Methodology and Assumptions used to estimate the Cost of Scaling Up selected Child Health Interventions

Technical working document

Department of Child and Adolescent Health and Development
and
Department of Health System Financing

World Health Organization March 2005
Table of contents

Executive Summary .............................................................................................................4
Acronyms ............................................................................................................................6
1 Introduction ......................................................................................................................7
2 Setting the parameters .................................................................................................8
   2.1 Target coverage and year .......................................................................................8
   2.2 List of countries .....................................................................................................8
   2.3 List of interventions ...............................................................................................9
   2.4 Delivery mechanisms ............................................................................................9
3 Overview of methodology .............................................................................................10
   3.1 Costing models used .............................................................................................10
   3.2 Definition of inputs ...............................................................................................11
   3.3 Country classification, scaling-up patterns and system inputs ..............................13
   3.4 Defining the population in need ..........................................................................14
   3.5 Current coverage ..................................................................................................15
4 Results ...........................................................................................................................16
   4.1 Breakdown of costs per input category .................................................................16
   4.2 Breakdown of costs per intervention and programme component .......................17
   4.3 Breakdown of costs per CMH region ....................................................................17
   4.4 Breakdown of costs per delivery level ..................................................................19
5. Discussion of methodology and results.......................................................................26
   5.1 Limitations of the methodology used .................................................................26
   5.2 Towards the MDG of reducing under-five mortality ............................................28
   5.3 Policy implications ...............................................................................................29
Annex 1 List of countries included in the cost analysis ....................................................33
Annex 2 Scale-up patterns .................................................................................................35
Annex 3 Key assumptions underlying patient costs: population in need and inputs per intervention .................................................................................................................................37
Annex 4 Child health interventions by delivery level .......................................................49
Annex 5 Estimating current coverage and target coverage by delivery point .................56
Annex 6 Key assumptions underlying programme costs .................................................60
Annex 7 Adjustment of population data ..........................................................................71
Annex 8 Estimated cost of F-75 and F-100 for feeding hospitalized children with severe malnutrition ....................................................................................................................72
Annex 9 Estimates of incremental human resources needed to scale up key child health interventions to 95% coverage at the health facility level ...............................................................73
Annex 10 Breakdown of costs per WHO GBD region .....................................................79
List of Boxes, Tables and Figures

Box 1  Policy messages from the cost analysis .......................................................... 5
Box 2  Criteria used to select countries included in the cost analysis ....................... 8
Box 3  Seven core intervention sets to improve child survival ................................. 10
Box 4  Definitions for desegregation of cost data ...................................................... 13
Box 5  Desegregation of cost data ........................................................................... 16
Box 6  Summary of policy implications from the cost analysis ................................. 30

Table 1. Sixteen cost-effective core intervention categories to improve child-survival 9
Table 2  Burden of disease and cost per intervention .................................................. 22
Table 3  Estimated additional costs related to current expenditures on health .......... 23

Figure 1. Cumulative cost of scaling up child health interventions, additional to current expenditure, by input category .......................................................... 17
Figure 2  Cost per intervention and programme cost category .................................. 18
Figure 3  Scaling up programme cost over years 2006-2015 (in US$ millions) .......... 19
Figure 4  Cost per intervention, years 2006 and 2015, in US$ millions .................... 20
Figure 5  Costs per capita per year per CMH category ............................................. 23
Figure 6  Relative expenditure required per input category (in millions US$ ) ............ 25
Figure 7  Estimated incremental costs per level of delivery ....................................... 25
Executive Summary

The World Health Report 2005 presents the incremental expenditures required to scale up selected child health interventions in 75 countries with 94.2% of the global burden of under-five mortality in year 1992. This paper reports on the methodology and assumptions used to derive these financial cost estimates, incremental to current investments.

The costs of delivering selected interventions and services were estimated annually over the period 2006-2015 and per country, based on an ingredients approach. They reflect a continuum of care throughout the health system, with investments at the levels of the community, primary health care facility, and first referral care facility, as well as national policy and legislation. Costs were estimated for 16 priority interventions, selected based on their feasibility of implementation and ability to reduce child mortality and morbidity. These interventions can be further regrouped into seven strategic intervention sets.

The sum of the additional costs for implementing the scaling-up scenarios is estimated to be US$ 52.4 billion. We estimate the need in 2006 to be US$ 2.2 billion, increasing to US$ 7.8 billion by 2015. Of the total, US$ 25.1 billion (48%) are costs for delivering services, most of which is wages and honorariums. US$20.4 billion (39%) are the estimated costs for drugs, supplies and lab tests, whereas the remaining US$7 billion (13%) are programme and health systems costs.

Sub-Saharan Africa (WHO's African region) accounts for 42% of all under-five deaths globally.1 In this cost estimate, 40 countries from this region were included, together accounting for 32% of estimated costs. WHO's South East Asian region accounts for 29% of global under-five mortality, and here the 6 countries included in the costing contribute to 28% of costs. WHO's Eastern Mediterranean region is estimated to have contributed to 13% of under-five deaths in year 2002/2003: here the 9 countries included from the EMRO region account for 13% of costs. Latin America and the Caribbean account for 4% of under-five mortality and the 8 countries included give rise to 12% of costs. WHO's Western Pacific Region accounts for another 10% of child mortality and 12% of costs (7 countries included). Finally, WHO's European region contributes to 3% of under-five deaths and the five countries included in the costing account for 4% of costs.

On average for all 75 countries an annual additional expenditure per capita ranging from of US$ 0.47 in 2006 to US$ 1.48 in 2015, is required to sustain the scale-up. A comparison of the required incremental cost per country with the current general government health expenditure (GGHE), reveals that the estimated costs required are equivalent to an average increase in general government health expenditure by 8% in 2006, and by 26% in 2015, over current levels. In the group of countries with the weakest health systems, this would correspond to almost a doubling of average general government expenditure on health in 2015, for scaling up child health interventions alone. Although a substantial proportion of the funds required can be mobilized from within countries themselves, for the low-income countries there is a need for continued external financial assistance in order to scale up provision of essential health services.

1 Bryce J et al. In press.
Reprioritization within current budgets can also contribute significantly to a reduction in under-five mortality at low incremental cost, as shown by experiences in Tanzania.

To a large extent the financial estimates mirror the unaddressed mortality burden. With integrated delivery mechanisms, such as IMCI, investments in interventions addressing diarrhoea, ARI and malaria, would become highly efficient. Investments in specific interventions will need to change over time according to the size of the coverage gap, the modelled pace and pattern of closing the coverage gap, and the effects of scaling up, given different baseline coverage. For example, funds for the management of neonatal infections, breastfeeding and complementary feeding counselling, case management of diarrhoea, and acute respiratory infections need roughly a tenfold increase by 2015 from 2006 levels. Immunization and malaria interventions require an estimated two-fold increase over the same time period. The only intervention category that would require less funding in 2015 than in 2006 is the treatment of measles complications, indicating that prevention pays off in the long run.

The elements contributing to the cost of scaling up varies across regions; in low income countries the highest relative investments are needed in drugs, equipment and supplies, while in high income countries the required investments in human resources are substantial. Service delivery costs at facility level, which are mostly salaries, account for 49% of costs in the least constrained countries, while for the other categories of countries service delivery costs are less than 30%.

The implementation of these scale-up scenarios would not necessarily lead to every country realizing MDG4 by a two-third reduction in under-five deaths – but at a global level we would expect to see the goal met for the reduction in child mortality. This would however require substantial financial investments in countries currently with the least progress. Some significant policy messages from the cost analysis are summarized in Box 1 below.

**Box 1 Policy messages from the cost analysis**

- Investments in child health need to be increased substantially, up to a doubling of current overall general government expenditure on health in low income countries.
- Low income countries will continue to rely on external support to reach MDG4.
- Current financing mechanisms need to be strengthened to allow a sufficient supply of child health services (and their equitable use and to prevent financial hardship due to service use).
- If investments were brought in line with disease burden, countries could achieve a mortality reduction required for reaching the child mortality MDG.
- Investments in child health need to address the under five mortality burden better, with increased investments in sets of interventions, such as IMCI, that address the major burden due to malnutrition, newborn health problems, pneumonia and diarrhoea.
- Sustained investments in immunization substantially reduced the associated disease burden and need to be maintained.
- Community based delivery may be an alternative in countries where utilization of formal health services is low.
- The elements contributing to the cost of scaling up varies across regions; in low income countries the highest relative investments are needed in drugs, equipment and supplies and in high income countries in human resources.
## Acronyms

<table>
<thead>
<tr>
<th>Acronym</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ALRI</td>
<td>Acute lower respiratory infection</td>
</tr>
<tr>
<td>CHOICE</td>
<td>CHOosing Interventions that are Cost Effective (WHO)</td>
</tr>
<tr>
<td>CHW</td>
<td>Community Health Workers</td>
</tr>
<tr>
<td>CMH</td>
<td>Commission of Macroeconomics and Health (WHO)</td>
</tr>
<tr>
<td>DCPP</td>
<td>Disease Control Priorities Project</td>
</tr>
<tr>
<td>DHS</td>
<td>Demographic and Health Survey</td>
</tr>
<tr>
<td>EIP</td>
<td>Evidence and Information for Policy (WHO)</td>
</tr>
<tr>
<td>FCH</td>
<td>Family and Community Health (WHO)</td>
</tr>
<tr>
<td>GBD</td>
<td>Global Burden of Disease</td>
</tr>
<tr>
<td>GGHE</td>
<td>General Government Health Expenditure</td>
</tr>
<tr>
<td>HFS</td>
<td>Health System Financing (WHO)</td>
</tr>
<tr>
<td>IDD</td>
<td>Iodine Deficiency Disorder</td>
</tr>
<tr>
<td>IEC</td>
<td>Information, Education, Communication</td>
</tr>
<tr>
<td>IMCI</td>
<td>Integrated Management of Childhood Illness</td>
</tr>
<tr>
<td>IVB</td>
<td>Immunization, Vaccines and Biologicals (WHO)</td>
</tr>
<tr>
<td>MDG</td>
<td>Millennium Development Goal</td>
</tr>
<tr>
<td>M&amp;E</td>
<td>Monitoring &amp; Evaluation</td>
</tr>
<tr>
<td>MPS</td>
<td>Making Pregnancy Safer (WHO)</td>
</tr>
<tr>
<td>MSH</td>
<td>Management Sciences for Health</td>
</tr>
<tr>
<td>ORS</td>
<td>Oral Rehydration Salts</td>
</tr>
<tr>
<td>RBM</td>
<td>Roll Back Malaria (WHO)</td>
</tr>
<tr>
<td>U5MR</td>
<td>Under-Five Mortality Rate</td>
</tr>
<tr>
<td>WHO</td>
<td>World Health Organization</td>
</tr>
<tr>
<td>WHR</td>
<td>World Health Report (WHO)</td>
</tr>
</tbody>
</table>
1 Introduction

It is well-known that proven strategies, properly implemented, could prevent millions of child deaths every year. In many countries, coverage of well-known, cost-effective, and efficient interventions is often unacceptably low. Costing child health strategies and implementation plans is an essential prerequisite for the development of investment plans and the mobilization of resources, yet there is very little data on costs in the public domain. To set an agenda for action, estimates of incremental costs, rather than total costs, are most useful for health planners.

Below follows an overview of the assumptions used to estimate the cost of scaling up key child health interventions to universal coverage in 75 countries with high under-five mortality burden, for the years 2006-2015. The methodology used in this document reflects assumptions based upon data and evidence available and where absent, upon expert opinion of staff at the Department of Child and Adolescent Health and Development (CAH) of the World Health Organization (WHO). The development of a model for analysing the costs of scale-up additional to current expenditure was carried out in partnership with the Department of Health Systems and Financing (HSF) of WHO. The estimates presented here are built on the principle of a continuum of care throughout the health system, reflecting investments at the community levels, primary health care facility level, and first referral care level, as well as national policy and legislation for strategic intervention sets. The selected interventions were included based on their feasibility of implementation and ability to reduce child mortality and morbidity. In total, the estimated costs include 16 interventions, that can be regrouped into seven strategic intervention sets. Interventions are classified according to the illness/condition to which they refer and their level of delivery in the health system. The intent of this tool is not to encourage "verticalization" of activities but to provide a cost estimate of scale-up of child health interventions. Health systems costs were therefore based on a holistic perspective of health system requirements at all levels of care and shared with other programmes when deemed appropriate.

This exercise was designed in conjunction with a cost assessment for scaling up interventions related to maternal and neonatal health. This required that interventions were classified according to the time of their delivery. While care during the first week of life is provided by either maternal or child health services, or by both, in different settings, antenatal, delivery and immediate neonatal care is usually provided by maternal health services, with care during the late neonatal period usually provided by child health services. All interventions delivered to the mother and/or the child during pregnancy and at birth were assigned to maternal health costs. Interventions linked to complications of pregnancy and child birth were included among the costs of maternal and newborn health services, whereas the treatment of neonatal infections were assigned to child health costs. Other interventions of public health importance delivered to the child from after birth up to the age of five have been included in the child health costs.

Costs are based on country-specific estimates for 75 countries representing 94.2% of the global burden of under-five mortality. The estimates build on previous costing work by WHO Departments of Evidence and Information for Policy (EIP), Immunization, Vaccines and

---

Biologica (IVB), and Roll Back Malaria (RBM), and also take into account the findings presented by The Bellagio Child Survival Study Group. Costs are estimated with an ingredients approach, using country-specific prices and quantities of goods and services needed, based on best-practice care models and expert opinion.

2 Setting the parameters

2.1 Target coverage and year

The 2006-2015 time span refers to global commitments to reach the Millennium Development Goals by 2015, and the target coverage was set at universal coverage, here defined as 95%, in all 75 countries. High coverage will be reached by combining a number of delivery strategies. Thus, each point of delivery (community/ facility /referral level) was given separate target coverage levels for every intervention up to and including 2015.

2.2 List of countries

The list of countries included in the cost exercise was jointly determined by WHO departments of Child and Adolescent Health and Development (CAH) and Making Pregnancy Safer (MPS) based on current data on maternal, neonatal and child health. Criteria of mortality, income, and regional representation were used to select countries, as shown in Box 2 below.

Box 2 Criteria used to select countries included in the cost analysis

1. Countries ranked by the highest child mortality in numbers, which together account for 90% of under-five mortality.
2. Countries whose under-five mortality rates (U5MR) are greater than or equal to 100, and with a GNI per capita less than US$ 1000.
3. Countries with the highest maternal mortality ranked by the highest maternal mortality in numbers, which together account for 95% of maternal mortality.
4. Countries whose maternal mortality ratios (MMR) are greater than or equal to 200.
5. Countries with the highest number of feto-neonatal mortality (FNMR) based on the top numbers of total deaths in each country until 93% of deaths reached.
6. Countries whose feto-neonatal mortality rates (FNMR) are 30 and above/ 1000 births.
7. Countries with the highest mortality rates (both U5MR and MMR) from underrepresented regions in the list (three countries per WHO European (EURO), Americas (AMRO) and Eastern Mediterranean (EMRO) region were added to the list to balance regional representation).

These criteria produce a list of 75 countries (annex 1). Together these countries stand for a population of 4.6 billion, with 496 million under-fives, in 2005. They represent more than 75% of

---

4 As published in Jones G et al. (2003).
the world’s population, almost 90% of all births worldwide, and approximately 95% of all maternal, neonatal and under-five deaths (or 94.2% of all under-five deaths, 93.1% of feto-neonatal deaths and 97.5% of maternal deaths) in year 2002. All countries with a U5MR greater than or equal to 100 are included, as are all countries experiencing reversal, stagnation or slow progress in the reduction of under-five mortality rates. Similarly, all countries with a maternal mortality ratio greater than or equal to 200 have been included.

### 2.3 List of interventions

Table 1 provides the list of interventions, selected on the basis of mortality reduction, morbidity reduction, and feasibility of delivery.

**Table 1. Sixteen cost-effective core intervention categories to improve child-survival**

1. Promotion of exclusive and continued breastfeeding
2. Improvement of complementary feeding
3. Case management of severe malnutrition
4. Case management of pneumonia
5. Case management of diarrhoea
6. Antibiotic treatment for dysentery
7. Treatment of measles and measles complications
8. Case-management of suspected sepsis
9. Case management of malaria using anti-malarial drugs
10. Vitamin A supplementation
11. Immunization
12. Deworming
13. Prevention of mother to child transmission of HIV (PMTCT) \(^5\)
14. Insecticide treated bednets
15. Universal salt iodization

The list above can be referred to as intervention categories rather than single interventions, since most categories include costs for various activities carried out at different delivery points and for different severity of illness. Further, as illustrated in Box 3 they can be grouped into seven intervention sets. Individual interventions are further specified in Annex 3.

### 2.4 Delivery mechanisms

Interventions are assumed to be delivered at different levels of care simultaneously, and in an integrated manner where appropriate, in order to ensure optimal use of every health service contact to deliver complementary interventions to mothers and children. Thus, the risk of missed opportunities is minimized. For high and equitable population coverage, multiple delivery points

---

\(^5\) PMTCT could technically be included either under maternal or child health. Here it was included in the costing of child health as the total costs for this intervention are driven by interventions delivered after the first days of birth (replacement feeding) rather than by interventions delivered in the perinatal period (administration of ARV).
need to be explored, including in communities and in the formal and informal health sectors. In areas where access to health facilities is poor, reaching coverage of curative interventions will require outreach services by health professionals or provision by community workers of treatments for uncomplicated diarrhoea, pneumonia and malaria. Increased engagement of private health care providers and non-governmental organizations is also needed to increase coverage.

Here we have defined delivery as occurring either at community, health facility or first referral level. Care at the community level as specified here is not necessarily through CHWs for all interventions, but could also be via family members or other actors at community level. In general, data on delivery channels is sparse, and the model was built on assumptions as to where incremental scale-up of interventions would be most feasible (for more information see annex 5).

**Box 3 Seven core intervention sets to improve child survival**

1. **Nurturing newborns and their mothers**: included in maternal and newborn health costing model.
2. **Infant feeding**: interventions 1, 2, 3, 10, 15, 16.
3. **Vital vaccines**: interventions 11, 12.
4. **Combating diarrhoea**: interventions 5, 6.
5. **Combating pneumonia and sepsis**: interventions 4, 7, 8.
6. **Combating malaria**: interventions 9, 14.

### 3 Overview of methodology

#### 3.1 Costing models used

To estimate costs CAH and HSF designed costing spreadsheets that contained assumptions on inputs, coverage, and population in need for most intervention categories. However, for some of the selected intervention categories we used existing models from other WHO departments, as well as from external institutions. In total, four different costing models were used:

- Costs for immunizations (intervention 11) were estimated using the WHO/IVB costing model.
  - This utilizes country-specific parameters to estimate the likely production function for scaling up coverage, and, using the WHO-CHOICE approach, defines costs separately for each component of the intervention category such as campaigns, social mobilization, cold chain etc. Costs per child contact in this model are not calculated per delivery level (facility-based versus outreach services), but instead based on estimates of the unit cost per contact at primary facilities, estimated at different population coverage levels using an econometric model. The model uses the assumption that at high levels of coverage, outreach facilities are located in the most remote areas in each district, reaching 90-100% population coverage. The incremental costs of scaling up immunization to 95% for included vaccines was estimated by running a rapid 95% coverage scenario (including costs for campaigns) and from this subtracting the estimated costs for a "constant routine" scenario (i.e. current coverage as baseline, assume no campaigns). The model includes countries that are eligible for support
from the GAVI initiative, and it was adapted to include only the CAH/MPS selected list of countries and vaccines.\(^6\) Costs include patient and selected programme costs.\(^7\)

- Costs for prevention and treatment of malaria for under-fives (interventions 9 and 14) were based on a malaria costing tool developed by WHO/RBM. No specific estimates for malaria-specific programme costs were included in the under-five cost estimate for this exercise, as these were expected to be subsumed either within general under-five programme costs or general malaria programme costs. The model includes only countries with reported cases of malaria greater than 1 case per 1000 population.\(^8\)

- To calculate the cost of anti-retroviral prophylaxis and infant feeding counselling (intervention 13) we utilized a model developed by the Futures Group.\(^9\) This particular model includes programme costs to some extent, and enabled costs to be estimated for 74 countries (Timor-Leste excluded).

