidemiology should result in fewer children needing curative care, thus lowering costs. Another limitation is the assumption that prices remain constant; we did not adjust for increasing marginal costs or economies of scale.

This costing reflects the perspective of a public health provider. Demand-side barriers are assumed to be addressed through communication interventions and community-based delivery, but the model does not consider activities that explicitly aim at improving the ability of the poor to access care, such as health financing initiatives. Moreover, any costs of overcoming system-wide constraints facing health systems, such as an inability to produce and maintain health professionals, are not addressed. These will not be particular to child health programmes but need to be part of an effort undertaken throughout the wider health system.

Although the scaling-up of child health programmes will occur in a broader development context, this study has not accounted for interactions between child health programmes and sectors related to other Millennium Development Goals, such as the seventh goal to improve water and sanitation and the use of solid fuels, or the first goal, which aims to reduce poverty.

Fig. 3. Incremental expenditures in US\$ required in 2015 to increase the coverage of child health interventions above current average general government health expenditure (GGHE) per capita, by Commission on Macroeconomics and Health index category



### Implications

This study demonstrates that providing universal coverage of key child survival interventions throughout a health system is financially attainable at an additional cost of US\$ 1.46 per capita in 2015. This cost appears low, yet it corresponds to an average increase in total funding for health of 8%, or an increase in general government health expenditure by 26% if services are provided through the public sector. These values reflect the relatively low levels of current public health expenditure in these countries and indicate that countries with weak health systems may experience difficulties mobilizing enough public funds domestically.

The costing confirms the need for additional health workers. Translating additional health-worker time into full-time equivalent years of work indicates that globally at least 100 000 new health workers would be needed in 2015 at the facility level to scale up coverage (calculations not shown). Given that most health workers do not spend all their time on child health,<sup>22</sup> the actual increase in multipurpose health professionals may be two to four times greater, and will occur in addition to the large investments that are needed to develop networks of community health workers. Moreover, the current low salaries of health workers may need to be significantly increased. Projected costs would increase by 25% were salary costs to double.

Assumptions made for scale-up scenarios have different implications for different interventions. While 95% coverage of management of pneumonia and diarrhoea may seem realistic given current coverage levels, which are above 50% in many countries, the success of nutrition interventions will depend on the development of well-designed counselling programmes as well as the general availability and affordability of food. Moreover, there is an overlap between vertical disease programmes at the country level. For example, of the additional US\$ 12.31 required per child aged < 5 years, 18% could be attributed to malaria programmes and another 12% to immunization programmes.

Mechanisms for financing the scaling-up of interventions as presented here will vary from country to country. Current efforts related to HIV, malaria and tuberculosis demonstrate that additional funds for priority health problems can be mobilized within a short time frame.<sup>23</sup> Countries themselves can mobilize a good proportion of funds. Reprioritization within current budgets may also contribute substantially towards reducing mortality among children aged < 5 years at low incremental cost; experiences in the United Republic of Tanzania have shown this.<sup>15,24</sup> However, as stated by the Commission on Macroeconomics and Health, continued external financial assistance may be needed to scale up the provision of essential health services, in particular for low-income countries.<sup>25</sup>

This paper specifies the required funds for interventions aimed at improving child survival and highlights the sizeable increase in funds needed in countries with weak health systems. The estimates serve as a reminder of the importance of the eighth Millennium Development Goal, which aims at developing a global partnership for development, and underlines the need to raise additional resources for child health programmes in order to reach universal coverage of key child survival interventions at low additional costs. ■

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## Résumé

### Marche à suivre sur le plan financier pour la mise à l'échelle nationale des interventions essentielles pour la santé infantile dans 75 pays

**Objectif** Évaluer les ressources supplémentaires requises pour la mise à l'échelle nationale d'interventions destinées à réduire la morbidité et la mortalité infantiles, conformément au quatrième objectif du Millénaire pour le développement, qui prévoit de faire baisser de deux tiers la mortalité des enfants de moins de 5 ans d'ici 2015.