- For the remainder of the selected interventions, CAH constructed a costing model which includes both patient and programme costs for under-five care. Sections 3.2 - 3.5 below mainly refer to this model.

### 3.2 Definition of inputs

Since the objective of the cost analysis was to estimate the additional financial requirements on top of current finances available for under-five health, projected national finances for under-five health for the years ahead were assumed to sustain current coverage levels. Costs were divided into 'patient costs' and non-patient or 'programme costs'. Patient costs refer to costs at the point of delivery, such as bed days, outpatient visits, drugs, or laboratory tests. Programme costs include costs incurred at the administrative levels of the district, provincial or central-levels. These costs are incurred at a level other than the delivery point of an intervention to beneficiaries, and components include such items as training, supervision or media campaigns.\(^10\)

Costs are presented in (2004) US dollars, including 3% inflation, and estimated by cost category, country and year from 2006 to 2015. The costing model estimates quantities of inputs needed for individual patient care and health system investments using new data and analysis done by WHO/EIP and WHO/CAH in collaboration with other WHO departments. Inputs were defined in accordance with current standards of treatment and based on general experience of health system requirements. Costs for service delivery were based on unit costs derived from the Disease Control Priorities

---

\(^6\) The model excluded costs for six countries: Brazil, Guatemala, Kazakhstan, Namibia, Peru and South Africa.

\(^7\) For more information on patient and programme costs included, refer to annexes 3 and 5. For more detailed information on the costing methodology used for vaccines, refer to IFFIim Proposal Annex 3: Costing methods and estimation of mortality impact, *Proposal for an International Financing Facility for Immunization*. GAVI Partners, 2004.

\(^8\) Malaria costs have hence not been calculated for 21 countries: Afghanistan, Azerbaijan, Bolivia, Brazil, China, Egypt, Guatemala, Iraq, Kazakhstan, India, Kyrgyzstan, Lesotho, Mexico, Morocco, Nepal, Nicaragua, Philippines, South Africa, Tajikistan, Timor-Leste, and Turkey.


Project,\textsuperscript{11} while salaries related to other activities, such as programme management or training, utilized data from the WHO-CHOICE database.\textsuperscript{12} For drug costs we used the median prices reported in the MSH database.\textsuperscript{13} The cost estimates do not account for storage, loss or wastage of drugs and supplies.

The additional financial needs were estimated for the following cost components:

**Patient costs** \textsuperscript{14}

a. Drugs, vaccines, lab tests and medical supplies

b. Service delivery costs - include consultation time (salaries of multi-purpose health workers), and locally procured goods such as overhead costs for electricity, running water and buildings. The estimates use current prices.\textsuperscript{15}

**System costs** (programme costs) \textsuperscript{16}

c. Programme management

d. Honoraria for community health workers delivering child health interventions only

e. Training

f. Supervision

g.Externally funded technical assistance

h. Information, education and communication

i. Monitoring and evaluation

j. Infrastructure

k. Advocacy

l. Laws, policy, regulation

m. Programme costs for immunization (including supervision, cold chain, vehicles, and their maintenance).

In order to estimate costs, public provider prices were used. It is possible that provision of health services from private providers would have higher costs.\textsuperscript{17} The assumptions on provision


\textsuperscript{12}WHO-CHOICE has assembled regional databases on costs using a standardized methodology (website [www.who.int/evidence/cea](http://www.who.int/evidence/cea)).

\textsuperscript{13}The Management Sciences for Health (MSH) publishes the *International Drug Price Indicator Guide* which provides a spectrum of prices from drug suppliers and procurement agencies, based on their current catalogues or price lists.

\textsuperscript{14}See Annex 3 for the underlying assumptions used in the analysis of patient costs.

\textsuperscript{15}For unit costs for outpatient visits and hospital inpatient costs we used prices as provided by DCPP (available at: [http://www.fic.nih.gov/dcpp/wps/wp9.pdf](http://www.fic.nih.gov/dcpp/wps/wp9.pdf)). Note that, depending upon the particular context, the use of current prices may either underestimate costs if there is a need for higher salaries/incentives to recruit/keep health workers or to place them in needed locations, or overestimate costs if current staff can absorb some of the workload without any additional pay (when there is excess capacity).

\textsuperscript{16}See Annex 5 for the underlying assumptions used in the analysis of health system costs.

\textsuperscript{17}Drug prices used reflect those offered to public sector providers/international organizations.
however are not intended to be provider-specific. For this assessment, constant prices were used (prices were not dependent on coverage level).18

**Box 4 Definitions for desegregation of cost data**

<table>
<thead>
<tr>
<th>Terminology</th>
<th>Data included</th>
<th>Denominator</th>
</tr>
</thead>
</table>
| 1. Patient costs | a. Drugs, vaccines, lab tests and medical supplies  
b. Service delivery costs at facility level | Per patient       |
| 2. Programme costs | a. Investment in human resources at facility level  
and community level (training and supervision)  
b. Service delivery costs at community level (CHW honoraria)  
c. Investment in physical resources/infrastructure  
d. Investment in programme management and policy  
(management, advocacy, IEC, M&E, laws and regulations) | Per population / district |
| Service delivery costs at facility level (1 b above) | Includes staff consultation time, salaries of multi-purpose health workers, locally procured goods, electricity and maintenance of buildings. |                     |
| Human resources for service delivery | Includes 1.b and 2.b above. * |                     |

* Note that 1.b includes more than just human resource costs. However, human resources is the main cost component, thus this is used as an approximate measure.

### 3.3 Country classification, scaling-up patterns and system inputs

Theoretically it is possible to fill the gap between present coverage levels and near universal coverage within a 10 year period. In some countries the coverage gap is relatively small and the health system strong enough to rapidly bridge it. In others the challenge is much bigger, all the more since health systems there are less developed and more fragile. The CMH (Commission on Macroeconomics in Health) index was used to classify countries into different levels of health systems strength. The CMH index arranges 84 developing countries into four quartiles, from the most to the least constrained quartile. Classification is based on constraints, other than lack of finance, such as those related to the demand for health services, weak health systems and broader economic, social and political factors.19

---

18 Since the model assumes a high level of community health worker outreach, coverage-sensitive prices were not imputed. An increasing price assumption would specifically be based on providing facility based services to more and more remote areas, whereas for this estimate a majority of the population living in remote areas would be covered by CHWs for several interventions.

19 The constraint index is a measure of the average level of constraint that operated in a country over the time period 1985-1999. See Ranson M K et al. (2003) for further information.
The framework categorizes constraints to scaling up according to:

- the level at which the constraint operates,
- the extent to which constraints can be relaxed through additional funds.\(^{20}\)

The index combines variables from the community/household level, health service delivery level and environment level. For those countries for which there was no CMH value calculated,\(^{21}\) we used Global Burden of Disease (GBD) regional median values or made assumptions based on income per capita.\(^{22}\)

The CMH classification was used in two aspects:

- to determine the pattern and timing of scaling up interventions (scaling up patterns are shown in annex 2). For each country a group-specific scenario of scale-up of coverage was applied to current levels of coverage with each intervention.
- to make assumptions on the need for additional system inputs, including capital items such as hospital equipment, capacity development and training. Countries with a lower CMH index were attributed greater need for incremental investments in the health system.

### 3.4 Defining the population in need

The estimated country-specific population in need for a particular intervention was principally calculated using three parameters: the population size, the geographical distribution of population, and the incidence or prevalence of a condition or risk, including some interactions of scale up upon epidemiology.

The population of under-fives in need of each intervention was estimated by country, using population figures from the UN Population Division 2002 projections. Data on the proportion of population per country living in rural and urban areas respectively was utilized to estimate the population in need at the community level and facility level for some interventions. Data on incidence and prevalence and detailed assumptions for each intervention are explained in greater detail in annex 3.

Ideally, a cost analysis such as this exercise should take account of the impact of scaling up interventions on disease epidemiology. The analysis does adjust for some interactions between prevention and treatment, such as the modelled reduction in pneumonia incidence as the haemophilus influenzae type-b (Hib) vaccine is scaled up in countries,\(^ {23}\) and likewise a reduction in the estimated number of measles cases as measles vaccinations are scaled up. However, the analysis does not take into account impact associated with scaling up other goals like decreasing poverty and hunger (MDG1), or scaling up water and sanitation interventions and decreasing use of solid fuels (MDG7). The scale-up of interventions aimed at these goals would likely lead to certain child health illnesses to be prevented or eased.

---

\(^{20}\) This is relevant since the cost estimate is based on the ability to "buy-out" barriers to scaling up.

\(^{21}\) East-Timor, Djibouti, Equatorial Guinea, Guatemala, Kazakhstan, Peru, Swaziland, Brazil, Egypt, Mexico, Morocco and Turkey.

\(^{22}\) Countries were sorted into regions based on GBD and income, and for countries for which no CMH value has been calculated were assigned the median value of their group, subject to review by expert opinion.

\(^{23}\) Research indicates that 20% of episodes of pneumonia in children may be due to Hib. Refer to Mulholland et al (1997).
In order to calculate the impact of interventions on population size, population was adjusted to account for additional lives saved due to scaling up of mortality-reducing health interventions. For more information on methodological issues related to the adjustment of population data for additional lives saved due to scaling up, refer to annex 6.

### 3.5 Current coverage

The cost analysis was designed to estimate incremental resources required to scale up above the baseline of current coverage levels. Current coverage of interventions was determined using various sources of information, including DHS surveys when available from year 1995 and later. In general, for countries for which there was no data on coverage, GBD regional averages were imputed. Expert opinion was consulted to ensure that extrapolated data seemed reasonable, or else the coverage estimates were adjusted. For interventions for which there was no current coverage data available in DHS, experts within WHO were consulted.

In general there is very limited data available on coverage of interventions by delivery level. Consequently, assumptions on the proportions of each intervention delivered at each level of care had to be estimated based on judgements of efficiency, feasibility and acceptability. A more detailed methodology for estimating current coverage by delivery level can be found in annex 5.
4 Results

4.1 Breakdown of costs per input category

The sum of the additional costs for implementing the scaling-up scenarios is estimated to be at least US$ 52.4 billion. Box 5 below highlights the different breakdowns of cost data with reference to Box 4 in section 3.2. Intervention-specific patient costs account for US$ 40.2 billion, or 77% of costs, whereas US$ 12.2 billion (23%) are the estimated costs for strengthening the health system, including care at the community level.

**Box 5 Desegregation of cost data**

<table>
<thead>
<tr>
<th>Costs</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Patient costs</td>
<td>US$ 40.2 billion (77%)</td>
</tr>
<tr>
<td>a = US$ 20.4 billion (38%)</td>
<td></td>
</tr>
<tr>
<td>b = US$ 19.9 billion (39%)</td>
<td></td>
</tr>
<tr>
<td>2. Programme costs</td>
<td>US$ 12.2 billion (23%)</td>
</tr>
<tr>
<td>a + c + d = US$ 7 billion (13%)</td>
<td></td>
</tr>
<tr>
<td>b = US$ 5.2 billion (10%)</td>
<td></td>
</tr>
<tr>
<td>Service delivery costs at facility level</td>
<td>US$ 19.9 billion (38%)</td>
</tr>
<tr>
<td>Human resources for service delivery</td>
<td>US$ 25.1 billion (48%)</td>
</tr>
</tbody>
</table>

**Terminology Costs included**

1. Patient costs
   - a. Drugs, vaccines, lab tests and medical supplies
   - b. Service delivery costs at facility level

2. Programme costs
   - a. Investment in human resources at facility level and community level (training and supervision)
   - b. Service delivery costs at community level (CHW honoraria)
   - c. Investment in physical resources/infrastructure
   - d. Investment in programme management and policy (management, advocacy, IEC, M&E, laws and regulations)

Service delivery costs at facility level (1 b above)
Include staff consultation time, salaries of multi-purpose health workers, locally procured goods, electricity and maintenance of buildings.

Human resources for service delivery
Includes 1. b and 2. b above.*

* Note that 1 b includes more than just human resource costs. However, human resources is the main cost component, thus this is used as an approximate measure.
Patient-specific costs can be further broken down into expenditure on delivering child health interventions at facility and referral level, and expenditure on drugs, supplies and lab tests. These account for 38% and 39% of the global price tag respectively. Expenditure on community health workers, devoted to delivering child health interventions only, is calculated as a system-specific cost and in total accounts for 10% of all costs. In total, around US$ 25.1 billion is for service delivery at community, facility and first referral level, most of which is wages and honoraria. Programme costs other than CHWs, such as infrastructure, policy, training and supervision, account for 13% of costs.

In 2006 additional expenditures are estimated at US$ 2.2 billion, rising over time with expanding coverage to US$ 7.8 billion in 2015 (Fig.1).

**Figure 1. Cumulative cost of scaling up child health interventions, additional to current expenditure, by input category**

![Graph showing cumulative cost of scaling up child health interventions](image)

### 4.2 Breakdown of costs per intervention and programme component

Figure 2 provides the breakdown of total costs per intervention and programme cost category. The intervention with the highest total cost is diarrhoea case management (19.7%), followed by malaria interventions (13.8%) and management of severe malnutrition (12.7%). Control of diarrhoeal diseases, acute respiratory infections (notably pneumonia) and malaria accounts for some 40% of patient costs.
Figure 2 Cost per intervention and programme cost category *

* Costs per intervention include: (i) drugs, vaccines, tests and medical supplies; and (ii) service delivery costs at facility level. Malaria costs have been divided between ITNs and antimalarials (treatment, diagnostics and drugs).
At the population level, treatment of diarrhoea with ORS and zinc is a greater relative proportion of total cost than pneumonia treatment, despite a lower cost per child treated. These higher costs are mainly driven by a higher disease incidence and by a liberal administration of ORS, which is fully justified by the prevention of more expensive management of dehydration. Another reason why the costs for pneumonia case management appear relatively low is that oxygen has been costed as infrastructure (purchase and maintenance of oxygen concentrators) rather than consumption on a per-client basis (litres of oxygen per ill child). Moreover, oxygen costs do not include capital or maintenance cost. The costs for breastfeeding and complementary feeding counselling, largely captured in service delivery and CHW cost categories, are relatively low compared to the important burden they address. Similarly, management of neonatal infections (sepsis) has nearly no cost at all as shown here, which is largely due to the assumption of delivery at community level (delivery cost falls under CHW costs). Some categories have a cost of near 0% of total, the reader is reminded that these are incremental costs additional to inputs already present.

The cost estimates are highly dependant on assumptions used for delivery and inputs. For example, severe malnutrition has here been modelled as treatment required at the referral level, with follow-ups at community level. Ongoing research on case management of severe malnutrition may indicate that home treatment is more cost-effective, which would reduce costs for treatment further.

Among the programme costs, CHWs is the largest component, followed by training (3.9%), programme costs for immunizations (82.2%) and IEC (2.1%). Figure 3 shows the relative distribution of estimated programme costs over the scale-up period. Variations within the different programme cost categories demonstrate three patterns: a) high initial catch up or investment costs such as for vaccines; b) cyclical investments, such as for training and IEC; and c) the pattern associated with increasing coverage such as the scale-up of supervision and the implementation of laws, policies and regulation, and the cost of providing infrastructure which peaks mid-way through the period.

*Figure 3  Scaling up programme cost over years 2006-2015 (in US$ millions)*
Figure 4 Cost per intervention, years 2006 and 2015, in US$ millions

- Breastfeeding counselling
- Complementary feeding counselling
- Case management of severe malnutrition
- Case management of pneumonia
- Case management of diarrhoea
- Antibiotic treatment for dysentery
- Treatment of measles
- Case management of suspected sepsis
- Malaria (ITNs + antimalarials)
- Vitamin A supplementation
- Immunization
- Deworming
- PMTCT
- Universal salt iodization
Figure 1 showed that the sum of estimated programmatic investments will be relatively stable between 2006 and 2015, while reaching more individual children and their care providers with increasing amounts of commodities will require substantial cumulative investments during the scale-up period. As illustrated in Figure 4, the investment in specific interventions will change due to the size of the coverage gap, the pace of closing the coverage gap, and the effects of scaling up, given different baseline coverage. For example, funds for community based management of neonatal infections, breastfeeding and complementary feeding counselling, case management of diarrhoea, and acute respiratory infections need roughly a tenfold increase by 2015 from 2006 levels. Immunization and malaria interventions require an estimated two-fold increase over the same time period. The only intervention category that would require less funding in 2015 than in 2006 is the treatment of measles complications, indicating that prevention pays off in the long run.

Table 2 shows the global under-five mortality by cause of death in 2002/2003, along with the estimated cost per intervention in 2006 and 2015. A comparison of the table with Figure 3 reveals that although the relative cost of malaria interventions falls from 31% in 2006 to 16% by 2015, in absolute terms the additional financial expenditure required to scale-up doubles. Thus there will be a need for policy makers and programme managers to distribute resources in a dynamic manner between interventions throughout the period, at the same time as total expenditures will need to increase.

The overall patient costs mirror the burden of under-five mortality, with some notable exceptions. Note however that the proportion of incremental costs per intervention will depend upon the level of current investments: the lower the current coverage, the greater the additional costs to reach universal coverage. This limits the ability to draw conclusions from Table 2, although the reader may note that compared to the large proportion of deaths associated with malnutrition, the scale-up of the three nutrition interventions from very low initial coverage (breastfeeding 5-20%, complementary feeding 2%, and management of severe malnutrition 5%) to 95% account for relatively modest proportions of the additional costs of scaling up interventions (8%, 2% and 18% respectively in 2015).
Table 2  Burden of disease and cost per intervention

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Malnutrition (associated with 53% of mortality) b</td>
<td>Malaria (ITNs + antimalarials) (31%)</td>
<td>Case management of diarrhoea (28%)</td>
</tr>
<tr>
<td>Neonatal conditions (37%)</td>
<td>Immunization (26%)</td>
<td>Case management of severe malnutrition (18%)</td>
</tr>
<tr>
<td>Pneumonia (19%)</td>
<td>PMTCT (13%)</td>
<td>Malaria:ITNs+ antimalarials (16%)</td>
</tr>
<tr>
<td>Diarrhoea (17%)</td>
<td>Case management of diarrhoea (12%)</td>
<td>Immunization (11%)</td>
</tr>
<tr>
<td>Malaria (8%)</td>
<td>Case management of severe malnutrition (7%)</td>
<td>Case management of pneumonia (9%)</td>
</tr>
<tr>
<td>Measles (4%)</td>
<td>Case management of pneumonia (4%)</td>
<td>Complementary feeding (8%)</td>
</tr>
<tr>
<td>HIV/AIDS (3%)</td>
<td>Complementary feeding (3%)</td>
<td>PMTCT (4%)</td>
</tr>
<tr>
<td>Injuries (3%)</td>
<td>Treatment of measles (1%)</td>
<td>Antibiotic treatment for dysentery (2%)</td>
</tr>
<tr>
<td>Others (10%)</td>
<td>Antibiotic treatment for dysentery (1%)</td>
<td>Breastfeeding counselling (2%)</td>
</tr>
<tr>
<td></td>
<td>Breastfeeding counselling (1%)</td>
<td>Deworming (1%)</td>
</tr>
<tr>
<td></td>
<td>Deworming (0%)</td>
<td>Vitamin A supplementation (0%)</td>
</tr>
<tr>
<td></td>
<td>Vitamin A supplementation (0%)</td>
<td>Treatment of measles (0%)</td>
</tr>
<tr>
<td></td>
<td>Universal salt iodization (0%)</td>
<td>Universal salt iodization (0%)</td>
</tr>
<tr>
<td></td>
<td>Case management of suspected sepsis (0%)</td>
<td>Case management of suspected sepsis (0%)</td>
</tr>
</tbody>
</table>


b Malnutrition is not measured as a direct cause but as an associated cause of death. Undernutrition is estimated to be associated with 53% of under-five deaths (source: Caulfield L E et al. (2004)).

### 4.3 Breakdown of costs per CMH region

On average, the global price tag of US$ 52.4 billion corresponds to an additional US$ 0.47 per inhabitant in 2006, expanding to US$ 1.48 in year 2015, when 95% of the child population would be covered with the full range of 16 interventions in every country (see the line marked *Average* in figure 5). The estimated costs required to sustain the scale-up are equivalent to an average increase in general government health expenditure (GGHE) by 8% in 2006, and by 26% in 2015, over current levels. Per capita additional expenditure was also calculated for each of the CMH categories. In order to retrieve averages for each group of countries, expenditures were weighted on a population basis. Note that costs are higher in year 2006 (year 1) than in 1997 (year 2) in CMH 1 countries due to the high perceived need for initial health system investments.
Figure 5 Costs per capita per year per CMH category

The 13 countries in the group with the most favourable starting situation, CMH4, together account for 50% of the global price tag of US$ 52.4 billion. One reason for why this category accounts for such a large share of the costs is that labour, drugs and supplies are relatively more expensive in these countries. Another reason is that large countries such as India and China are included within this group, which together represents 55% of the population included in the cost analysis. Average expenditure on child health in this group would have to increase by US$ 0.29 per inhabitant in 2006, rising to an additional US$ 1.01 in 2015. In CMH3 countries expenditure on child health would have to increase by on average US$ 0.65 in 2006 to US$ 1.49 in 2015. Table 3 shows the current average public expenditure on health per region and demonstrates that considerable increases in health expenditures are required to reduce mortality.

Table 3 Estimated additional costs related to current expenditures on health

<table>
<thead>
<tr>
<th>CMH 1</th>
<th>CMH 2</th>
<th>CMH 3</th>
<th>CMH 4</th>
<th>All 75 countries</th>
</tr>
</thead>
<tbody>
<tr>
<td>$11,494</td>
<td>$9,553</td>
<td>$5,161</td>
<td>$26,231</td>
<td>$52,440</td>
</tr>
<tr>
<td>22 %</td>
<td>18 %</td>
<td>10 %</td>
<td>50 %</td>
<td>100%</td>
</tr>
<tr>
<td>17%</td>
<td>18%</td>
<td>10%</td>
<td>55%</td>
<td>100%</td>
</tr>
<tr>
<td>34%</td>
<td>18%</td>
<td>8%</td>
<td>35%</td>
<td>94%</td>
</tr>
<tr>
<td>$4.54</td>
<td>$10.79</td>
<td>$14.10</td>
<td>$27.81</td>
<td>$22.17</td>
</tr>
<tr>
<td>$1.27</td>
<td>$0.63</td>
<td>$0.65</td>
<td>$0.29</td>
<td>$0.47</td>
</tr>
<tr>
<td>$3.58</td>
<td>$2.02</td>
<td>$1.49</td>
<td>$1.01</td>
<td>$1.48</td>
</tr>
</tbody>
</table>

a For data on general government health expenditure (GGHE), refer to the tables on National Health Accounts in World Health Report 2005 Annexes. Data presented here is from 2002, which is the latest available.

b Average GGHE per capita and average incremental cost per capita were weighted by the year-specific population for each country.
In CMH1 and 2, where conditions currently are most challenging, approximately US$ 21.0 billion would be required to scale up interventions. These are low income countries with high mortality levels, low coverage and relatively weak health systems – but where the current prices of labour and supplies are comparatively low. Countries with weak health systems in CMH 1, where the situation is currently most difficult, like Angola, Chad, Côte d'Ivoire, the Democratic Republic of Congo, Ethiopia, Mali, Niger, Nigeria, and Somalia, would have to spend an additional US$ 1.27 on under-five health in 2006. As these countries move towards full coverage over time, this amount would increase to US$ 3.58 per capita in 2015. When compared to the average current general government health expenditure, the scale-up of child health interventions would require almost a doubling of government expenditure on health in these countries. In CMH 2 countries the additional expenditure required is less substantial: US$ 0.63 in 2006 and US$ 2.02 in 2015, compared to a current average GGHE of $10.79 per capita.

Figure 6 demonstrates that major cost drivers vary between countries. Although physical inputs of drugs and lab tests are the major cost components in countries belonging to CMH1, 2 and 3, in those countries that have the strongest health systems and highest coverage already, salary expenditures are the major input to drive costs. Thus in CMH4, service delivery costs, which is mostly salaries, account for 49% of costs, compared to 24% in CMH2 countries.

For a breakdown of costs per WHO GBD region see annex 10.

4.4 Breakdown of costs per delivery level

A breakdown of costs per level of delivery emphasizes the need to invest throughout the health system. Note that the distribution of costs between the different levels as shown in Figure 7 is contingent on estimated current expenditures at each level, in that is shows investments additional to current expenditures. The current provision of health services at community level is estimated to be less developed than referral care provision in most countries. The total optimal sum of investments at these two levels may however be very different, and likely to vary between countries. In general more research on delivery strategies is warranted at the country level.

---

24 All countries included in this cost analysis under CMH categories 1 and 2 have been classified as low-income economies by the World Bank, except for Djibouti and Iraq.

25 In this respect it should be noted that this study does not take into account any incentives or increased remuneration that might be necessary to attract and sustain human resources required to scale-up to universal coverage at present salary levels.
Figure 6 Relative expenditure required per input category (in millions US$)

Figure 7 Estimated incremental costs per level of delivery

* Programme costs are shared between all levels of delivery
5. Discussion of methodology and results

5.1 Limitations of the methodology used

Financial incremental costs
Expenditures required to scale up interventions were estimated as incremental to current investments. Thus, expenditures required to maintain current coverage levels until 2015 were not included.\textsuperscript{26} Financial costs as estimated here represent actual expenditures on goods and services purchased, but do not reflect opportunity costs or how resources could be otherwise spent (whereas economic costs tend to consider investments from a societal long-term perspective).

Similarly, the exercise is a supply-side analysis, meaning that demand has not been explicitly addressed in terms of accessibility and quality of care for those with poor health care seeking behaviour. The implications of estimating costs from a provider perspective means that we have not accounted for costs related to health seeking behaviour, such as (financial) transport costs to the health care facility or the (economic) opportunity cost of time spent seeking care (lost wages etc). Instead we assume that improved care-seeking at all levels is to be supported by IEC interventions and increased information from CHWs at community level.

This analysis has not sought to estimate how to overcome other constraints which health systems face (such as poor absorptive capacity and inability to attract and maintain human resources). Likewise at the client level there may be non-financial barriers to utilizing health services (such as excessive travel time, low sensitivity of staff, poor quality and poor acceptability of services). Programmes with more intensive outreach and equity focus could possibly indicate a need for greater expenditures than calculated here. In short, the performance and sustainability of the health sector in the long run depends on factors that go beyond this analysis, and the results presented should be seen as a conservative estimate of the expenditures required to scale up by 2015, given the assumptions and data available.\textsuperscript{27}

Costing models, uncertainty and sensitivity of results
The use of four different models to estimate costs brings some uncertainty to the comparability of cost estimates per intervention. However, all the models were built from a bottom-up, ingredients approach, and used the same sources for prices, hence differences should not overly impact comparability. No uncertainty analysis was done to determine the range of possible costs given uncertainty in the input parameters. Neither was there any attempt to do a sensitivity analysis in order to give ranges for the cost estimates, either as a total nor for separate interventions/models.

Synergy
Issues of synergy have been addressed to a limited extent. One reason for this is the difficulties associated with bringing together four different costing models. Another reason is the lack of reliable

---

\textsuperscript{26} Since the data available on current investments in child health is very sparse, costs were estimated with the assumption that current coverage levels can be maintained in all countries without additional resources. This assumes that resources are currently being used at a similar efficiency level as those assumed in the model.

\textsuperscript{27} It is assumed here however that countries have the capacity to reach 95\% coverage by 2015.
evidence showing the direct impact of interventions on mortality in intervention-specific and quantitative terms. A specific example is the integrated treatment of childhood illness (IMCI), where the child may have more than one disease classification and be treated for both at once. This modelling did not account for such integrated treatment of illness (though some synergy has been accounted for regarding preventive interventions).28 One implication of this is that treatment costs at facility level (i.e. prices for staff time) have been based on single and not multiple disease classification.

**Estimating the need for additional human resources**

Human resources should make up the operational unit for developing the scale-up scenarios, since the speed of the scale-up scenarios is determined by the possibilities of developing and deploying them, particularly in situations of massive need. However, this analysis has not attempted to cost the production (i.e. pre-service training) of incremental staff required at facility and referral level in order to scale-up. The estimated cost of additional service delivery does not relate salary levels to efficiency or capacity of the system, but is based on current actual price estimates for salaries and infrastructure, per country. No attempt was made to adjust costs for either excess capacity in the existing system nor to account for extra incentives.

A correct estimate of the cost of additional human resources required for improved management of child health would require an overall assessment of human resources for the health system as a whole (accounting for a wide range of issues including, but not limited to, AIDS, migration, time trends in training, retention, unemployment, geographical [mal]distribution, as well as the synergies in scale-up plans, access to care, the ability of health workers to treat many different kinds of patients, and public/private/NGO treatment sectors and pay compensations). Only after such a holistic approach could the estimated human resources be apportioned to different programmes. As no such holistic modeling has been done here, estimating the need for additional child health workers is complicated. The incremental ability to recruit, train, and maintain these health workers is largely unknown, country specific, and subject to the current capacity of medical schools vis-à-vis human resource retention rates. For these reasons, this exercise did not include any estimates of the long term costs to develop and deploy additional human resources at the health facility and first referral level. However, the incremental salary cost of human resources has been included in the outpatient visit and bed-day costs, capturing the bulk of the human resource costs that will be needed for under-five interventions.

This cost assessment also includes cost for additional investments in recruitment of programme managers and personnel for monitoring and evaluation at national and district level. Again, this exercise includes only the incremental salary cost of human resources at these levels, and no estimates of the long term costs to develop and deploy additional human resources.

Some preliminary calculations to provide a rough measure of the human resources required to scale up interventions as planned within this exercise suggest that incremental health workers will need to be recruited in many countries to cope with increased demands, and in CMH1 countries in particular the need for additional staff at the health facility and referral levels is substantial. In total it has been

---

28 One reason for why integrated management was not costed is the fact that IMCI classifications do not correspond to disease diagnosis; while epidemiological data is disease-specific. Synergy between preventive interventions include the joint delivery of immunizations, vitamin A and deworming.
estimated that the equivalent of around 100,000 incremental health workers solely devoted to child health, will be required in the 75 countries (see annex 9). This estimate should be considered with caution as it is based on particular assumptions on case-management time and estimates on current number of health workers per country. It does not take into account attrition nor the fact that staff at facility level are usually multi-purpose health workers. Furthermore, the human resource issue will become even more acute once other programmes start scaling up health services to address tuberculosis, HIV and malaria. A separate, health system wide costing of recruitment and education would be vital for a complete picture of the financial resources needed.

The cost of training community health workers was separately calculated within CAH's model. Assumptions are that CHWs will be recruited to work with child health only and that they can be recruited and trained in a relatively short period of time without large infrastructure developments (their training is a short-run cost). Based on assumptions on CHWs required per population, the model estimates that 4.6 million may be needed in the 75 countries. To account for the issues listed above, a 25% yearly attrition rate was assumed for CHWs.

5.2 Towards the MDG of reducing under-five mortality

This cost analysis does not provide the absolute number of deaths averted due to scale-up of interventions. To produce such results would require full population modeling, which was not done for this exercise. However, Jones et al (2003) have estimated that scaling-up 22 interventions to 99% coverage in 42 countries would be associated with a two-third reduction in under-five mortality, corresponding to MDG4. Of these 22 interventions, all but one have been included in the joint list of interventions of WHO/CAH and WHO/MPR. For under-fives, 15 out of the 22 Lancet interventions have been costed, corresponding to about 75% of preventable under-five deaths as estimated by Jones et al. Since this cost estimate covers 75 countries corresponding to 94.2% of the global burden of under-five mortality, and in addition includes a number of interventions supplementary to those considered by Jones et al (such as immunizations of BCG, polio, yellow fever and Hepatitis B; hospitalization of severe malnutrition; universal salt iodization; deworming; and the treatment of measles), we would argue that the estimate of costs presented herein gives an approximate measure of the resources required to reduce substantially under-five mortality. When the cost estimates for scaling up child health and maternal and newborn health interventions are taken together, the impact would very likely exceed the MDG4 target, which is to reduce child deaths by two thirds by 2015 (from a base year of 1990).

29 Jones G et al. (2003).
30 Costs for scaling up water and sanitation have not been considered here.
31 The remaining interventions have been included in the cost estimate for maternal and neonatal health. The estimate of 75% of avoidable deaths was calculated from table 2 in Jones et. al. This estimate of preventable deaths does not take into account delivery strategies, and should thus be considered as very rough estimate for our analysis.
32 For more information refer to *Estimating Cost of Scaling-up Maternal and Newborn Health Interventions to Reach Universal Coverage: methodology and assumptions*. Departments of Making Pregnancy Safer (FCH/MPS) and Health System Financing (EIP/HSF), World Health Organization March 2005.
5.3 Policy implications

We have estimated the cost of scaling up interventions that address the handful of preventable and treatable conditions that are responsible for more than 70% of all child deaths: - pneumonia, diarrhoea, malaria, measles, HIV/AIDS, and conditions arising during the neonatal period. Costs were estimated to combat malnutrition, which although rarely listed as a direct cause, contributes to more than half of all childhood deaths. The cost estimates reflect the financial investments required to maximize under five mortality reduction and reach MDG4, with improved health and development as additional benefits.

Section 4 conveys that to a large extent the financial estimates mirror the unaddressed mortality burden. With integrated delivery mechanisms, such as IMCI, investments in interventions addressing the high disease burden associated with diarrhoea, ARI and malaria, would become highly efficient. In addition, the relatively low costs for breastfeeding and complementary feeding counselling, in comparison to the important burden they address, should be an extra stimulus to further prioritize these interventions. Similarly, continued investments in vaccine programmes are justified by previous investments and the reduction in disease burden that is associated with previously sustained immunization efforts. Countries with relatively high neonatal mortality rates would also need to devote resources to address the major causes of death in that period with simple interventions available today. With respect to delivery mechanisms, community-based delivery may be an alternative in countries with weak health systems and low utilization of health services.

This exercise demonstrates that universal coverage of key child survival interventions throughout the health system is financially attainable. At only an additional US$ 1.48 per capita in 2015, coverage of life-saving interventions can be universally extended. This seems like a small cost, yet the increase in resources required corresponds to an average increase in general government health expenditure by 26%; a value which reflects the relatively low current public health expenditure in these countries. The scale-up to universal coverage will in the group of countries with the weakest health systems require even more substantial resources, as incremental costs correspond to a doubling of current general government health expenditures.

This paper does not look into financing scenarios, nor does it seek to advocate that resources must necessarily be channelled through the government. However, the vulnerability of children and mothers advocates for the universal provision of child, maternal and neonatal health services at no or low cost. The specific modalities for financing will depend on the country context. A significant implication of the analysis is however that low-income countries classified as CMH1 and CMH2 currently doing worst, are likely to need external financial assistance in order to scale up provision of essential health services.

Yet increased aid alone is not the answer. A greater financial resource base is necessary, but these resources also need to be used in an effective, efficient and equitable way. Current financing mechanisms should be strengthened and policy makers should also explore the feasibility of

---

33 The US$ 7.8 billion required in year 2015 to reduce child mortality can be compared with examples of current non-health expenditures, such as the estimated US$17 billion spent annually on pet food in North America and Europe (The Second Child Survival Revolution - BASICS II September 2003).
implementing new and innovative funding mechanisms that address these objectives. In countries with high under-five mortality, policies as well as issues of coordination, harmonization, simplification and effectiveness and efficiency must be addressed. Although financially obtainable with donor assistance, a sustainable progress towards reducing child mortality and morbidity will require a radical willingness on the part of countries to alter delivery methods, organizations, planning, and accounting, in order to absorb and then disburse the money in such a way that it will be used to directly impact under-five mortality. A substantial proportion of the funds required can be mobilized from within the countries themselves. Sufficient investments in IMCI have already helped to reduce under-five mortality in Tanzania, and moreover were affordable within existing district budgets.\(^{34}\) The effectiveness of child health interventions have been known for a long time; now budget estimates, programme management and political will is required for implementation.

How rigorous is the estimate of US$ 52.4 billion? This is a general benchmark of resources needed, while actual resources needed will depend upon the actions of individual countries. We assume that the estimate is conservative, as it does not consider capacity constraints, migration, poor incentives, or fungibility of funds. However, as shown in the Tanzania example above, reprioritization within current budgets can also lead to a reduction in under-five mortality at a lower incremental cost than has been estimated here within.

### Box 6 Summary of policy implications from the cost analysis

- Investments in child health need to be increased substantially, up to a doubling of current overall general government expenditure on health in low income countries.
- Low income countries will continue to rely on external support to reach MDG4.
- Current financing mechanisms need to be strengthened to allow a sufficient supply of child health services (and their equitable use and to prevent financial hardship due to service use).
- If investments were brought in line with disease burden, countries could achieve a mortality reduction required for reaching the child mortality MDG.
- Investments in child health need to address the under five mortality burden better, with increased investments in sets of interventions, such as IMCI, that address the major burden due to malnutrition, newborn health problems, pneumonia and diarrhoea.
- Sustained investments in immunization substantially reduced the associated disease burden and need to be maintained.
- Community based delivery may be an alternative in countries where utilization of formal health services is low.
- The elements contributing to the cost of scaling up varies across regions; in low income countries the highest relative investments are needed in drugs, equipment and supplies and in high income countries in human resources.

\(^{34}\) Armstrong Schellenberg JRM et al. (2004).
We have not considered non-financial constraints nor the high cost of sustainable efforts to support equity. For this, country-specific solutions must be found to alleviate the large burden that non-financial and financial barriers to access incur on the poor, both through health system planning and through innovative financing mechanisms.

Finally, a word of caution: this estimate should not be seen as absolute or universal. Other cost estimates would give different results depending upon the interventions included, the time frame and delivery mechanisms considered, and the data available to estimate coverage and prices - and when lack thereof, the assumptions made. The results presented here should thus be recognized in interpretation of, and in comparison with, other cost estimates, and the most appropriate measure should be considered depending upon context-specific needs.

The following people contributed to this costing exercise:

**CAH co-ordinating working group:** Karin Stenberg and Robert Scherpbier (WHO/FCH/CAH).

**Clinical and health systems assumptions and projections:** Rajiv Bahl, Cynthia Boschi-Pinto, André Briend, Olivier Fontaine, V Chandra-Mouli, Peggy Henderson, Thierry Lambrechts, José Martines, Elizabeth Mason, Shamim Qazi, Marcus Stahlhofer, Constanza Vallenas, Martin Weber, Cathy Wolfheim and other members of WHO/FCH/CAH.

**Costing methodology, design of cost templates and population interactions:** Benjamin Johns and Tessa Tan Torres-Edejer (WHO/EIP/HSF).

**Contributions from other WHO departments and external contributions:** Colleagues in other WHO departments who offered their invaluable assistance include: Marta Gacic Dobo and Lara Wolfson (WHO/IVB/VAM), Kristjana Sigurbjörnsdóttir and Helga Fogstad (WHO/FCH/MPS), Maria Andersson and Sultana Khanum (WHO/NMH/NHD), Claudine Prudhon (NMH/SCN), Henrietta Allen, Lorenzo Savioli and Dirk Engels (WHO/CDS/CPE). The contributions of WHO/RBM on guidance on costing malaria interventions, and the Futures Group on the estimates of costs related to PMTCT, are also acknowledged.