**Méthodes** Un modèle d'évaluation des coûts a été mis au point pour obtenir une estimation des moyens financiers nécessaires dans 75 pays pour étendre à l'échelle nationale des interventions prioritaires s'attaquant aux causes majeures de mortalité chez les enfants de moins de 5 ans, dont la malnutrition, la pneumonie, la diarrhée, le paludisme et d'autres causes importantes de décès pour les nouveau-nés, telles que la septicémie. Des calculs effectués selon des approches ascendantes et par composants ont permis d'estimer les coûts financiers par intervention, par pays et par an. Ces coûts prennent en compte les recommandations de l'OMS sur les intrants et les stratégies de mise en œuvre des interventions et couvrent cette mise en œuvre aux niveaux des communautés et des établissements de soins. Ils incluent aussi les investissements programmatiques nécessaires à l'échelle du pays et des districts.

**Résultats** Le scénario de mise à l'échelle prévoit un coût supplémentaire de US \$ 52,4 milliard pour la période 2006-2015. Ce coût représente une augmentation des dépenses de santé totales par habitant dans ces 75 pays de US \$ 0,47 pour 2006, chiffre qui devrait passer à US \$ 1,46 pour 2015, d'après les projections. Les coûts projetés pour 2015 correspondent à une augmentation des dépenses totales moyennes de santé de 8 % pour l'ensemble des sources de financement des 75 pays et de 26 %, par rapport aux chiffres de 2002 (dernière année pour laquelle on disposait de données pendant l'étude), pour les dépenses générales de santé couvertes par les États. D'après le scénario de mise à l'échelle, les pays dont le système de santé est encore faible pourraient avoir des difficultés à mobiliser au niveau national des fonds publics suffisants.

**Conclusion** Bien que les résultats de cette étude soient des estimations grossières, ils font apparaître un important déficit de capacités d'investissement, que les pays à revenu faible ou moyen et leurs partenaires de développement devront combler pour atteindre le quatrième objectif du Millénaire pour le développement.

## Resumen

### Hoja de ruta financiera para expandir las intervenciones de salud infantil esenciales en 75 países

**Objetivo** Estimar los recursos adicionales requeridos para expandir las intervenciones encaminadas a reducir la mortalidad y la morbilidad en la niñez en el contexto de la meta del cuarto Objetivo de Desarrollo del Milenio de reducir la mortalidad entre los menores de cinco años en dos tercios para el año 2015.

**Métodos** Se elaboró un modelo de cálculo de costos para estimar los recursos financieros que se necesitaban en 75 países para expandir intervenciones prioritarias que abordan las principales causas de mortalidad entre los menores de cinco años, entre ellas la malnutrición, la neumonía, la diarrea, la malaria y causas importantes de mortalidad neonatal como la septicemia. Las estimaciones se llevaron a cabo mediante métodos microeconómicos y basados en componentes, lo que permitió estimar los costos financieros para cada intervención, país y año. Los costos reflejan las directrices de la OMS sobre los insumos y las estrategias de ejecución y abarcan la aplicación de intervenciones a nivel de comunidad y de servicio. Esos costos incluyen también las inversiones específicas de programa necesarias a nivel

nacional y de distrito.

**Resultados** El escenario de expansión prevé que se necesitarán US\$ 52 400 millones más para el periodo 2006-2015. Ello representa un aumento del gasto sanitario per cápita total en los 75 países de US\$ 0,47 en 2006, y según las proyecciones la cifra aumentaría a US\$ 1,46 en 2015. Los costos previstos para 2015 equivalen a aumentar el gasto sanitario total medio con cargo a todas las fuentes de financiación en los 75 países en un 8%, y el gasto del gobierno general en salud en un 26%, respecto a los niveles de 2002. (Los últimos datos disponibles en el momento de realizar el estudio eran los de 2002.) El escenario de expansión indica que los países con sistemas de salud precarios pueden tener dificultades para movilizar suficientes fondos públicos nacionales.

**Conclusión** Si bien se trata de estimaciones aproximadas, los resultados muestran un déficit considerable de inversión que los países de ingresos bajos y medios y sus asociados para el desarrollo deberán subsanar para alcanzar el cuarto Objetivo de Desarrollo del Milenio.

## ملخص

## خارطة طريق مالية للنهوض بالمدخلات الأساسية لصحة الطفل في 75 بلداً

الصحة للاستثمار الخاص في برامج معينة.