**Strategic guidance:** provided by the World Health Report team, editor in chief Wim van Lerberghe, and Annick Manuel.
List of Annexes

Annex 1  List of countries included in the cost analysis
Annex 2  Scale-up patterns
Annex 3  Key assumptions underlying patient costs: population in need and inputs per intervention
Annex 4  Child health interventions included by delivery level
Annex 5  Estimating current coverage and target coverage by delivery point
Annex 6  Key assumptions underlying programme costs
Annex 7  Adjustment of population data
Annex 8  Estimated cost of F-75 and F-100 for feeding hospitalized children with severe malnutrition
Annex 9  Estimating incremental human resource needs for scaling up key child health interventions to 95% coverage at the health facility level
Annex 10 Breakdown of costs per WHO GBD region
### Annex 1 List of countries included in the cost analysis

<table>
<thead>
<tr>
<th>Country</th>
<th>CMH a Classification</th>
<th>WHO GBD regions b</th>
<th>Under-five mortality rate c</th>
<th>Percentage of global under-five deaths c</th>
</tr>
</thead>
<tbody>
<tr>
<td>Afghanistan</td>
<td>1</td>
<td>EMR D</td>
<td>257.0</td>
<td>3%</td>
</tr>
<tr>
<td>Angola</td>
<td>1</td>
<td>AFR D</td>
<td>263.0</td>
<td>2%</td>
</tr>
<tr>
<td>Azerbaijan</td>
<td>3</td>
<td>EUR B</td>
<td>75.3</td>
<td>0%</td>
</tr>
<tr>
<td>Bangladesh</td>
<td>2</td>
<td>SEAR D</td>
<td>72.3</td>
<td>3%</td>
</tr>
<tr>
<td>Benin</td>
<td>1</td>
<td>AFR D</td>
<td>162.1</td>
<td>0%</td>
</tr>
<tr>
<td>Bhutan</td>
<td>2</td>
<td>SEAR D</td>
<td>92.6</td>
<td>0%</td>
</tr>
<tr>
<td>Bolivia</td>
<td>3</td>
<td>AMR D</td>
<td>75.6</td>
<td>0%</td>
</tr>
<tr>
<td>Brazil</td>
<td>4</td>
<td>AMR B</td>
<td>38.4</td>
<td>1%</td>
</tr>
<tr>
<td>Burkina Faso</td>
<td>2</td>
<td>AFR D</td>
<td>224.2</td>
<td>1%</td>
</tr>
<tr>
<td>Burundi</td>
<td>1</td>
<td>AFR D</td>
<td>183.3</td>
<td>0%</td>
</tr>
<tr>
<td>Cambodia</td>
<td>3</td>
<td>WPR B</td>
<td>136.9</td>
<td>1%</td>
</tr>
<tr>
<td>Cameroon</td>
<td>2</td>
<td>AFR D</td>
<td>160.2</td>
<td>1%</td>
</tr>
<tr>
<td>Central African Republic</td>
<td>1</td>
<td>AFR E</td>
<td>180.5</td>
<td>0%</td>
</tr>
<tr>
<td>Chad</td>
<td>1</td>
<td>AFR D</td>
<td>191.0</td>
<td>1%</td>
</tr>
<tr>
<td>China</td>
<td>4</td>
<td>WPR B</td>
<td>36.0</td>
<td>7%</td>
</tr>
<tr>
<td>Comoros</td>
<td>2</td>
<td>AFR D</td>
<td>76.1</td>
<td>0%</td>
</tr>
<tr>
<td>Congo</td>
<td>2</td>
<td>AFR E</td>
<td>105.1</td>
<td>0%</td>
</tr>
<tr>
<td>Côte d’Ivoire</td>
<td>1</td>
<td>AFR E</td>
<td>168.2</td>
<td>1%</td>
</tr>
<tr>
<td>Dem. Rep. of the Congo</td>
<td>1</td>
<td>AFR E</td>
<td>209.7</td>
<td>5%</td>
</tr>
<tr>
<td>Dem. Republic of Timor Leste</td>
<td>1</td>
<td>SEAR B</td>
<td>125.5</td>
<td>0%</td>
</tr>
<tr>
<td>Djibouti</td>
<td>2</td>
<td>EMR D</td>
<td>149.9</td>
<td>0%</td>
</tr>
<tr>
<td>Egypt</td>
<td>4</td>
<td>EMR D</td>
<td>38.4</td>
<td>1%</td>
</tr>
<tr>
<td>Equatorial Guinea</td>
<td>2</td>
<td>AFR D</td>
<td>150.9</td>
<td>0%</td>
</tr>
<tr>
<td>Eritrea</td>
<td>1</td>
<td>AFR E</td>
<td>109.5</td>
<td>0%</td>
</tr>
<tr>
<td>Ethiopia</td>
<td>1</td>
<td>AFR E</td>
<td>176.9</td>
<td>5%</td>
</tr>
<tr>
<td>Gabon</td>
<td>4</td>
<td>AFR D</td>
<td>89.7</td>
<td>0%</td>
</tr>
<tr>
<td>Gambia</td>
<td>4</td>
<td>AFR D</td>
<td>124.8</td>
<td>0%</td>
</tr>
<tr>
<td>Ghana</td>
<td>3</td>
<td>AFR D</td>
<td>102.8</td>
<td>1%</td>
</tr>
<tr>
<td>Guatemala</td>
<td>3</td>
<td>AMR D</td>
<td>53.9</td>
<td>0%</td>
</tr>
<tr>
<td>Guinea</td>
<td>3</td>
<td>AFR D</td>
<td>157.9</td>
<td>1%</td>
</tr>
<tr>
<td>Guinea-Bissau</td>
<td>1</td>
<td>AFR D</td>
<td>206.5</td>
<td>0%</td>
</tr>
<tr>
<td>Guyana</td>
<td>4</td>
<td>AMR B</td>
<td>55.4</td>
<td>0%</td>
</tr>
<tr>
<td>Haiti</td>
<td>1</td>
<td>AMR D</td>
<td>133.2</td>
<td>0%</td>
</tr>
<tr>
<td>India</td>
<td>4</td>
<td>SEAR D</td>
<td>90.9</td>
<td>22%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Country</th>
<th>Region</th>
<th>Stage</th>
<th>Cost</th>
<th>Change</th>
</tr>
</thead>
<tbody>
<tr>
<td>Indonesia</td>
<td>3</td>
<td>SEAR B</td>
<td>40.8</td>
<td>0%</td>
</tr>
<tr>
<td>Iraq</td>
<td>1</td>
<td>EMR D</td>
<td>115.1</td>
<td>1%</td>
</tr>
<tr>
<td>Kazakhstan</td>
<td>3</td>
<td>EUR C</td>
<td>33.4</td>
<td>0%</td>
</tr>
<tr>
<td>Kenya</td>
<td>2</td>
<td>AFR E</td>
<td>116.0</td>
<td>1%</td>
</tr>
<tr>
<td>Kyrgyzstan</td>
<td>3</td>
<td>EUR B</td>
<td>59.1</td>
<td>0%</td>
</tr>
<tr>
<td>Lao People's Dem. Republic</td>
<td>2</td>
<td>WPR B</td>
<td>138.8</td>
<td>0%</td>
</tr>
<tr>
<td>Lesotho</td>
<td>3</td>
<td>AFR E</td>
<td>163.4</td>
<td>0%</td>
</tr>
<tr>
<td>Liberia</td>
<td>1</td>
<td>AFR D</td>
<td>232.4</td>
<td>0%</td>
</tr>
<tr>
<td>Madagascar</td>
<td>2</td>
<td>AFR D</td>
<td>135.2</td>
<td>1%</td>
</tr>
<tr>
<td>Malawi</td>
<td>3</td>
<td>AFR E</td>
<td>193.3</td>
<td>1%</td>
</tr>
<tr>
<td>Mali</td>
<td>1</td>
<td>AFR D</td>
<td>228.4</td>
<td>1%</td>
</tr>
<tr>
<td>Mauritania</td>
<td>1</td>
<td>AFR D</td>
<td>170.8</td>
<td>0%</td>
</tr>
<tr>
<td>Mexico</td>
<td>4</td>
<td>AMR B</td>
<td>27.2</td>
<td>1%</td>
</tr>
<tr>
<td>Morocco</td>
<td>4</td>
<td>EMR D</td>
<td>42.1</td>
<td>0%</td>
</tr>
<tr>
<td>Mozambique</td>
<td>2</td>
<td>AFR E</td>
<td>206.4</td>
<td>1%</td>
</tr>
<tr>
<td>Myanmar</td>
<td>2</td>
<td>SEAR D</td>
<td>106.2</td>
<td>1%</td>
</tr>
<tr>
<td>Namibia</td>
<td>4</td>
<td>AFR E</td>
<td>94.8</td>
<td>0%</td>
</tr>
<tr>
<td>Nepal</td>
<td>2</td>
<td>SEAR D</td>
<td>84.2</td>
<td>1%</td>
</tr>
<tr>
<td>Nicaragua</td>
<td>3</td>
<td>AMR D</td>
<td>38.1</td>
<td>0%</td>
</tr>
<tr>
<td>Niger</td>
<td>1</td>
<td>AFR D</td>
<td>252.5</td>
<td>1%</td>
</tr>
<tr>
<td>Nigeria</td>
<td>1</td>
<td>AFR D</td>
<td>182.0</td>
<td>8%</td>
</tr>
<tr>
<td>Pakistan</td>
<td>2</td>
<td>EMR D</td>
<td>110.0</td>
<td>5%</td>
</tr>
<tr>
<td>Papua New Guinea</td>
<td>3</td>
<td>WPR B</td>
<td>95.1</td>
<td>0%</td>
</tr>
<tr>
<td>Peru</td>
<td>3</td>
<td>AMR D</td>
<td>36.2</td>
<td>0%</td>
</tr>
<tr>
<td>Philippines</td>
<td>4</td>
<td>WPR B</td>
<td>36.1</td>
<td>1%</td>
</tr>
<tr>
<td>Rwanda</td>
<td>3</td>
<td>AFR E</td>
<td>178.2</td>
<td>1%</td>
</tr>
<tr>
<td>Senegal</td>
<td>2</td>
<td>AFR D</td>
<td>133.8</td>
<td>0%</td>
</tr>
<tr>
<td>Sierra Leone</td>
<td>1</td>
<td>AFR D</td>
<td>317.3</td>
<td>1%</td>
</tr>
<tr>
<td>Somalia</td>
<td>1</td>
<td>EMR D</td>
<td>220.6</td>
<td>1%</td>
</tr>
<tr>
<td>South Africa</td>
<td>4</td>
<td>AFR E</td>
<td>83.5</td>
<td>1%</td>
</tr>
<tr>
<td>Sudan</td>
<td>2</td>
<td>EMR D</td>
<td>108.6</td>
<td>1%</td>
</tr>
<tr>
<td>Swaziland</td>
<td>3</td>
<td>AFR E</td>
<td>145.9</td>
<td>0%</td>
</tr>
<tr>
<td>Tajikistan</td>
<td>3</td>
<td>EUR B</td>
<td>62.9</td>
<td>0%</td>
</tr>
<tr>
<td>Togo</td>
<td>1</td>
<td>AFR D</td>
<td>138.1</td>
<td>0%</td>
</tr>
<tr>
<td>Turkey</td>
<td>4</td>
<td>EUR B</td>
<td>43.2</td>
<td>1%</td>
</tr>
<tr>
<td>Uganda</td>
<td>1</td>
<td>AFR E</td>
<td>142.2</td>
<td>2%</td>
</tr>
<tr>
<td>United Republic of Tanzania</td>
<td>3</td>
<td>AFR E</td>
<td>153.7</td>
<td>2%</td>
</tr>
<tr>
<td>Viet Nam</td>
<td>4</td>
<td>WPR B</td>
<td>37.0</td>
<td>1%</td>
</tr>
<tr>
<td>Yemen</td>
<td>1</td>
<td>EMR D</td>
<td>100.2</td>
<td>1%</td>
</tr>
<tr>
<td>Zambia</td>
<td>3</td>
<td>AFR E</td>
<td>183.8</td>
<td>1%</td>
</tr>
<tr>
<td>Zimbabwe</td>
<td>3</td>
<td>AFR E</td>
<td>111.5</td>
<td>0%</td>
</tr>
</tbody>
</table>

\(^{a}\) Refer to Ranson M. K. et al. (2003) for further information. 
\(^{b}\) WHO Global Burden of Disease regions. 
\(^{c}\) WHO 2002 data.
Annex 2 Scale-up patterns

The modeling of scale-up curves was theoretical for the sake of this exercise. Thus coverage targets are not to be interpreted as prescriptive in terms of what individual countries have to reach in order to reduce child mortality. Country-specific scale-up curves for each intervention will in reality depend on country plans and current patterns of implementation, and there was no intention with this exercise to prescribe that all countries implement interventions in the same manner.

For countries classified as CMH1 we assumed a slow start due to a need for countries to strengthen the health system in initial years before commencing rapid scale-up.

For CMH2 countries we assumed a sigmoid curve in line with the "traditional" shape of scale up curves: slow start-up followed by a period of rapid progress, then slower progress again as coverage levels rise.
Countries classified as CMH3 were assumed to need less initial investments before takeoff. The model assumes an almost linear scale up pattern, only slowing down at near universal coverage.

For countries classified as CMH4, costs are based on the assumption that rapid linear scale-up is immediately feasible and that the 95% target can be reached in the first five years.
Annex 3 Key assumptions underlying patient costs: population in need and inputs per intervention

The following section provides technical details on the assumptions used to estimate patient-level inputs required for each intervention. The population in need is estimated separately for each intervention and level of delivery (see annex 5 for further information). Partial delivery of certain interventions at the community level is assumed to be a feasible option, in particular for the rural population. Thus the number of cases treated at community level as estimated here depends on data on the rural/urban population per country; coverage gaps per country and intervention; and our assumptions on feasible delivery. Delivery points for the interventions described below are thus not to be interpreted as general WHO recommendations, but were necessary for this exercise in order to define costs per level of delivery. Note also that the assumptions below refer to the incremental delivery of interventions required to reach universal coverage, and that current coverage is supposed to be maintained using current strategies.

Intervention 1. Promotion of exclusive and continued breastfeeding

Description of intervention: Mothers are counselled to exclusively breastfeed for 6 months after delivery, followed by appropriate complementary feeding and continued breastfeeding for 2 years or beyond. Costs were included for three counselling visits: one session within the first week after birth; one session at 6 weeks; and one session between 5 and 6 months of life. The delivery of this intervention was split between three levels of delivery.36

Population in need: all newborns. Population in need at each delivery level was estimated as explained in annex 5.

Service delivery costs:37 The intervention includes visits by the community health worker twice a day for 10 days (these are included in the programme costs); or three visits at the health facility level or first referral level.

Intervention 2. Improvement of complementary feeding

Description of intervention: Costs are included for one care giver per child to be given intensive counselling (two full sessions: one at 9 months and the second at 12 months) on the importance of continued breastfeeding after six months of age along with appropriate complementary feeding practices.38 The delivery of this intervention was split between community and health facility level.

Population in need: All children at 9 months and 12 months of age.


37 Service delivery costs include staff compensation (salaries) as well as running costs of buildings, water and electricity, using country-specific price data from the Disease Control Priorities Project (DCPP). Note that no costs for follow-up visits were included.

38 Guiding principles for complementary feeding of the breastfed child, PAHO/WHO.
Service delivery costs: The intervention includes three counselling sessions by the community health worker (included in programme costs) for 50% of children and three counselling sessions at a health centre for 50% of children.39

Intervention 3. Case management of severe malnutrition

Description of intervention: All severely malnourished children with weight-for-height below 3 Standard Deviations (SD) and/or oedema are hospitalized during the initial phase of their treatment. After the medical complications associated with severe malnutrition are under control and initial stabilization has occurred, all severely malnourished children receive a highly fortified, therapeutic diet, high in energy and protein, to allow rapid catch up growth until full recovery.40

Population in need: population in need was approximated using WHO data on the percentage of children with weight-for-height below -3 SD.41 This proportion was then applied to the population aged 0-59 months in every country.

Hospital in-patient days: The cost was included for an average of 14 days of inpatient hospital costs (assuming continuing community rehabilitation and 5 follow-up visits by a community health worker upon discharge from the hospital).42

Required lab tests: Costs were included for a routine blood count including blood grouping urine stool test for 100% of cases plus 20% repeat tests (equivalent to 120% of cases). In addition, costs were included for a blood glucose level test (Glucose Stick or Dextrostick) for 100% of cases, and a chest X-ray for 20% of children.

Drug costs for the management of complications: To estimate the cost of treatment of complications it was assumed that 20% of children treated would have complications and receive treatment with injectable ampicillin and gentamicin. Within this proportion we included the need for treatment of septicaemia, hypoglycaemia, hypothermia, severe respiratory infection and other complications.43 The dosage costed is 50 mg/kg ampicillin, intramuscular(IM) or intravenous(IV)

39 There is limited data available on current delivery points for complementary feeding interventions. Here the costs are based on the assumption that counselling will take place at the primary health care facility level or at the community level by a community health worker. The effectiveness of complementary feeding interventions has been shown by Caulfield LE, Huffman SL, Piwoz EG. (1999), among others. Several of the interventions cited by Caulfield et al were delivered using community health workers.

40 Case fatality rates have decreased to below 5% in treatment centres applying an appropriate management scheme recommended in WHO guidelines (Training in the management of severe malnutrition, WHO).

41 Data gathered from "WHO Global Database on Child Growth and Malnutrition (www.who.int/nutgrowthdb), 2004. More details on the methodology applied in this database are available in de Onis M, Blössner M. (2003). For countries with no national survey reports on malnutrition we used regional estimates.

42 A study by Ashworth A, Khanum S. (1997) lends supports to the treatment of severely malnourished children in hospital and at home as the most cost-effective treatment option. Their study estimated the costs of hospitalization for one week with follow-ups at home by trained health workers once/week for one month until children reached 80% of the NCHs median for weight-for-height.

43 We assume that 15% of all severely malnourished children will need to be treated for septicemia. In Ashworth A, Khanum S. (1997), 11 % of children were suspected as having septicaemia. However, in Ahmed T et al. (1999), the findings showed that 29% of children who underwent the treatment according to the guidelines had septicemia diagnosed on clinical grounds (hypo or hyperthermia, absent or poor radial pulse in the absence of dehydration, poor mental status, profound leucopenia or leucocytosis etc). Only 6% had positive blood cultures. In general an estimate of severely malnourished children that are septicemic would be 15-20% (personal communication Dr. Tahmeed Ahmed).
every 6 hours for 2 days, and gentamicin 7.5 mg/kg IM or IV once daily for 7 days followed by oral antibiotics (amoxicillin) 15 mg/kg orally every 8 hours for 5 days, or oral ampicillin (50mg/kg/6 hourly for 5 days). In addition, glucose treatment of severe hypoglycaemia was included. We assumed that 10% of severely malnourished children suffer from severe hypoglycaemia, and that the immediate treatment given is intravenous (IV) sterile 10% glucose (5 ml/kg of body weight), followed by 50 ml of 10% glucose or sucrose by nasogastric (NG) tube, after which starter F-75 formula food is fed to the child every 30 minutes.

**Drug costs for the management of non-complications:** For the remaining 80% of (non-complicated) cases we included the cost of the standardized treatment with oral antibiotics (cotrimoxazole (25 mg of sulfamethoxazole + 5 mg of trimethoprim/kg) twice daily for 5 days. Costs for case management of dehydration: If the child suffers from dehydration, ReSoMal rehydration fluid will need to be administered orally or by nasogastric (NG) tube, at between 70 and 100 ml of ReSoMal per kg of body weight. To account for average cost we assumed that an estimated 67% of cases would need 500 ml (amount based on a 5 kg child), and that this amount is given over 12 hours, starting with 5 ml/kg every 30 minutes for the first 2 hours orally or by NG tube, followed by 5–10 ml/kg per hour.

**Cost for formula diets and micronutrients:** Costs are included for formula diets, F-75 (75 kcal or 315 kJ/100 ml) used during the initial phase of treatment, and F-100 (100 kcal or 420 kJ/100 ml) used during the rehabilitation phase. Using a 5-kg child as a standard for treatment, it was assumed that a child will need 4 days of F75 and 10 days of F-100, at a total cost of about 7 Euros per child (refer to appendix 8 for calculations on cost). The cost of additional micronutrients was calculated for a single dose of oral vitamin A and folic acid, given on the first day of treatment.

**Other costs included:** In addition to the inputs mentioned above, we included the cost of 2 paediatric nasogastric tubes for 25% of all children. In addition, costs were included for IV kit, syringe, needle, and cotton as required per patient. The reader should note that no costs were calculated for

44 To estimate average drug doses we used a mean child weight of 5 kg for all inputs. This corresponds to 2000 mg of ampicillin, 1125 mg of amoxicillin and 262.5 mg gentamicin.

45 10% should cover a sufficient proportion of children admitted. In a study by Ahmed et al (1999), a total of 8% (6-12%) of the children had hypoglycemia on admission (personal communication Dr. Tahmeed Ahmed, ICDDR).