**الموجودات:** يتوقع سيناريو النهوض بالمدخلات الاحتياج إلى 25.4 بليون دولار إضافية للفترة 2006 – 2015. ويمثل هذا المبلغ زيادة في الإنفاق الصحي الإجمالي للفرد في البلدان الخمسة والسبعين، مقدارها 0.47 دولار في عام 2006. ويتوقع أن يزداد هذا المبلغ إلى 1.46 دولار في عام 2015. وتتساوى التكاليف المتوقعة في عام 2015 مع زيادة مقدارها 8% في متوسط الإنفاق الإجمالي على الصحة من جميع المصادر الصحية في البلدان الخمسة والسبعين، ومع زيادة مقدارها 26% في الإنفاق الحكومي العام على الصحة بالمقارنة مع مستويات عام 2002 (وقد كانت أحدث البيانات المتاحة في وقت الدراسة تعود إلى عام 2002). ويشير سيناريو النهوض إلى أن البلدان ذات النظم الصحية الضعيفة قد تواجه صعوبات في حشد الاعتمادات المالية المحلية العامة الكافية.

**الاستنتاج:** برغم أن النتائج هي مجرد تقديرات تقريبية، إلا أنها تبين وجود فجوة كبيرة تحتاج البلدان ذات الدخل المنخفض والمتوسط، وشركاؤهم في التنمية، إلى سدها لكي تحقق المرمى الرابع من المرامي الإنمائية للألفية.

**الغرض:** استهدفت هذه الدراسة تقدير الموارد الإضافية اللازمة للنهوض بالمدخلات الرامية إلى تخفيض معدل الوفيات والمراضة لدى الأطفال، في إطار المرمى الرابع من المرامي الإنمائية للألفية، والذي يهدف إلى تخفيض معدل وفيات الأطفال الأقل من عمر خمس سنوات بنسبة الثلث بحلول عام 2015.

**الطريقة:** تم إعداد نموذج لحساب التكاليف، لتقدير الموارد المالية اللازمة في 75 بلداً للنهوض بالمدخلات ذات الأولوية التي تتصدى للأسباب الرئيسية للوفيات بين الأطفال الأقل من عمر خمس سنوات. وتشمل هذه الأسباب: سوء التغذية، والالتهاب الرئوي، والإسهال، والملاريا، إضافة إلى المسببات الرئيسية للوفيات بين حديثي الولادة، مثل الإنتان. وأجريت العمليات الحسابية باستخدام الأسلوب المتدرج من القاعدة إلى القمة، والأسلوب المرتكز على المكونات. وأتاح ذلك إمكانية تقدير التكاليف المالية لكل مداخلة ولكل بلد ولكل سنة. تتفق هذه التكاليف مع الدلائل الإرشادية التي وضعتها منظمة الصحة العالمية، والمتعلقة بالمدخلات واستراتيجيات إيتاء الخدمات، وهي تشمل تقديم المدخلات على مستوى المجتمع ومستوى المرفق الصحي كما تشمل هذه التكاليف اللازمة على المستوى الوطني ومستوى المنطقة