46 Once treated most children stabilise within 30 minutes. If the child is less severe, that is conscious, then the glucose/sucrose solution is given orally or by NG tube (50 ml bolus) after which the child is fed F-75 every 30 minutes.

47 For a child of "mean weight" (5 kg) this equals 125 mg sulfamethoxazole + 15 mg trimethoprim per dose. Total dose is 125x2x5=1250 mg sulfamethoxazole and 15x2x5 = 150 mg trimethoprim.

48 Here we assume that ReSoMal is purchased commercially, though the liquid can also be made by diluting one packet of the standard WHO-recommended ORS in 2 litres of water (instead of 1 litre) and adding 50 g of sucrose (25 g/l) and 40 ml (20 ml/l) of mineral mix solution1. Reference: Management of Severe malnutrition: a manual for physicians and other senior health workers, WHO (1999).

49 67% is the proportion reported by Alam NH et al. (2003).

50 When using pre-mixed sachets; the recommendation for micronutrient supplementation is to give a single dose oral vitamin A (50 000 IU; 100 000 IU; 200 000 IU) and folic acid on day 1 (Management of the child with a serious infection or severe malnutrition, WHO).

51 Assume 2 NG tubes are needed per day for 25% of all admitted severely malnourished children who refuses oral feeds or vomits 30-50% of all feeds a day.
accompanying family members staying with the child in the hospital, nor have we included costs for increased home fluids after discharge.

**Intervention 4. Case management of pneumonia**

This intervention is split according to the severity of pneumonia and the assumed delivery point of treatment. See below a-d.

4a **Case management of non-severe pneumonia at the community level**

**Description of intervention:** A community health worker provides standard management of non-severe cases of acute respiratory infections. Children diagnosed as having mild or moderate pneumonia are given oral amoxicillin every 8 hrs for 3 days, and Paracetamol to treat fever.

**Population in need:** WHO estimates of ALRI incidence for under-fives are given by WHO GBD region. Around 86% of all pneumonia cases have been estimated as non-severe. Costs are based on the assumption that community health workers will treat 80% of incremental non-severe cases in rural areas while the remaining 20% seek treatment at the facility level. All patients in urban areas are assumed to seek treatment at a health facility.

**Drugs and supplies:** Oral amoxicillin (15 mg/kg) every 8 hrs for 3 days, and on average, 6 doses of paracetamol (100 mg tablet). Dosages are based on WHO recommended case management of a 1-year old child that weighs 10 kg.

**Service delivery costs:** The intervention includes follow-ups by the community health worker twice a day for 10 days (included in programme costs).

4b **Case management of non-severe pneumonia at the facility level**

**Description of intervention:** A health facility worker provides standard management of non-severe respiratory infections at the health facility. Children diagnosed as having mild or moderate pneumonia are given oral amoxicillin every 8 hrs for 3 days, and Paracetamol to treat fever. It is assumed that 10% of cases have wheezing and receive salbutamol for 4 days.

**Population in need:** as explained for 4a.

**Drugs and supplies:** Oral amoxicillin (15 mg/kg) every 8 hrs for 3 days, and on average, 6 doses paracetamol (100 mg tablet). The cost of oral salbutamol was included for 10% of cases for 4 days (a dose of one 2-mg tablet for a child aged 2-11 months and one 2-mg tablet for a child 1-4 years, 3 times per day). Dosages are based on a 1-year old child that weighs 10 kg.

**Service delivery costs:** One outpatient visit.


53 ALRI stands for acute lower respiratory infection.

54 Hadi, A (2003) gives the following proportions of severity of pneumonia cases in a community setting: 86% non-severe, 12% severe, and 2% very severe. Similar proportions are reported by Mehnaz A et al. (1997).


56 For the assumption on 10% prevalence of wheeze around the year for non-severe pneumonia, refer to Eric Simoes, University of Colorado at Denver and Health Sciences Centre (personal communication).
4c Case management of severe pneumonia at the hospital level

**Description of intervention:** Standard management of severe acute respiratory infection at the referral level.\(^5^7\) Children stay on average three days as inpatients and are given injectable antibiotics for these three days, followed by oral amoxicillin for five days as outpatients. 50% of cases are expected to have wheezing, and are treated with nebulized salbutamol for 4 days.\(^5^8\) An X-ray-test will be required for about 20% of children treated. Oxygen will be required by about 19% of children.

**Population in need:** It was assumed that 12% of children with pneumonia will have severe pneumonia and will be treated at first referral level.\(^5^9\)

**Drugs and supplies:** We included the cost for injectable ampicillin for 3 days (50 mg per kg every 6 hrs); oral amoxicillin for 5 days (15 mg per kg every 8 hrs); and nebulized salbutamol for 4 days for 50% of cases (an average dose of 2.5 mg salbutamol (0.5. mg of the 5 mg/ml nebulizer solution) given 4-hourly for 4 days. Dosages are based on a 1-year old child that weighs 10 kg. Other costs include IV kit, syringe, needle, cotton, oxygen tubing and nasal aspirator as required per patient. Oxygen was not costed on a per-patient basis.\(^6^0\)

**Required lab tests:** Cost of chest X-ray was included for 20% of cases.

Service delivery costs: 3 days inpatient.

4d Case management of very severe pneumonia at the hospital level

**Description of intervention:** Standard management of very severe acute respiratory infections at the referral level. Children are hospitalized for an average of five days, during which they are given injectable antibiotics (penicillin or ampicillin). Oxygen will be required by 50% of children. An estimated 50% wheezing receive nebulized salbutamol and an estimated 5% of children with Bronchial Asthma will require treatment with steroids for 4 days.\(^6^1\) All children at this level are assumed to require a chest X-ray test. Upon discharge, case management is continued at out-patient level for another five days.

**Population in need:** It was assumed that 12% of children with pneumonia will have severe pneumonia and will be treated at first referral level.\(^6^2\)

**Drugs and supplies:** dosages have been based on a 1-year old child that weighs 10 kg, as follows:
- Five days injectable ampicillin: four injections per day (50 mg per kg every 6 hrs).
- Ten days injectable gentamicin: one injection per day for 5 days inpatient + 5 days outpatient treatment (dose 2.5 mg/kg).
- Oral amoxicillin for five days of out-patient treatment (15 mg per kg every 8 hrs).
- Nebulized salbutamol for 4 days for 50% of cases (an average dose of 2.5 mg salbutamol given 4-hourly for 4 days).

---

\(^5^7\) In Qazi S A (1996) standard management resulted in a fall in the case fatality rate in children admitted with ARI from 9.9% to 4.9%, while the overall case fatality fell from 8.7% to 6.2%.

\(^5^8\) Wheezing was noted in at least one out of four clinical assessments within 24 h of enrolment in severe pneumonia cases in Addo-Yobo E et al. (2004).

\(^5^9\) Qazi S A (1996) gives the same proportions of severe and non-severe pneumonia as Hadi (2003) above.

\(^6^0\) Oxygen was costed as a programme input, based on the purchase of oxygen concentrators, rather than consumption per patient. However, treatment with oxygen is an essential input and will be required for 19% of severe cases (refer to table 4 of Addo-Yabo et al. (2004)).

\(^6^1\) The same proportion of estimated cases of wheezing (50%) was used for very severe as for severe pneumonia.

\(^6^2\) Qazi S A. (1996) as above.
- Steroids for 5% of cases: a 10 mg dose of oral prednisolone (1mg/kg) once/day for three days. Additional costs were included for IV kit, syringe, needle, cotton, oxygen tubing and nasal aspirator as required per patient. Oxygen was not costed on a per-patient basis.63

**Lab tests:** the cost of a chest X-ray test was included for 100% of cases.

**Service delivery costs:** 5 days inpatient and 5 days outpatient treatment.

### Intervention 5. Case management of diarrhoea

Costs included for this intervention are based on standard recommendations on diarrhoea management with ORS and zinc, and in the case of very severe dehydration, rehydration by intravenous injection.64 The intervention was split according to the severity of diarrhoea and the assumed delivery point of treatment. To estimate costs by delivery level the assumption was used that 80% of all incremental (currently non-treated) cases will be treated by a family member or a community health worker, and that the other 20% will be managed at the health facility level, and that 1% of all cases will be referred and treated at the hospital level. See below a-c.

**5a Diarrhoea management at population/community level**

**Description of intervention:** Community health workers are trained to assess and manage dehydration caused by diarrhoea with home-available fluids or with ORS if available. We assume that 80% of all diarrhoea cases are treated at home, either by a CHW or by a family member.65 The model specifies that half of these children (i.e. 40% of all diarrhoea cases) will be treated with ORS, zinc and increased consumption of home fluids, whereas the other half (i.e. 40% of all cases) will be treated with increased home fluids only.

**Population in need:** 80% of under-five diarrhoea incidence as given by WHO GBD regional estimates.

**Drugs and supplies:** The model specifies that 40% of all diarrhoea cases are treated with ORS (one litre per day for two days), and zinc. The average dose of zinc costed is 20 mg per day for 14 days (10 mg per day for infants under six months old). No cost for drugs was included for the remaining 40% of all cases treated at community level.66

**5b Diarrhoea management at the facility level**

**Description of intervention:** Trained health workers use an algorithm for the assessment and management of dehydration caused by diarrhoea. Children brought to health facilities with watery stools are assessed for signs of dehydration and if severely dehydrated, the child is rehydrated in the health facility or referred to higher-level facility, as necessary. A rough estimate assumes that around 10% of cases at the facility level will be severely dehydrated and receive treatment with intravenous electrolyte solution, followed by ORS and zinc. This corresponds to 2% of all diarrhoea incidence (20% of cases are modelled to be treated at facility level, of which 10% are severely dehydrated).

---

63 Oxygen would be required for 50% of cases (Duke et al (2002)).


65 Whether a family member or a CHW administers the ORS will not have an impact on costs since CHW honorariums are included in system costs and not estimated on a per-client basis.

66 No cost for home fluids was included.
90% of children treated at the facility level are expected to have no dehydration or moderate dehydration. They are provided with ORS and zinc.

**Population in need:** 20% of under-five diarrhoea incidence as given by WHO GBD regional estimates.

** Drugs and supplies:** Injectable antibiotics and intravenous electrolyte solution (for an average of 6 hrs) for 10% of cases treated at this level. All children treated at this level receive two litres of ORS plus zinc.\(^{67}\) The average dose of zinc costed is 20 mg per day for 14 days (10 mg per day for infants under six months old). Other inputs include IV infusion kit, syringe, needle, cotton, gloves as required per patient, and printed take-home material with advice on preventing diarrhoea at home.

**Service delivery costs:** One outpatient visit.

---

**5c Diarrhoea Management at referral level**

**Description of intervention:** Assumed that 1% of all diarrhoea cases will be referred and treated at the referral level, where dehydration is treated with intravenous electrolyte solution.

**Population in need:** 1% of diarrhoea incidence as given by WHO GBD regional estimates.

** Drugs and supplies:** ORS for 3 days as in-patient + 2 days to take home. Zinc is provided for for 14 days, in the same doses as above. Other costs included were IV kit, electrolyte solution (for about 12 hrs), syringe, needle, cotton, and take-home materials with advice on preventing diarrhoea at home.

**Service delivery costs:** Three hospital inpatient days.

---

**Intervention 6. Antibiotic treatment for dysentery**

**Description of intervention:** Trained health workers use an algorithm for the assessment and management of bloody diarrhoea in children under 5 years of age. If bloody diarrhoea is present, the children will be provided with a three day course of ciprofloxacin and re-evaluated after 2 days. We assume that around 5% of diarrhoea cases need to be treated with antibiotics due to presence of bloody diarrhoea or shigellosis.\(^{68}\)

**Population in need:** 5 % of diarrhoea incidence as given by WHO GBD regional estimates.

** Drugs and supplies:** ciprofloxacin 2 tablets (250mg) per day for 3 days.

**Service delivery costs:** One outpatient visit.

---

**Intervention 7. Treatment of measles and measles complications**

**Description of intervention:** Health facility workers manage non-complicated measles with vitamin A therapy,\(^{69,70}\) and paracetamol in case of fever. It is assumed that 10% of cases will develop severe

---

\(^{67}\) We estimated that on average a diarrhoeic child will consume 300ml of ORS at home per day for two days. As ORS should not be kept for more than 24 hours, this means that diarrhoeic children will use one litre of ORS per day for two days (even if they do not drink the whole litre).


\(^{69}\) The recommendations is to give Vitamin A to all children with measles unless the child has already received adequate Vitamin A as outpatient or received preventive vitamin A supplement within 1 month. If a child is severely malnourished or has vitamin A deficiency it should be given a third dose 2-4 weeks after the second dose
complicated measles with pneumonia complications and need to be treated at the first referral level (no other complications were included in this model).71

**Population in need:** Country-specific measles incidence was estimated by the WHO/IVB costing tool, using a static model to estimate epidemic cycles. As the immunization program is scaled up, the number of predicted measles cases decreases. Since only incremental costs have been included, estimates of the number of cases were compared to the estimated current number of cases treated for complications in 2005. When estimated cases were fewer than those treated in 2005, there was assumed to be no incremental cost.

**Drugs and supplies:** For general measles treatment the cost of two Vitamin A therapy doses was included: the first on diagnosis, the second the next day. Dose varies with age: 50 000 IU (<6 months), 100 000 IU (6-11 months) or 200 000 IU (12 months-5 years). For measles with pneumonia complications, costs were included as given for severe pneumonia above.

**Service delivery costs:** the cost of one outpatient visit was included for non-complicated cases. For pneumonia complications, the cost of inpatient treatment at hospital was calculated as for severe pneumonia above.

**Intervention 8. Community based case management of suspected sepsis**

**Description of intervention:** Community health workers, assumed to be trained in neonatal care and diagnosis and management of sepsis, identify sick newborns through a combination of home visits and care-seeking by families. Neonates suspected to have sepsis are treated with antibiotics.

**Population in need:** It was assumed that 6.5% of all neonates would have suspected sepsis and require treatment with antibiotics.72

**Drugs and supplies:** Costs for antibiotics are based on doses of gentamicin: 5 mg twice daily for 10 days for preterm babies (BW<2500g), and 7.5 mg twice daily for 7 days for full-term babies (BW>2500g), administered by intramuscular injection with disposable syringes. The pre-term babies were assumed to be 50% of cases. In addition costs were included for co-trimoxazole (half a pediatric tablet twice daily) for 7 days.

Management of the child with a serious infection or severe malnutrition, WHO).

70 Case management of measles is based around giving vitamin A, antibiotics, oxygen, fluids, and good nutrition. Two doses of 200 000 units of vitamin A reduce the severity and duration of complications as well as mortality (relative risk of death if treated with vitamin A 0·51, 95% CI 0·35–0·74) of measles in children ill enough to be admitted to hospital (reference Duke et al. (2002)).

71 Measles-related pneumonia: Pneumonia arises in 2–27% of a community-based developing country population and in 16–77% of children admitted to hospital. Measles-associated severe pneumonia carries more than twice the risk of mortality that severe pneumonia in children without measles does (Duke and Mgone (2003)).

72 Assumptions are based on findings of (1) Bang AT et al.(1999); and (2) Bang AT Et al (2001). The case fatality rate reported in the study for suspected sepsis without treatment was 18.5%, which implies that about 1.2% of all newborns (18.5% of 6.5%) would die of neonatal sepsis if no treatment was available. However, since the intervention described here uses diagnosis based on clinical signs only, the population in need of the intervention will be five times higher than the number of infants with risk of mortality. The study found that community management of sepsis had an effectiveness of 62% reduction (P<0.001) in neonatal mortality compared to concurrent controls. In the second year of the study, when treatment of sepsis was the only intervention added, there was a 30% reduction in neonatal mortality compared to the previous year.
Service delivery costs: The intervention includes follow-up visits by the community health worker twice a day for 10 days (included in programme costs).


Description of intervention: Costs were estimated using the WHO/RBM costing tool for malaria interventions. Patient costs include costs for long lasting insecticide treated bed nets (ITNs, with an assumed useful life of 3 years), costs for treatment with first and second line drugs, and treatment diagnostics. Long lasting ITNs are assumed to be distributed to children in conjunction with routine post-natal care, and especially in conjunction with vaccine administration. The costs for ITNs for under-fives goes down over time in the model since it is assumed children will use nets distributed to the pregnant women after the pregnant women give birth. No estimates for malaria-specific programme costs were included in under-five cost estimate for this exercise.73

Population in need: The model includes countries with reported cases of malaria greater than 1 case per 1000 population.74 Incidence was sorted by 6 different classifications and the assumption used is that 50-80% of cases are currently self medicated and will not utilize the formal health system. These cases are assumed to be covered by community health workers or continue self medication.

Drugs and supplies: Cost estimates include the immediate switch to an artesunate based therapy (the average cost of ART + AQ or CoA is used, unless a country has already specified an artesunate based treatment). Switching first line drugs was assumed to lower the need for second line drugs.

Diagnostics: Diagnostics (rapid diagnostic tests, RDTs) are included immediately in countries where P. Vivax accounts for a high proportion of malaria cases, with those testing negative for P. Falciparum presumptively treated for P. Vivax (assumed to be the current government recommended drug therapy).75 In countries where P. Falciparum accounts for a high proportion of malaria cases, costs for RDTs were included only after the impact of ITNs will result in a significant proportion of patients not carrying P. Falciparum (generally by 2010 or after). Before this, a high proportion fever cases are assumed to be presumptively treated with anti-malarial drug therapy.

Service delivery costs: One visit by a CHW. In case of failure, the child is referred to a medical facility. However, due to the increased effectiveness of new drugs and the preventive affect of LLITNs, no incremental costs were included for referral.

Intervention 10. Vitamin A supplementation

Description of intervention: Vitamin A is supplemented to all children aged 3, 9 and 15 months, with subsequent doses every 6 months up to the age of 5 years. To estimate cost, we assumed that the

73 It was assumed that most of the programme costs specific to under-fives will be covered under the umbrella programme costs as calculated, or allocated to a malaria specific programme costs, which would cover adults as well as children and thus be difficult to allocate to a child specific cost.

74 Malaria costs have thus not been calculated for 21 countries: Afghanistan, Azerbaijan, Bolivia, Brazil, China, Egypt, Guatemala, Iraq, Kazakhstan, India, Kyrgyzstan, Lesotho, Mexico, Morocco, Nepal, Nicaragua, Philippines, South Africa, Tajikistan, Timor-Leste, and Turkey.

75 Author correspondence (EIP/HSF) with C. Morel. October 2004.
vitamin A capsules are delivered at the health facility in urban areas (100%) and either at the facility level (20%) or by a community health worker (80%) in rural areas.

**Population in need:** Vitamin A should be administered to all children under five in countries recommended to give Vitamin A supplementation. The following criteria were all used to identify countries in need of Vitamin A supplementation:

(i) countries where vitamin A deficiency (VAD) has been identified in national level prevalence assessments.
(ii) countries where VAD is considered to be a likely public health problem (based on sub-national data) and U5MR > 70.
(iii) For countries where data on VAD is missing a combination of indirect indicators were used as a base for decision, and countries included were those where U5MR > 70 and measles immunization coverage < 50% (indirect indicator).76

**Drugs and supplies:** One 50,000 Units capsule in the first six months (total 1 dose). One 100,000 Units capsule in the second six months of life (total 1 dose). One 200,000 Units capsule every six months from 12-59 months (total 8 doses).

### Intervention 11. Immunization

**Description of intervention:** The cost estimate includes vaccination with BCG, measles, yellow fever, 3 doses each of Diphtheria- Tetanus-Pertussis (DTP), oral polio, *Haemophilus influenzae* type-b (Hib), and Hepatitis B.

**Population in need:** All children under five.

**Costs as estimated by the IVB model:** The costs for immunization were based on a model jointly developed by WHO/IVB and WHO/FER, for countries eligible for support from the GAVI initiative.77 Costs per child contact in this model are not calculated per delivery level (facility-based versus outreach services), but instead based on estimates of the unit cost per contact at primary facilities, estimated at different population coverage levels using an econometric model developed by Adam T et al.78 Unit costs have been estimated separately for individual countries at different coverage levels, allowing for economies and diseconomies of scale in unit costs with increased coverage levels. The model uses the assumption that at higher levels of coverage, outreach facilities are located in the most remote areas in each district, reaching 90-100% population coverage.

Costs included vaccines, staff salaries and campaign costs. Costs were also included for safe injection materials including auto-disposable syringes, and safe disposal of medical waste. Incremental costs of scaling up immunization to 95% for included vaccines was estimated by running a rapid scale-up to 95% coverage by the 2015 scenario including costs for campaigns. Then the estimated costs for a

---

76 In countries where data on VAD is missing a combination of indirect indicators could be used as a base for decision, U5MR > 70 can be used in conjunction with at least one additional indirect indicator. *(Vitamin A Global Initiative: A Strategy for Acceleration of Progress in Combating Vitamin A Deficiency*, by UNICEF, MI, WHO, CIDA, USAID, 1998, p.6. The list of proposed indirect indicators can be found on p. 8 in *"Indicators for assessing Vitamin A Deficiency and their application in monitoring and evaluating intervention programmes"*. WHO, 1996.

77 Costs were not calculated for scaling up selected vaccines in Brazil, Guatemala, Kazakhstan, Namibia, Peru and South Africa.

78 Adam T. et al. (forthcoming).
"constant routine" scenario (i.e. using current coverage as baseline, assuming no campaigns) were subtracted from the 95% coverage scenario cost estimates. Scaling up trajectories were based on doubling, as necessary, current trends of increasing immunization coverage, and were thus different from those illustrated in annex 2. The model was adapted to allow for the introduction of Hepatitis B and Hib in 2006. However, the introduction of a routine second doses of measles vaccine was assumed to occur for each country in the year that routine coverage with the 1st dose of measles vaccine reached 80%. Final coverage of DPT3 was 95-99% depending upon country and scaling-up trajectory.

The model calculates a reduction in cases following immunization trajectories and based on vaccine effectiveness. In addition, costs for ARI treatment are reduced by 20% when countries have fully scaled up Hib vaccinations, following the assumption that 20% of all pneumonia cases are due to Hib. For more detailed information on the costing methodology used for vaccines, refer to the GAVI Partners Proposal for an International Financing Facility for Immunization.79

**Intervention 12: Regular deworming**

**Description of intervention:** Regular treatment with anthelminthics (as from WHO list of essential medicines) of any child over the age of 12 months in areas where soil-transmitted helminths are of public health relevance. We assumed that the deworming activities would be carried out once a year and that delivery would piggyback on other interventions (notably immunization and Vitamin A distribution by community health workers or at health facilities). Thus no extra staff costs were included for this intervention.

**Population in need:** All children aged 1-5.

**Drugs and supplies:** Generic albendazole (400mg tablets): 1 tablet for children aged above 24 months and 1/2 tablet for the age group of 12-24 months. Other inputs include monitoring forms or out-patient registers used in routine services.

**Service delivery costs:** none included.

**Intervention 13. Prevention of mother to child transmission of HIV**

**Description of intervention:** To calculate the cost of anti-retroviral prophylaxis and infant feeding counselling we used a costing model developed by the Futures Group. The model assumes that 10-50% of women attending ante-natal clinics are tested. Using country-specific prevalence data, costs have been based on the assumption that 90% of HIV-positive mothers accept treatment and that 50% decide to use replacement feeding. The model as adapted here includes the following patient-specific costs:

**Drugs and supplies:** the model includes the cost of providing replacement feeding (commercial infant formula) for six months to HIV-positive mothers, including when necessary the cost of providing bottled water.

---

Service delivery costs: costs include one group counselling session on testing for HIV, and for women consenting to take an HIV test and for which the test is confirmatory, further counselling sessions.\textsuperscript{80}

For more information refer to the website of Futures Group (http://www.futuresgroup.com).

Intervention 15. Universal salt iodization

Description of intervention: The costs for implementing this intervention mainly reside in the category of programme costs. The patient costs included account for the cost of adding iodine to salt.\textsuperscript{81} Programme costs include a legislative and policy process, the purchase of industry equipment for iodizing salt, as well as monitoring visits to producing factories. For more information refer to annex 6 on system costs.

Population in need: WHO data on the current status of countries affected by iodine deficiency were used to define the population in need.\textsuperscript{82}

Intervention 16. Implementing the International Code of Marketing of Breast Milk Substitutes

Description of intervention: National governments take steps to implement the International Code of Marketing of Breast Milk Substitutes, including the enactment of legislation and introduction of measures to control the marketing of breast milk substitutes. This intervention includes only programme costs and no patient costs.\textsuperscript{83}

\textsuperscript{80} No double counting was assumed to take place between the visits estimated for these follow-up sessions and regular counselling sessions on breastfeeding and complementary feeding.

\textsuperscript{81} The cost of iodized salt was estimated at 3 cents per day. The variable cost to the producer for a bag of 75 kg iodized salt has been estimated at $0.042 (see M. G. Venkatesh Mannar and John T. Dunn *Salt Iodization for the elimination of iodine deficiency*, International Council for Control of Iodine Deficiency Disorders, 1995). Assuming that a child consumes 12 g per day of salt that comes out to be a cost of $0.03. [http://www.micronutrient.org/Salt_CD/4.0_useful/4.1_fulltext/pdfs/4.1.1.pdf](http://www.micronutrient.org/Salt_CD/4.0_useful/4.1_fulltext/pdfs/4.1.1.pdf)


## Annex 4 Child health interventions by delivery level

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Target population</th>
<th>Estimated current coverage based on evidence</th>
<th>Provided during</th>
<th>Major cost components (&quot;cost drivers&quot;)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Interventions at National/Population Level</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>The International Code of marketing of Breast milk Substitutes</strong></td>
<td>All citizens in countries with estimated need of incremental legislation activities</td>
<td>Country-specific</td>
<td>Throughout period</td>
<td></td>
</tr>
<tr>
<td>National governments take steps to implement the International Code of marketing of Breast milk Substitutes, including the enactment of legislation and introduction of measures to control the marketing of breast milk substitutes.</td>
<td>All citizens in countries with estimated need of incremental legislation activities</td>
<td>Country-specific</td>
<td>Throughout period</td>
<td></td>
</tr>
<tr>
<td><strong>Universal salt iodization</strong></td>
<td>All citizens in countries with estimated need of incremental iodization activities</td>
<td>Country-specific</td>
<td>Throughout period</td>
<td></td>
</tr>
<tr>
<td>Costs include legislative and policy process, the purchase of industry equipment for iodizing salt, as well as monitoring visits to producing factories.</td>
<td>All citizens in countries with estimated need of incremental iodization activities</td>
<td>Country-specific</td>
<td>Throughout period</td>
<td></td>
</tr>
</tbody>
</table>

**Care at community level**

<table>
<thead>
<tr>
<th>Breastfeeding counselling</th>
<th>All newborns (we estimate that by year 2015, 55% of mothers will receive counseling at community level)</th>
<th>Based on expert opinion, estimated total coverage is 5% for CMH 1-3 and 20% for CMH 4 countries. Coverage at the community level is estimated at 0% in CMH 1-3 and 5% in CMH 4.</th>
<th>Three follow-ups (first week after birth; 6 weeks; and 5-6 months).</th>
<th>No important cost driver at this level</th>
</tr>
</thead>
<tbody>
<tr>
<td>All mothers are provided with post-delivery counselling on exclusive breastfeeding for 6 months, followed by appropriate complementary feeding and continued breastfeeding for 2 years or beyond.</td>
<td>All newborns (we estimate that by year 2015, 55% of mothers will receive counseling at community level)</td>
<td>Based on expert opinion, estimated total coverage is 5% for CMH 1-3 and 20% for CMH 4 countries. Coverage at the community level is estimated at 0% in CMH 1-3 and 5% in CMH 4.</td>
<td>Three follow-ups (first week after birth; 6 weeks; and 5-6 months).</td>
<td>No important cost driver at this level</td>
</tr>
<tr>
<td><strong>Counselling for complementary feeding</strong></td>
<td>All infants. Assumed that 50% of the counselling will take place at health facilities and 50% at community level by a CHW.</td>
<td>Based on expert opinion, estimated global coverage is 5%</td>
<td>Two full sessions: one at 9 months and 12 months.</td>
<td>No important cost driver at this level</td>
</tr>
<tr>
<td><strong>Case management of severe malnutrition</strong></td>
<td>Population in need was approximated by children under-five with weight-for-height: below -3 SD</td>
<td>As specified in definition below.</td>
<td>5 follow-up visits by CHW</td>
<td></td>
</tr>
<tr>
<td><strong>Pneumonia case management</strong></td>
<td>86% of all pneumonia cases estimated to be non-severe. Out of these, we assumed that 20% of incremental cases in rural areas, and 100% of incremental cases in urban areas, will be treated at the facility level.</td>
<td>Current coverage of ARI case management as reported by DHS surveys from 1995 or later.*</td>
<td>When ill</td>
<td></td>
</tr>
<tr>
<td><strong>Diarrhoea management with zinc</strong></td>
<td>Assumed that 80% of cases are treated at home, either by a CHW or a family member, of which half require ORS.</td>
<td>Current coverage of diarrhoea treatment reported by DHS surveys from 1995 or later. *</td>
<td>When ill</td>
<td></td>
</tr>
<tr>
<td><strong>Community-based case management of neonatal infections (antibiotics for possible neonatal sepsis)</strong></td>
<td>All newborns</td>
<td>10%</td>
<td>When ill</td>
<td></td>
</tr>
</tbody>
</table>

*When ill Drugs, in particular zinc
<table>
<thead>
<tr>
<th>Service Description</th>
<th>Areas of Need</th>
<th>Coverage Source</th>
<th>Delivery Method</th>
</tr>
</thead>
</table>
| **Antimalarials for under-fives**  
At community and health centers. | Under-fives in areas with malaria | Current coverage from RBM model (from DHS) | When ill |
| **Vitamin A supplementation**  
Vitamin A supplementation for all children aged 3, 9 and 15 months, and subsequently doses every 6 months up to the age of 5 years, at the health centre or with outreach/campaign delivery.  
To estimate the cost, we assume that the vitamin A shots are delivered at the health facility in urban areas (100%) and either at the facility (20%) or by a community health worker (80%) in rural areas. | Population in need: All children under five in countries identified to have a need for Vitamin A supplementation (indicated by vitamin A deficiency or combination of indirect indicators) | WHO data. | Delivered by CHW/immunization worker when appropriate (at 3, 9 and 15 months, and subseq. doses every 6 months up to the age of 5 years). |
| **Immunizations**  
Includes BCG, DPT, measles, yellow fever, polio, Hib, and HepB | All under-fives. Delivery at facility level and campaigns. | Country-specific | Vaccines depending on country, but particularly Hib. |
| **Regular deworming**  
Regular treatment with anthelminthics (as from WHO list of essential medicines) of any child over the age of 12 months in areas where soil-transmitted helminths are of public health relevance. Delivery is expected to piggyback on other interventions (notably the CHWs or health facilities which distribute Vitamin A, and immunization workers). | All children aged 12-59 months in countries concerned. | Country-specific coverage data, imputing current coverage of 0% in countries for which we had no data. | Anthelmintics |
| **Insecticide treated materials**  
LLITNs given out in community and at health centres, in conjunction with routine post-natal care and vaccine administration. | Under-fives in areas with malaria | Current coverage from RBM model (from DHS) | Long lasting ITNs are distributed to children every 3 years |
| **Care at first level facilities** | | | |

*WHO/FCH/CAH Methodology and assumptions used to estimate the cost of scaling up selected child health interventions*
<table>
<thead>
<tr>
<th><strong>Breastfeeding counselling</strong></th>
<th>All newborns (estimated that by 2015 20% of mothers will receive counseling at the health facility level)</th>
<th>Based on expert opinion, assume current total coverage is 5% for CMH 1-3 and 20% for CMH 4 countries. Current coverage at health facility level: assume 1% in CMH 1-3 and 5% in CMH 4</th>
<th>Three follow-ups (first week after birth; 6 weeks; and 5-6 months)</th>
<th>Staff salaries</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Counselling for complementary feeding</strong></td>
<td>All infants. In this cost estimate it was assumed that 50% of the counselling will take place at health facilities and 50% at community level.</td>
<td>Based on expert opinion, we assumed a conservative global current coverage of 2%.</td>
<td>Two full sessions: one at 9 months and 12 months.</td>
<td>Staff salaries</td>
</tr>
<tr>
<td><strong>Pneumonia case management</strong></td>
<td>86% of pneumonia cases are defined as non-severe. Of these, we estimated that 20% of incremental cases in rural areas, and 100% of incremental cases in urban areas, will be treated at the facility level.</td>
<td>Used current coverage of ARI case management as reported by DHS surveys from 1995 or later. *</td>
<td>When ill</td>
<td>Staff salaries</td>
</tr>
<tr>
<td><strong>Diarrhoea management</strong></td>
<td>Estimated that 20% of diarrhoea cases are treated in facilities, of which 10% (i.e. 2% of total) are severely dehydrated.</td>
<td>Used current coverage of diarrhoea treatment reported by DHS surveys from 1995 or later. *</td>
<td>When ill (incidence)</td>
<td>Drugs, in particular zinc (although very low unit price)</td>
</tr>
<tr>
<td><strong>Antibiotics for dysentery</strong></td>
<td>Population in need estimated at 5% of diarrhoea incidence.</td>
<td>Current coverage was approximated by the DHS indicator of diarrhoea treatment with ORS or RHS as described above.*</td>
<td>When ill</td>
<td>Drugs</td>
</tr>
<tr>
<td>-------------------------------</td>
<td>---------------------------------------------------------------</td>
<td>-------------------------------------------------------------------------------------------------</td>
<td>--------</td>
<td>-------</td>
</tr>
<tr>
<td><strong>Treatment of measles and measles complications at the health facility level</strong></td>
<td>Non-complicated measles cases are assumed to be managed by a health facility worker using vitamin A therapy (referral if complications).</td>
<td>Current coverage estimated by ratio of reported measles cases over total estimated measles cases (as reported by the IVB model).</td>
<td>When ill</td>
<td></td>
</tr>
<tr>
<td><strong>Antimalarials for under-fives</strong></td>
<td>Under-fives in areas with malaria</td>
<td>Current coverage from RBM model (from DHS)</td>
<td>When ill</td>
<td>Drugs</td>
</tr>
<tr>
<td><strong>Vitamin A supplementation</strong></td>
<td>All children under five in countries identified to have a need for Vitamin A supplementation (indicated by vitamin A deficiency or combination of indirect indicators). Vitamin A is delivered at the health facility in urban (100%) and rural (20%) areas.</td>
<td>Based on reported country-specific coverage.</td>
<td>Every 6 months up to the age of 5 years</td>
<td>Vitamin A</td>
</tr>
<tr>
<td><strong>Immunizations</strong></td>
<td>All under-fives. Delivery at facility level and campaigns (no % given)</td>
<td>Country-specific</td>
<td>Vaccines depending on country, but particularly Hib.</td>
<td></td>
</tr>
<tr>
<td><strong>Regular deworming</strong></td>
<td>All children aged 12-59 months, all countries concerned</td>
<td>Based on reported coverage. Current coverage of 0% imputed for countries for which there was no data available.</td>
<td>Assume provided with Vitamin A.</td>
<td>Anthelmintics</td>
</tr>
</tbody>
</table>
facilities which distribute Vitamin A, and immunization workers).

<table>
<thead>
<tr>
<th>Insecticide treated materials</th>
<th>Under-fives in areas with malaria</th>
<th>Current coverage from RBM model (from DHS)</th>
<th>Long lasting ITNs are distributed to children every 3 years</th>
<th>Bednets</th>
</tr>
</thead>
<tbody>
<tr>
<td>LLITNS given out in community and at health centres, in conjunction with routine post-natal care and vaccine administration.</td>
<td>By 2015, 20% of all mothers will receive counseling at the first referral level.</td>
<td>Based on expert opinion, assume current total coverage is 5% for CMH 1-3 and 20% for CMH 4 countries Current coverage at first referral level: assume 4% in CMH 1-3 and 10% in CMH 4</td>
<td>Three follow-ups (first week after birth; 6 weeks; and 5-6 months).</td>
<td>Salaries, in particular at referral hospital level</td>
</tr>
</tbody>
</table>

**Care at First Referral Level**

**Breastfeeding counselling**
All mothers are provided with post-delivery counselling on exclusive breastfeeding for 6 months, followed by appropriate complementary feeding and continued breastfeeding for 2 years or beyond.

<table>
<thead>
<tr>
<th>Case management of severe malnutrition</th>
<th>Population in need was approximated by children under-five with weight-for-height below -3 SD</th>
<th>Based on expert opinion and the extent of training done so far in the countries included, we assumed a conservative global current coverage of 5%.</th>
<th>When weight-for-height below -3 SD</th>
<th>Inpatient hospital costs, blood test, formula diet</th>
</tr>
</thead>
<tbody>
<tr>
<td>All severely malnourished children with weight-for-height below -3 SD and/or oedema are hospitalized during the initial phase of their treatment. Once the medical complications associated with severe malnutrition are under control, and after initial stabilization all severely malnourished children receive a highly fortified high energy high protein therapeutic diet allowing rapid catch up growth until full recovery.</td>
<td>Estimated that 12% of children with pneumonia have severe pneumonia and are treated at first referral level.</td>
<td>Current coverage of ARI case management as reported by DHS surveys from 1995 or later. *</td>
<td>When ill Injectable drugs and X-ray test.</td>
<td>Salaries at referral hospital level</td>
</tr>
<tr>
<td><strong>Case management of severe pneumonia</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standard management of severe cases of acute respiratory infections at the referral level. Children stay on average three days as inpatients and are given injectable antibiotics followed by oral amoxicillin for 5 days as outpatients. 50% of cases are treated for wheezing.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Case management of very severe pneumonia</td>
<td>Estimated that 2% of children with pneumonia have very severe pneumonia and are treated at the hospital level.</td>
<td>Current coverage of ARI case management as reported by DHS surveys from 1995 or later. *</td>
<td>When ill</td>
<td>Inpatient hospital costs, injectable drugs and X-ray test.</td>
</tr>
<tr>
<td>-----------------------------------------</td>
<td>--------------------------------------------------------------------------------------------------</td>
<td>-----------------------------------------------------------------------------------</td>
<td>-------</td>
<td>---------------------------------------------------</td>
</tr>
<tr>
<td>Standard management of very severe cases of acute respiratory infections at the referral level. Children are hospitalized for an average of five days, during which they are given injectable antibiotics. Injectable gentamicin is given for 10 days (including 5 days outpatient). 50% of cases are treated for wheezing, and 5% receive steroids.</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Case management of severe dehydration (this intervention is included under diarrhoea management). Severely dehydrated children are referred to hospital where they receive treatment with intravenous electrolyte solution, followed by ORS and zinc.</td>
<td>1% of diarrhoea incidence</td>
<td>Current coverage of diarrhoea treatment reported by DHS surveys from 1995 or later. *</td>
<td>When ill</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Treatment of measles complications at the first referral level</td>
<td>10% of measles cases estimated by the IVB model are assumed to have severe complicated measles including pneumonia complications</td>
<td>Coverage data for treatment of pneumonia was used as proxy</td>
<td>When ill (estimated by projected measles cases as given by IVB model)</td>
<td>Supplies (infusions) and salaries at referral hospital level. Drugs for severe pneumonia. X ray</td>
</tr>
</tbody>
</table>

* For countries which lacked an estimate, we extrapolated regional values weighed by under-five population size per country.

** Note that PMTCT: anti-retroviral prophylaxis and infant feeding counselling is not included in the table above.
Annex 5 Estimating current coverage and target coverage by delivery point

In general, the data available on current coverage is very limited. The proportions of interventions delivered at each level suggested below were chosen for this particular costing exercise and do not reflect WHO recommendations in general.