## References

- Jones G, Steketee RW, Black RE, Bhutta ZA, Morris SS, Bellagio Child Survival Study Group. How many child deaths can we prevent this year? *Lancet* 2003;362:65-71.
- Edejer TT, Aikins M, Black R, Wolfson L, Hutubessy R, Evans DB. Cost effectiveness analysis of strategies for child health in developing countries. *BMJ* 2005;331:1177-83.
- World health report 2005: make every mother and child count. Geneva: WHO; 2005.
- Sachs J, McArthur J, Schmidt-Traub G, Bahadur C, Faye M, Kruk M. Millennium Development Goals needs assessments: country case studies of Bangladesh, Cambodia, Ghana, Tanzania and Uganda, 2004. Available from: [http://www.unmillenniumproject.org/documents/mp\\_ccs\\_paper\\_jan1704.pdf](http://www.unmillenniumproject.org/documents/mp_ccs_paper_jan1704.pdf)
- Kumaranyake L, Kurowski C, Conteh L. Costs of scaling up priority health interventions in low-income and selected middle-income countries: methodology and estimates. Commission on Macroeconomics and Health Working Paper No. WG5:18. Geneva: WHO; 2001.
- Bryce J, Black RE, Walker N, Bhutta ZA, Lawn JE, Steketee RW. Can the world afford to save the lives of 6 million children each year? *Lancet* 2005; 365:2193-2200.
- Methodology and assumptions used to estimate the cost of scaling up selected child health interventions. Geneva: WHO; 2005. Available from: [http://www.who.int/whr/2005/technical\\_documents/en/index.html](http://www.who.int/whr/2005/technical_documents/en/index.html)
- Wolfson L, Lydon P. Methods for estimating global immunization costs and impact, 2000-2015. Geneva: WHO; 2006.
- Kiszewski A et al. An estimate of the global costs of intensified interventions. Boston: Harvard School of Public Health, draft report; 14 February 2005.
- Constella Futures. Resource needs for HIV/AIDS: model for estimating resource needs for prevention, care, and mitigation, 2005. Available from: <http://www.constellafutures.com/Resources.cfm?area=2a&get=Resource%20Needs>
- Johns B, Sigurbjörnsdóttir K, Fogstad H, Zupan J, Mathai M, Tan-Torres Edejer T. Estimated global resources needed to attain universal coverage of maternal and newborn health services. *Bull World Health Organ* 2007;85:256-263.
- Darmstadt GL, Bhutta ZA, Cousens S, Adam T, Walker N, de Bernis L. Evidence-based, cost-effective interventions: how many newborn babies can we save? *Lancet* 2005;365:977-88.
- El Arifeen S, Blum LS, Hogue DM, Chowdhury EK, Khan R, Black RE, et al. Integrated Management of Childhood Illness (IMCI) in Bangladesh: early findings from a cluster-randomised study. *Lancet* 2004;364:595-602.
- Gouws E, Bryce J, Habicht JP, Amaral J, Pariyo G, Schellenberg JA, et al. Improving antimicrobial use among health workers in first-level facilities: results from the multi-country evaluation of the Integrated Management of Childhood Illness strategy. *Bull World Health Organ* 2004;82:509-15.
- Armstrong Schellenberg JRM, Adam T, Mshinda H, Masanja H, Kabadi G, Mukasa O. et al. Effectiveness and cost of facility-based Integrated Management of Childhood Illness (IMCI) in Tanzania. *Lancet* 2004; 364:1583-94.
- Ranson MK, Hanson K, Oliveira-Cruz V, Mills A. Constraints to expanding access to health interventions: an empirical analysis and country typology. *J Int Dev* 2003;15 (1):15-39.
- Johns B, Baltussen R, Hutubessy R. Programme costs in the economic evaluation of health interventions. *Cost Eff Resour Alloc* 2003;1(1):1.
- World Health Organization. *Choosing interventions that are cost-effective (WHO-CHOICE)*, 2000. Available from: <http://www.who.int/choice/en/>
- Mulligan J, Fox-Rushby JA, Adam T, Johns B, Mills A. *Unit costs of health care inputs in low- and middle-income regions*, 2003. Disease Control Priorities Project Working Paper No. 9. Available from: <http://www.dcp2.org/file/24/wp9.pdf>
- Management Sciences for Health. *International drug price indicator guide*, 2004. Available from: <http://erc.msh.org/dmpguide/>
- National health accounts, 2007. Geneva: WHO. Available from: <http://www.who.int/nha>
- Adam T, Amorim DG, Edwards SJ, Amaral J, Evans B. Capacity constraints to the adoption of new interventions: consultation time and the Integrated Management of Childhood Illness in Brazil. *Health Policy Plan* 2005;20 Suppl 1:S49-57.
- A force for change: the Global Fund at 30 months. Global Fund to Fight AIDS, Tuberculosis and Malaria, 2004. Available from: <http://www.theglobalfund.org/en/about/publications/forceforchange/>
- De Savigny D, Kasale H, Mbuya C, Reid G. *Fixing health systems*, 2004. Available from: [http://www.idrc.ca/en/ev-64437-201-1-DO\\_TOPIC.html](http://www.idrc.ca/en/ev-64437-201-1-DO_TOPIC.html)
- Commission on Macroeconomics and Health. *Macroeconomics and health: investing in health for economic development. Report of the Commission on Macroeconomics and Health*. Geneva: WHO; 2001.

Annex 1. List of countries included in the global price tag for scaling up coverage of child-health interventions

Country	Index category <sup>a</sup>	Mortality rate for children < 5 years <sup>b</sup>	Thousands of deaths among children < 5 years	% of deaths among children < 5 years <sup>b</sup>
Afghanistan	1	257.0	263.8	3
Angola	1	263.0	171.4	2
Azerbaijan	3	75.3	9.4	0
Bangladesh	2	72.3	302.2	3
Benin	1	162.1	42.5	0
Bhutan	2	92.6	6.9	0
Bolivia	3	75.6	19.1	0
Brazil	4	38.4	133.6	1
Burkina Faso	2	224.2	133.4	1
Burundi	1	183.3	50.1	0
Cambodia	3	136.9	63.7	1
Cameroon	2	160.2	88.0	1
Central African Republic	1	180.5	25.8	0
Chad	1	191.0	72.0	1
China	4	36.0	727.3	7
Comoros	2	76.1	2.0	0
Congo	2	105.1	15.9	0
Côte d'Ivoire	1	168.2	97.6	1
Democratic Republic of the Congo	1	209.7	488.3	5
Djibouti	2	149.9	3.9	0
Egypt	4	38.4	69.9	1
Equatorial Guinea	2	150.9	2.9	0
Eritrea	1	109.5	16.8	0
Ethiopia	1	176.9	508.9	5
Gabon	4	89.7	3.8	0
Gambia	4	124.8	6.1	0
Ghana	3	102.8	65.7	1
Guatemala	3	53.9	22.0	0
Guinea	3	157.9	53.1	1
Guinea-Bissau	1	206.5	14.0	0
Guyana	4	55.4	0.9	0
Haiti	1	133.2	34.3	0
India	4	90.9	2317.2	22
Indonesia	3	40.8	18.2	0
Iraq	1	115.1	99.4	1
Kenya	2	116.0	121.8	1
Kazakhstan	3	33.4	8.4	0
Kyrgyzstan	3	59.1	6.4	0
Lao People's Democratic Republic	2	138.8	27.2	0
Lesotho	3	163.4	9.0	0
Liberia	1	232.4	37.5	0
Madagascar	2	135.2	91.9	1
Malawi	3	193.3	101.2	1
Mali	1	228.4	139.2	1
Mauritania	1	170.8	19.4	0
Mexico	4	27.2	62.2	1
Morocco	4	42.1	28.8	0
Mozambique	2	206.4	152.6	1
Myanmar	2	106.2	119.9	1
Namibia	4	94.8	6.2	0
Nepal	2	84.2	66.6	1

(Annex 1, cont.)

Country	Index category <sup>a</sup>	Mortality rate for children < 5 years <sup>b</sup>	Thousands of deaths among children < 5 years	% of deaths among children < 5 years <sup>b</sup>
Nicaragua	3	38.1	6.5	0
Niger	1	252.5	151.3	1
Nigeria	1	182.0	861.3	8
Pakistan	2	110.0	570.0	5
Papua New Guinea	3	95.1	16.4	0
Peru	3	36.2	22.8	0
Philippines	4	36.1	72.6	1
Rwanda	3	178.2	61.9	1
Senegal	2	133.8	47.6	0
Sierra Leone	1	317.3	71.5	1
Somalia	1	220.6	104.5	1
South Africa	4	83.5	86.3	1
Sudan	2	108.6	115.7	1
Swaziland	3	145.9	5.4	0
Tajikistan	3	62.9	9.8	0
United Republic of Tanzania	3	153.7	216.2	2
Timor-Leste		125.5	2.2	0
Togo	2	138.1	24.8	0
Turkey	4	43.2	56.9	1
Uganda	2	142.2	169.2	2
Viet Nam	4	37.0	56.8	1
Yemen	1	100.2	82.6	1
Zambia	3	183.8	81.0	1
Zimbabwe	3	111.5	46.2	0
Total			9 887.8	
% of total deaths				94.2
Total no. deaths globally			10 494 737	

<sup>a</sup> The Commission on Macroeconomics and Health index classifies countries' health systems into four different levels of strength, with lower numbers indicating greater need for incremental investments. See text for further details. Also, see Table 6 in reference 16 for further information.

<sup>b</sup> Probability of dying (per 1000) based on WHO data from 2002, which was the latest data set available at the time of this study.