1. Breastfeeding counselling

Estimated current coverage: While data may be available on rates of exclusive breastfeeding, information on coverage of counselling interventions is extremely limited. Based on expert opinion, a conservative global estimate of 5% was assumed for countries with a CMH classification 1 to 3. For CMH 4 countries, current coverage was assumed to be higher, at 20%. This assumption is based on the fact that countries such as Brazil, Egypt and Turkey have all expanded coverage of breastfeeding counselling by training counsellors, either with the WHO/UNICEF course or with other similar training. Other countries belonging to the CMH 4 category included in our cost assessment were assessed based on their reported rates of exclusive breastfeeding at 4 months and this was compared with information on general policy and training on breastfeeding counselling in the countries concerned. Following this procedure, it was agreed that a general estimate of 20% for CMH 4 countries would be appropriate.

2015 coverage at various delivery points: This intervention was assumed to be delivered at three levels, and so costs were based on a predicted split of coverage by delivery level. The assumption used was that by 2015, 55% of all newborns will receive counselling sessions at the community level, 20% at the facility level and 20% at the first referral level.

Estimated current coverage by delivery point: Again, data is limited and assumptions had to be based on expert opinion. In countries with a relatively weak health system, here classified as CMH 1-3, it was presumed that most of the counselling currently takes place at the referral level (4%) and a lesser fraction at facility level (1%), whereas current coverage at community level was assumed to be negligent (0%). As CMH 4 countries included in the cost analysis have a more developed health system at the community level, different proportions of estimated current delivery were used. The 20% estimated current coverage in 2005 was apportioned in the following manner: 5% at community level, 5% at facility level and 10% at the first referral level.

Summary: The model estimates the costs for scaling up accordingly:

In countries with CMH 1-3:
- Counselling at the community level is scaled up from 0 to 55%
- Counselling at the health facility level is scaled up from 1 to 20%
- Counselling at the first referral level is scaled up from 4 to 20%

In countries with CMH 4:
- Counselling at the community level is scaled up from 5 to 55%
- Counselling at the health facility level is scaled up from 5 to 20%
- Counselling at the first referral level is scaled up from 10 to 20%

2. Counselling to improve complementary feeding

There are no reliable estimates of current coverage of this counselling intervention. Based on expert opinion, we assumed a conservative global current coverage of 2%. Costs were based on the theory that 50% of the counselling will take place at health facilities and 50% at community level. Current coverage per delivery point was assumed to be similarly divided, so that counselling at the community and health facility level is each scaled up from 1 to 50%.

3. Case management of severe malnutrition
Based on expert opinion and the extent of training done so far in the countries included, we assumed a conservative global current coverage of 5%, scaled up to 95% at referral level.


To estimate the current coverage of case management of pneumonia, we used current coverage of treatment of acute respiratory infection as reported by DHS surveys from 1995 or later.\(^{84}\) GBD regional averages were extrapolated using country estimates weighted by under-five population and used for countries which lacked a reported coverage level. Given the lack of coverage indicators per level of delivery, the DHS indicator was used as a proxy for coverage at all three levels (community; health facility and first referral level).\(^{85}\)

To estimate the current coverage of case management of diarrhoea we used the DHS indicator of diarrhoea treatment with ORS or RHS as reported by DHS surveys from 1995 or later.\(^{86}\) This value was used as a proxy for current treatment coverage at all three levels of delivery (community; health facility and first referral level).\(^{87}\) For countries which lacked an estimate, we extrapolated regional values weighted by under-five population size per country.

For treatment of dysentery, current coverage was approximated by the DHS indicator of diarrhoea treatment with ORS or RHS as described above.\(^{88}\) The current coverage of zinc for diarrhoea management was estimated at 0% at all levels of delivery.

7. Treatment of measles and measles complications

To estimate the current coverage of general case management of non-complicated measles (90% of incremental cases), we used the ratio of reported measles cases over total estimated measles cases (as reported by the IVB model). This is based on the assumption that all reported cases are currently treated with Vitamin A. To estimate the current coverage of the treatment of measles complications, we used

---

\(^{84}\) Exact DHS phrasing: "Prevalence and treatment of acute respiratory infection and of fever: "Percentage of children under five years who were ill with a cough accompanied with rapid breathing and the percentage who were ill with fever during the two weeks preceding the survey, and the percentage of ill children who were treated with specific remedies, by selected background characteristics." Our indicator thus measures whether the child was taken to a medical facility for treatment of the fever and/or cough. This indicator should include all public sector facilities and all medical private sector facilities except for pharmacies.

\(^{85}\) In reality we would expect correct case management at the referral level to have a lower current coverage than case management for non-severe pneumonia.

\(^{86}\) Exact DHS phrasing: "Treatment of diarrhoea: Percentage of children under five with diarrhoea in the two weeks preceding the survey who were taken for a treatment to a healthy facility or provider, percentage who received oral rehydration solution (ORS), and percentage who did not receive any treatment." To estimate current coverage we used the percentage of under-fives receiving either ORS or recommended home solution (RHS).

\(^{87}\) In reality, correct case management of severe dehydration at the referral level would be expected to have a lower current coverage than that reported for management of non-severe diarrhoea.

\(^{88}\) We found no data indicating whether current coverage of care for dysentery differed from that of non-severe diarrhoea. The coverage of ORS/RHS treatment, as reported in DHS, was therefore used as a proxy indicator of correct case management of dysentery.
the same reported coverage as for general pneumonia case management. This intervention was scaled up using the same scale-up curves as regular ARI treatment.  

8. Community based case management of suspected sepsis

The lack of country-specific data necessitated a global estimate of current coverage set at 10%.  

9. Antimalarials for under-fives

Estimated coverage as used in the malaria costing tool was based on DHS data and extrapolated by WHO GBD region.  

10. Vitamin A supplementation

To estimate current coverage for Vitamin A supplementation we used WHO data available for supplementary activities or Vitamin A linked to immunization in 2003. Whenever there were several different estimates of coverage reported we used the highest coverage quoted. When data was not available for year 2003, the most recent estimate from years 1997-2002 was used. For countries with very limited indication of current coverage, the reported immunization schedules were examined to check whether countries include distribution of Vitamin A during the routine schedule. When there were indications that this was done, the time at which Vitamin A was reportedly given was compared with the coverage of the corresponding antigen that Vitamin A was assumed to be given with, using WHO-UNICEF estimates of coverage.

11. Immunizations

Estimated coverage in the WHO-IVB costing model is based on WHO/UNICEF data.  

12. Deworming

Until now, there has been no systematic monitoring of deworming activities globally and large-scale programmes reaching under five year olds is only just starting. Country-specific estimates of coverage were used when available. In order not to underestimate the need we used very conservative estimates, imputing a current coverage of 0% in countries for which we had no data.

13. Prevention of mother to child transmission of HIV (anti-retroviral prophylaxis and infant feeding counselling)

Coverage as in the Futures Group costing tool.

14. Insecticide treated bednets and other materials

Current coverage in the malaria costing tool was based on DHS data, extrapolated by WHO GBD region.

---

89 The fact that severe pneumonia is costed elsewhere may produce some double counting of treatment of pneumonia cases. However, the number of measles cases treated is very small and will drop as immunization coverage is scaled up. The possible additional cost arising from double counting is thus negligible.

90 Global coverage has been estimated at 10% by Jones G et al. (2003).

91 For example, if Vitamin A is given at 6 months of age this indicates that it is given with DPT3; if given at 9 months this indicates that it is given together with measles. Information on schedule and coverage per country found at http://www.who.int/vaccines/globalsummary/immunization/countryprofileselect.cfm (last accessed 16/02/2005)

92 Personal communication Dr Henrietta Allen Parasitic Diseases and Vector Control (PVC) Communicable Diseases Control, Prevention and Eradication (CPE), WHO.
15. Universal Salt Iodization
Country data on the percentage of households consuming iodized salt was gathered from the International Council for the Control of Iodine Deficiency Disorders (ICCIDD). This was used as a proxy of current coverage for scaling up the consumption of iodized salt.

16. Implementing the International Code of marketing of Breast Milk Substitutes
The implementation of the Code as modelled here includes only programme costs, which are implemented continuously throughout the period. Please refer to annex 6 on system costs for more details on the scale-up of monitors etc.

93 http://www.people.virginia.edu/~jtd/iccidd/mi/cidds_alpha.html (last accessed 16/02/2005)
Annex 6 Key assumptions underlying programme costs

Programme costs have been estimated as umbrella costs for all under-five interventions, with the exception of some activities that are particularly related to certain interventions, such as legislation on iodine, or cold chains for vaccine storage. Costs were estimated using a bottom-up ingredients approach with a holistic perspective on health system requirements at all levels. Costs were shared with other programmes when deemed appropriate, but for the most part costs were fully attributed to under-five health. The quantity of inputs required for health system development is modelled differently for countries according to their CMH classification, as we assume that countries will have different needs and requirements to reach the target coverage set.

Prices are based on programme cost regression models \(^{94}\) and adjusted for national inflation rates. Local inflation rates (based on consumer price indices) were applied to local or mixed goods (such as media, buildings etc.) to bring all cost figures to year 2004 US$ levels (inflation rates were taken from countries’ central bank web sites or, when not available there, from IMF data). Observed per diems were used when available, and otherwise derived from the programme cost regression model.

6.1 General programme management

Employment of staff for under-five programme management
This category includes the cost of employing additional staff at the national level for one fulltime programme manager, one general assistant, one assistant for training and one assistant for community issues. In countries with a population of 30 million and above, the incremental cost of employing similar staff teams at the provincial level was also included. \(^{95}\)

Development of Strategic Plans for Child Health
Costs include development and/or revision of four strategic plans for under-five health, based on diarrhoea, ARI, malnutrition and newborn health. Activities are assumed to occur every three years.

Situational Assessment
Costs include setting up a co-ordination group, holding consensus-building meetings, hiring consultants to do a literature review to gather and analyse relevant data, and the cost for site visits for situational assessment (national staff visiting on average ten facilities per year). These activities are assumed to take place every three years.

Annual work plans and inter-departmental coordination meetings
The situational assessment process is assumed to feed into the development of annual work plans (four work plans per country for the four key areas), for which costs include travel costs and Per Diems for both national and extra-national experts, meetings costs and support staff. Estimated costs also include holding one inter-departmental coordination meeting per year.


\(^{95}\) The cost of additional staff at the national level was seen as necessary in all countries. In smaller countries (i.e. those with a population of 30 million or less) a national team was considered sufficient to be able to manage child health programmes.
District microplans
Incremental costs for the development of annual district micro plans for child health include workshops with national and local attendants, and meeting costs.

Policies and regulations
Costs are included for revision and distribution of policies and regulations every three years. Activities required are background research based on the situation analysis, policy review and policy reformulation. Assumed two policy review processes for each three-year plan period.

Recruitment and management of community health workers
Additional staff will be required to recruit and manage the vast numbers of CHWs that will be needed in order to scale up community management of childhood illness. Estimated costs include employing CHW co-ordinators, where the need per country is estimated to vary with the number of provinces and with CMH classification. For countries with a CMH classification of 1 or 2, the cost was included for 0.67 co-ordinators per province. For CMH3 countries this number was 0.33 per province and for CMH4, no need for incremental co-ordinators was expected (i.e., it was assumed that the staff is already there but currently performing other tasks). The cost of employing community nurses to support the CHWs was estimated in a similar way.

6.2 Honorariums for community health workers
In recognition of the fact that good family and community practices are essential to promote child survival and development and that in many countries links between primary care and care at the community level need to be strengthened, costs include the establishment and support of child health workers at the community level. CHW honorariums were estimated as health system costs rather than patient costs on the assumption that the need for CHWs will be population-based; that community workers will receive the same honorarium independent of their daily workload; and that CHWs will pay visits to the well child as well as the sick child. \(^96\)

Costs here include honorariums, recruitment materials and care kits, while other CHW-related costs fall under the categories of training (6.3) and supervision (6.4). In order to estimate honorariums, we used a proxy variable of 33% (one third) of the estimated average gross salary of a lower level service staff in African countries, and 17% (one sixth) of the same wage category in countries outside of Africa. \(^97\)

To approximate the number of community health workers (CHWs) required to care for child health we estimated the need at one CHW per 1000 population in rural areas and one CHW per 1500 population in urban areas. The attrition rate was set at 25% per year. Data on current numbers of CHWs per country are limited, yet with a few exceptions the numbers are very small. Based on this and the fact that attrition rates are high, it was assumed that 100% of the required CHWs would need to be newly recruited.

\(^96\) For reasons of comparison an alternative estimate of CHW costs was calculated based on the number of client visits required for ill children using a similar estimate for honorarium rates, with assumptions made on the number of visits required per CHW per year. Using this methodology, the equivalent CHW "patient cost" came out to be more or less equivalent to that calculated as a programme cost.

\(^97\) WHO/EIP country-specific defaults were used for salaries. The estimates for honorariums were assessed by experts familiar with country specific incentive rates and found to be an acceptable proxy variable.
For each newly recruited CHW we added the cost of a care kit containing 1 thermometer, 1 packet of information materials, 1 watch, 1 jug, 1 bowl, spoons, cups, and in 20% of cases a bicycle. In addition to the care kit, the cost for recruitment materials included those of posters and flyers. The costs for human resource recruitment and development in this model was based on the projected scale up scenarios for each country; thus the CHW recruitment schedule was based on the scaled-up coverage of diarrhea management from current estimated coverage to 95% in 2015.

6.3 Training health workers

Costs have been included for short-term training of CHWs, health workers at facility and first referral level, and programme management staff. Training costs are based on activities occurring at various stages in the health system, including inputs for upgrading pre-service training; upgrading in-service training for staff at health facilities and hospitals; and expanding refresher training.

A. Upgrading pre-service training:
The costs of adapting curricula at pre-service institutions were estimated assuming that upgrading occurs every 5 years and involves a number of meetings held with health professionals and representatives from teaching institutions, where participants include local experts as well as extra-national experts. Costs include a review of current curricula, meeting costs, writing and printing training materials and testing of the updated curriculum.

B. Introductory training for CHWs
Costs were included for a general 9-day training course for all newly recruited community health workers. The cost of training was spread out over the years 2006-2014, following the projected country-specific scale-up patterns.

C. In-service training at health facilities to upgrade staff skills: IMCI training
In order to upgrade the skills necessary for efficient case management of childhood illness at the health facility level we estimated that 60% of all health workers in all countries would need to complete a training course in Integrated Management of Childhood Illness (IMCI) - a strategy for the combined management of the major childhood illnesses and malnutrition. The length of the course currently varies between countries: to estimate global costs we assumed that a standard course would be 9 days long and have 20 attendants. Training costs were spread out over the scale-up period (2006-2014) following projected country-specific scale-up patterns. Data on the total number of current health staff per country was used to estimate the total number of attendants for the course. Costs include

98 In order not to underestimate the cost for additional care at the community level, we made the assumption that additional CHWs would need to be recruited even in countries such as India and Pakistan, where a developed network of community health workers or Lady health workers already exists. It was not considered realistic that existing CHWs would be able to increase their work burden as much as deemed required.

99 As a technical note, this was done by calculating the incremental coverage and scale-up curve to be covered between 2006 and 2015, and then apportioning required CHWs accordingly in a proportional fashion.

100 The course would include management of suspected sepsis, diarrhoea, fever and mild pneumonia, as well as malnutrition interventions. Distribution of vitamin A and deworming activities would also be included in the curriculum.

101 Training cost trajectories followed the country-specific estimated scale-up of diarrhoea management.

102 The number of attendants are based on current staff numbers and do not include the additional health workers that would ultimately be required to scale-up interventions. Two reasons for this are a) the complications involved
travel costs, Per Diems for trainers, participants and resource staff; classroom costs and training materials. The costs also include a one-day follow-up visit when the coordinator travels to the health facility to evaluate the results of the training.

Further, costs were included for refresher training for health facility staff every three years, in the form of three-day courses with 20 participants in each course. Here as well, costs include travel costs, Per Diems for trainers, participants and resource staff; classroom costs and training materials.

D. Upgrading in-service training at first referral level: specialized training for the hospitalization of severely ill children

The first step of implementing a specialized training course for case management at referral level is regional training. This activity is currently funded by WHO and thus excluded from our estimate of incremental costs. The second step involves training at the national level, and the cost of a 10-day national training course for 20 participants was included for countries with CMH 1 and CMH2. It was assumed that countries classified as CMH3 and 4 should already have the relevant skills at the national level.

The third step in this process is hospital-based training, for which we included the cost of training three participants per first referral level facility. The number of staff in need of training was estimated by taking the maximum number of districts and hospitals respectively; adding the number of facilities upgraded to a hospital standard as required (see section 6.2.8 below). It was assumed that 5% of relevant staff would already have received the training, and costs were included for the remaining 95% of estimated staff in need of training at the first referral level. Differences between countries in present skills were accounted for by varying the length of the course, based on the criteria of CMH classification. In order to ensure that skills are kept up to date, we included the cost of regular follow-up seminars at hospital level, assumed to be held once a week in all hospitals in all countries, and in CMH1 countries additionally once a month with an expert from outside the institution (Per Diem, travel and meeting costs included).

E. Training for programme managers

The cost of training programme managers was estimated as a 10 day course composed of the general IMCI training course plus one additional day devoted to Child Rights and the Convention on the Rights with of estimating the exact number of additional human resources required (as explained in section 5.1), and b) the assumption that newly recruited health workers would have received adequate pre-service training.

103 The number of staff required to do each refresher course was estimated by the number of staff who did the 9-day IMCI course or the 3-day refresher course three years earlier. It is assumed that newly recruited personnel will fill any gaps due to regular attrition, and require refresher courses with the same intervals.

104 It was not however automatically assumed that the same three people would attend the different sessions included in the course (i.e. different staff may attend sessions on the case management of the severely malnourished child and those for counselling for breastfeeding).

105 The 5% estimate of current personnel with adequate training is based on estimates of WHO activities at country level.

106 The estimated required length of course was as follows: CMH1 countries have 6x3 days of training; CMH2 countries have 4x3 days, CMH3 countries 3x3 days, and CMH4 countries 2x3 days. These estimates were based on expert opinion on the need for additional training at referral level.
of the Child. Course attendants were estimated as one per district, one per province plus additional participation by newly recruited programme managers as in section 6.2.1)

6.4 Supervision

Costs of supervision were included at four levels, as shown in table A6 below: supervision at the district level, at first referral care level hospitals, at primary level health centers, and of community health workers. Cost for support staff and drivers were included for each supervision visit. It was assumed that all supervision visits include observation of case management, as well as systematic discussions on barriers to full implementation of case management guidelines. We assumed that barriers may be encountered in a small proportion of visits and thus a small budget for problem-solving associated with each supervisory visit was included.

Table A6  Assumptions used by CAH to estimate supervision costs

<table>
<thead>
<tr>
<th>Level of supervision</th>
<th>Number of supervisors</th>
<th>Number of trips per year</th>
<th>Number of days for each trip (incl. travel)</th>
<th>Proportion attributable to child health (%)</th>
<th>Number of visits requiring problem-solving expenditure</th>
<th>Supportive supervision expenditure</th>
<th>Yearly estimate spent by supervisor</th>
</tr>
</thead>
<tbody>
<tr>
<td>National to district level</td>
<td>2</td>
<td>3</td>
<td>2</td>
<td>100%</td>
<td>20%</td>
<td>US$ 20</td>
<td>US$ 12 per district</td>
</tr>
<tr>
<td>National to referral level</td>
<td>1</td>
<td>2</td>
<td>5</td>
<td>25%</td>
<td>20%</td>
<td>US$ 20</td>
<td>US$ 8 per hospital</td>
</tr>
<tr>
<td>District level to individual health facilities</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td>25%</td>
<td>20%</td>
<td>US$ 10</td>
<td>US$ 8 per facility</td>
</tr>
<tr>
<td>Health facility supervision of community health workers</td>
<td>1</td>
<td>4</td>
<td>1</td>
<td>100%</td>
<td>10%</td>
<td>US$ 2</td>
<td>US$ 0.8 per CHW</td>
</tr>
</tbody>
</table>

Budget for supervision and problem-solving

In order to ensure that supervision activities are supportive, it was assumed that 10% to 20% of visits will result in the supervisor encountering an unexpected constraint which would require immediate attention, and some expenditure not already accounted for in the budget. The anticipated need for financial expenditures, tied to the supervisor's visit and related to problem-solving activities, was based on the experience of unforeseen barriers and problems (such as lost equipment, consequences of the weather and natural environment, stock shortages etc) that may require unexpected financial outlays in many countries. In this respect, it was assumed that the supervisor should have access to a small amount of readily accessible money with which he/she could promptly assist in cases of unexpected constraints. The expenditure level was set at a range from $2-$20, based on expert opinion. It was expected that supervision costs could be shared with other health programs at the referral care and health facility level. At these levels child health only budgets 25% of expected costs in terms of Per Diems, travel costs, and support staff salaries. It is thus assumed that the supervisors at these levels are capable of assessing
work within all major areas of health. At the district and community level 100% of supervision costs are attributed to child health.

**Recruitment of new supervisors**
No costs were included for recruitment or training of supervisors. The model assumes that required staff is already there but that current capacity utilization of staff time is inefficient.

**Timing of supervision scale-up**
Supervision activities at the referral, facility and district levels, are scaled up in three years in all countries (2006-2008). The costs for supervision of CHWs is tied to the number of CHWs employed per year.

### 6.5 Externally financed technical assistance

Estimated expenditures for technical assistance includes costs related to upgrading country capacity. The specific activities involved depend upon country needs and present capacity, and have not been made specific in this model. As a proxy value, we included the annual costs of 5 international consultants for 20 working days each; 4 local consultants for 6 weeks each and 2 national consultants per district for one week each total. These estimates will cover some of the country-specific needs to strengthen national capacity, in addition to other activities as specified elsewhere in the model.

### 6.6 Information, Education and Communication (IEC)

**General awareness to improve care seeking:**
Activities for which costs are included on a regular basis include formative research every four years for developing and improving child health strategies in the community. Costs for conducting the formative research were based on the recruitment of one international consultant and a national research team for one month, as well as follow-up research every year by the same team for a shorter period of time, plus transport costs.

**Media and social mobilization:**
Costs were included for hiring agencies to produce radio and TV spots, and for airing three radio spots and one TV spot per day for the whole period, in every country. Costs for printing posters were estimated on a population basis with 15 posters required every 3 years per 1000 population. Costs were also included for training staff to use the communication materials effectively in communication with clients.

**Staff costs**
Staff costs included hiring social mobilization officers as designated focal points for IEC and advocacy at the national level. It was assumed that these are already present in CMH 4 countries. Staff costs were included for one social mobilization officer and one part-time secretary in CMH 3 countries, and for three social mobilization officers and one secretary in CMH 1 and 2. Costs also include office supplies and equipment for staff.
6.7 Monitoring and Evaluation

**Staff costs**
Data entry personnel and epidemiologists will be required at the national level to consolidate and analyse information collected at health facilities. We included staff costs for one data entry clerk per province and one epidemiologist per 2 million population, working mainly with under-five health data.

**Strategic review**
In countries classified as CMH1, we included costs for review and integration child health in monitoring and evaluation frameworks and designs at the national and district level. Costs include a strategic review every three years, with a number of meetings involving local experts as well as an international expert per meeting.

**IT infrastructure**
M&E costs also include installing and maintaining IT infrastructure and email systems. For the number of new E-mail connections established, 40% were attributed to under-five health care.

**Community and facility-based surveys**
Community-based surveys were costed every five years for countries who presently do not do DHS or MICS surveys. 30% of the estimated cost of a survey were attributed to under-fives. The cost for a Health Facility Survey (HFS) every 3 years has been included for countries who presently do not perform this type of activity. Costs included for human resources for survey planning and preparation was estimated by an average cost of 3 surveyors for 3 weeks each, per HFS. Costs for data entry and analysis and dissemination of findings were assumed to be included in staff costs at the national level. 80% of costs were assumed attributable to child health.

6.8 Infrastructure investments

The assumptions on infrastructure are specific for the level of care, and for the CMH classification. The estimated number of first referral hospitals required to cope with under-five health care was assumed to average one per 120,000 population across the included countries. For countries with a record of fewer hospitals than that, an appropriate number of health facilities were assumed to be upgraded to a referral standard, as described below. In addition, costs were included for maintaining/upgrading remaining health centers and hospitals by the addition of equipment assumed to be absent. Purchase of capital items needed for scale up was calculated and international insurance and freight charges were added to the prices.

**Infrastructure and buildings**
Costs for infrastructure and buildings were not included. It was assumed that additional activities with increased care can be carried out within current working space.

**Upgrading existing hospitals' equipment**
For this category the only major investment included in under-five costs was the perceived need of incremental X-ray machines. The percentage of first referral hospitals for which costs of new X-ray

---

107 120,000 population per district was used as a general average even though the authors recognize that specific countries/contexts will have different needs based on hospital size, treatment times, population demand, geographical distribution of patients, ease of transportation etc.
equipment was included for child health was as follows: CMH1: 50%, CMH2: 33%, CMH3: 17%; CMH4: 0%. The schedule for providing the equipment followed a five year pattern: 2006 (10%), 2007 (15%), 2008 (25%), 2009 (25%), 2010 (25%).

**Upgrading existing health centers to hospital standard**

The estimated number of first referral hospitals required to deal effectively with under-five health is one per 120,000 population. For countries with a record of fewer hospitals than that, an appropriate number of health facilities were assumed to be upgraded to a referral standard. The following costs were included: the purchase of an X-ray machine; lab equipment including a lab with tables and workbenches; refrigerators for food and drugs separately; one photometer; one glucose determination machine; one oxygen concentrator; one centrifuge and some other miscellaneous equipment.

It was assumed that 100% of facilities in all countries (CMH 1-4) will need all of the new equipment, except for drug refrigerators, which we assumed to be already present in 100% of health facilities in CMH4; in 70% of facilities in CMH3, and in 40% and 0% of health facilities in CMH2 and CMH1 respectively. 25% of all equipment costs was attributed to under-fives, except for microscopes and food refrigerators of which 40% of costs were attributed to child health. 10% of costs were added for maintenance. In addition salary costs were included for one X-ray technician and one lab technician for each upgraded facility (these staff are assumed to be additional to current staff availability).

**Upgrading existing health centers' equipment**

Costs were estimated by the perceived need for purchase/replacement of microscopes, thermometers and other essential equipment. As above, the quantity of inputs required for health system development is modeled differently for countries depending upon CMH classification, suggesting that countries will have different needs/requirements to reach the target coverage set. The estimated need of equipment replacement was assumed to be 90% for existing health facilities in countries with CMH 1, 60% in CMH2, 30% in CMH3 and 0% in CMH 4. The schedule for providing the equipment is as follows: 2006 (10%) 2007 (15%) 2008 (25%) 2009 (25%) 2010 (25%). 10% of total costs were added for maintenance.

**Vehicles**

Infrastructure costs also include the cost of vehicles with drivers, and estimates have been based on transport needs for supervision and training.

**Analysis/Limitations**

One limitation of the methodology is that no costs were added for establishment of additional Primary Health Centres as required on a per population basis. In general it was assumed that CHWs would be able to treat or refer patients in areas with poor access to the health system.

**6.9 Advocacy**

**Planning the advocacy strategy**

Costs include the formulation and review of the advocacy strategy: in this case costs were included for a strategic review every three years, a number of yearly meetings involving both

---

108 Costs related to the procurement and transport of drugs have however not been included, as we assumed piggybacking on existing logistics for supplies.
national and international experts, and support to the advocacy base i.e. materials and transportation costs.

**Advocacy activities**
Costs include meetings held within the country and a number of advocacy events to be held every year. Examples of events could be soccer matches, concerts etc where costs in addition to travel costs, per diems, and travel would also include incentives to media, the cost of venue, equipment, refreshments etc. In addition costs were included for annual meetings held with private practitioners' associations, with the aim of informing private practitioners on issues relevant to child health.

**Advocacy materials**
Costs for advocacy materials are calculated separately for brochures/leaflets, pens, information kits and video documentaries.

### 6.10 Laws, policy, regulation (LPR)

This section refers to costs estimated for drafting legislation and policies related to under-five health. Main legal processes included are the International Code of marketing of Breast milk Substitutes, legislation for national iodine fortification, and legislation and policy related to the CRC.

**International Code of Marketing of Breast Milk Substitutes**

**Costs for drafting the law**
Costs were included for drafting/reviewing the law every ten years. One lawyer and one government official would receive training on relevant issues after which a consultant is hired to draft the law. Costs are included for a number of meetings held to discuss the draft, involving both local and extra-national experts, followed by annual follow-up meetings. Further, costs are included for writing policy and regulations, and for preparation and national distribution of briefing documents on the new policy.

**Costs for monitoring the code**
Monitoring activities would include random sampling of products sold in the private sector related to the international code. Ten monitors per 250,000 population are given forms to use when visiting private sector shops, and honorariums corresponding to 10% of their working time for their continuous monitoring efforts. Supervision costs were calculated based on the estimate of one supervisor for every 5 monitors, with monthly supervisory visits. Supervision costs include travel costs, and Per Diems for the supervisor and support staff. In addition we included costs for a consultant to analyse the activities of the monitors and the data gathered.

**Training journalists, customs officials, monitors and supervisors of monitors**
To ensure follow-up of the implementation of the legislation, costs were estimated for a three-day course on the implementation of the International Code of marketing of Breast Milk Substitutes, for journalists and custom officials in every country. Costs specifically include travel costs, Per Diems for students, trainers, drivers and resource staff, training materials and classroom costs. The community monitors are given a shorter one-day training course in preparation for their work. The training of health workers on the Code is assumed to be incorporated into the normal training routine.

---

109 Monitors would typically be health workers, teachers, university students, academics and food inspectors.
**Iodine Fortification**

Costs were only included in countries with a perceived need of iodine fortification (as defined in annex 3) and included the following mechanisms:

**Setting up a national IDD council**

Costs were included for setting up a national body responsible to the government for IDD elimination. The body should be multidisciplinary, involving the relevant fields of nutrition, medicine, education, the salt industry, the media, and consumers, with a chairman appointed by the Minister of Health.\(^{110}\)

**Drafting the law**

Costs were estimated as for the International Code of marketing of Breast milk Substitutes.

**Supervision of salt factories**

We assumed that there would be one salt factory per every 10 million population in need of supervisory activities. Costs (Per Diem, travel etc) were included for supervisors making monthly visits to salt factories. Some additional cost was included under this category for a short specific training course for supervisors/monitors.

**Supporting the implementation and monitoring of the CRC**

**Policy and legislative review**

As a proxy for estimating costs for a legislative process supporting the implementation of the CRC and developing a legal framework to support under-five health, costs were estimated for drafting or making amendments to a national law on mandatory birth registration every ten years. In addition costs were included for a policy and legislative review every 2,5 years, linked to the CRC monitoring process, and involving the hiring of one national legal consultant for 15 days to assist the national government in reviewing laws and policies. The review would be followed by a multi stakeholder meeting to discuss findings, where participants include both national and international/regional experts.

**Supporting a systematic M&E process**

Costs were also included to support a systematic monitoring and evaluation process of reports to the CRC Committee on child health. This would involve hiring a local consultant to write a health section of the report to ensure the involvement of the Ministry of Health in the process as well as a comprehensive health component in the report to the CRC Committee. Costs also include a multi stakeholder meeting to discuss follow-up to CRC committee recommendations, where one day is devoted to child health and participants include national experts, experts from the international agencies and national experts from NGOs.

**Training on child rights**

Training on child rights is incorporated into a training course for programme managers as described under section 6.3 above.

6.11 Programme costs for immunization

Programme costs for immunization were based on the WHO/IVB model, and therefore used another set of strategies to classify countries and the programme inputs needed. The model estimates health system costs based on how countries are performing with respect to various parameters including the McKinsey Classification of countries,\textsuperscript{111} the Transportation index,\textsuperscript{112} the CMH index,\textsuperscript{113} and other indicators such as current and historical DTP3 coverage. Whereas patient costs for vaccines include the actual vaccines, staff salaries and campaign costs, programme costs as included here account for cold chain, transportation, and supervision.

\textit{Cold chain}
Ingredients include cold boxes, cold rooms, refrigerators, freezers and cold-chain technicians. The introduction of cold rooms and freezers is based on the McKinsey Classification and current vaccination schedules in countries. Maintenance costs are included for new items purchased.

\textit{Transport costs for outreach, campaigns, and vaccine distribution}
Costs include purchasing and operating vehicles and motorcycles, with maintenance costs included. Costs for incremental vehicles and motorcycles are based on the number of districts below 50\% coverage, the number of districts with uninterrupted supply of vaccines, and the McKinsey classification.

\textit{Supervision costs}
Costs include per diem and staff costs, as well as materials to undertake supervision. Two supervision visits were estimated per district in countries that currently do not report having supervisory activities.

For more detailed information on vaccines costing methodology used, refer to the \textit{Proposal for an International Financing Facility for Immunization}, GAVI Partners, 2004.

\textsuperscript{111} McKinsey report to GAVI Board, April 2004.
\textsuperscript{112} Limao N, Venables AJ (2001).
Annex 7 Adjustment of population data

Population without migration was not available in single year intervals. Yearly population change rates were hence calculated using UN Population Division 2002 extrapolated projections.

The UN Population Division 2002 under five mortality was disaggregated by country as follows:
- The estimated death rate was smoothed linearly to single year estimates based on the UN Population Division five-year estimates.
- The estimated distribution of infant mortality over time was based on the assumption that 85% of infant mortality occurs in the first six months, and 15% in the next six months.
- Infant mortality was then subtracted from under-five mortality, with the remaining under-five mortality spread across the 1-5 year age groups as follows (based on expert opinion): 30%, 25%, 25%, 20%.
- The number of births was "back-calculated" from the population at 6 months (age 0) to the number of births using the 85% of infant mortality ratio. As was noted, this often does not match the number of births as calculated using the crude birth rate.

In order to account for mortality reduction due to the scale-up of interventions, the model drew upon earlier studies by the Bellagio Child Survival Study Group which indicate the mortality attributed to each condition/preventable by each intervention. These estimates were utilized to estimate the number of lives saved per intervention. The incremental percentage of averted deaths (reaching 67% by 2015) were proportionally distributed throughout the years to be directly proportional to the increase in coverage.

The country-specific yearly change (decline) in death rate by age group was applied to the overall change rate as calculated using the UN Population Division 2002 extrapolated projections to account for migration. The new rates of change were then applied to the population over time, by country, to calculate the new, expected under-five populations.

Note that the other three models used to estimate costs were not adapted to use the same assumptions and population estimates as described above:
- The WHO/IVB model uses the projected changes in the size and age distribution of the population according to the UN Population Division medium projections.
- The WHO/RBM model uses base year population and country specific growth rates to estimate the yearly population in need of malaria interventions.
- The Futures Group's Resource Needs Model, used to estimate costs for PMTCT (replacement feeding), uses UN population yearly estimates for the number of pregnancies.

The effects of using different population estimates have in this case been estimated as minor.

---

114 Jones G et al. (2003).
Annex 8. Estimated cost of F-75 and F-100 for feeding hospitalized children with severe malnutrition

A. Required quantities of formula food

Lait Thérapeutique F75
Daily requirements: 55 ml x 12 feeds / 80 ml x 8 feeds / 110 ml x 6 feeds.
Total requirement used in the cost estimate: 650 ml per day, or 2600 ml for 4 days.

Lait Thérapeutique F100 BO
Daily requirements: 200ml/kg/day
Total requirement used in the cost estimate: 10 litres for 10 days.

B. Prices for formula food

Lait Thérapeutique F75
Unité de vente: le carton de 20 sachets de 410 g = 8.2 kg net.
Prix départ usine: 2.66 Euros (restitutions non déduites ) = 21.81 Euros / carton.

Lait Thérapeutique F100 BO
Unité de vente: le carton de 30 sachets de 456g = 13.68 kg net.
Prix départ usine: 2.41 Euros (restitutions non déduites ) = 32.97 Euros / carton.

The price of the milk is given by weight.
1000 ml of F-75 is equivalent to 205g of dry powder of commercial F-75.
1000 ml of F-100 is equivalent to 228g of dry powder of commercial F-100.

C. Calculating the price of required formula food

Lait Thérapeutique F75
2600 ml of F-75 = 2.6 x 205g = 533g.
One bag contains 410 g, thus a child needs 533/410 = 1.3 bags of F75.
The cost of 1.3 bags is 1.3 x (21.81 Euros /20) = 1.418 Euros.

Lait Thérapeutique F100 BO
10L of F-100 = 10 x 228 g of F-100 = 2280 g.
One bag contains 456 g, thus a child needs 2280/456 = 5 bags of F-100.
The price of 5 bags of F-100 = 32.97 Euros /6 = 5.50 Euros.

No costs were included for wasted food formula.117
No costs were included for increased home fluids.

---

116 Prices gathered from personal communication with Catherine Melin, WHO Department of Nutrition for Health and Development, 2004-09-03.
117 No costs were included to account for formula that would be prepared but not used, such as when less exact quantities of F75 and F100 is prepared.
Annex 9  Estimates of incremental human resources needed to scale up key child health interventions to 95% coverage at the health facility level

Below is an estimate of incremental human resources needed to scale up under-five care in 75 countries at the health facility level. A gap analysis was utilized for selected interventions, based on coverage estimates and case management time. The estimates should be interpreted with caution since they rely on particular assumptions related to incidence, the proportion of cases that require delivery at the health facility level for each intervention, data on current coverage, the time required for case management, current human resources available, and the capacity of current human resources available to increase capacity.

A. Estimating scaled up case management and demands on health worker time
The costs of additional human resources were based on the estimated scale up of case management of childhood illness at the health facility level. To calculate case management time projected to the child population that requires care, the following information was reviewed:
(a) the total population of children under five, (b) incidence/ population in need of each intervention (c) the average number of under-five visits required at the health facility for each intervention (prevention and/or treatment interventions), (d) the average case management time for each intervention, (e) estimates of the number of disease classifications per child, and (f) current coverage of interventions.

(a) Population of children under five was gathered from UN population statistics. The data above for (b) on the average number of disease specific episodes per region was estimated by WHO incidence data (comorbidity visits were taken into account under (e) below).

Estimates for (c) were based on the assumptions used for delivery points in the cost analysis.

The average case management time (d) was based on expert opinion for some interventions, while for IMCI interventions we used an average health visit time based on time and motion studies from Tanzania. It has been shown that the estimated time per under-five visit is dependant on the coverage level of care: Adam T. et al found that when the number of visits increases, a provider spends less time per child until reaching a capacity constraint. The results of this analysis were implemented by estimating a reduction in minutes per visit due to the incremental increase in coverage levels. The results from Adam T et al show that each 1% increase in visits per provider per day will decrease the

118 To estimate the total need of case management time by full implementation (95% coverage) in the target year 2015, we used estimated under-five population data per country for year 2015.
119 From studies in Tanzania and Brazil it is known that it takes an IMCI trained, experienced health worker on average 8.2 minutes to administratively register and manage a sick child under five years of age and counsel the caretaker. CAH. Time-and-motion study, Multi-Country Evaluation of IMCI, Tanzania, 1999.
120 Consultation time was negatively correlated with the number of consultations per provider per day — each 1 % increase in the number of consultations results in a 0.50% decrease in consultation time per under-five child (p<0.0001). Adami T et al. Capacity constraints to the adoption of new interventions: consultation time and the Integrated Management of Childhood Illness in Brazil (forthcoming).
time per visit by 0.5%. The average time per case management as estimated from IMCI studies in Tanzania was 8.2 minutes, at an estimated capacity level of 65%. To calculate the time required for similar case management at 80% capacity level, we adjusted the time accordingly to:

\[
8.2 \text{ minutes} \times (1 - \frac{(80\% - 65\%)}{2}) = 7.6 \text{ minutes}
\]

Data on (e) was required since children usually have multiple diseases during one sickness episode. In general the number of disease classifications per child is different in different settings. Findings from Bangladesh, Tanzania and Uganda indicate that the median number of illnesses included under IMCI management per under-five visit in these countries was on average estimated to be 2.0.\(^{121}\) Based on the fact that the average IMCI case management time includes management of pneumonia, diarrhoea, dysentery, measles and malaria, we divided the average health visit time by 2.0 for the case management of these illnesses at the health facility level, to allow for integrated management of childhood illness. Thus the time required for treating a child with fever (malaria) would be 3.8 minutes (7.6 minutes/2.0).

Case management time was also estimated for follow-up visits, as well as for healthy child visits (vitamin A, deworming, immunizations, as well as growth monitoring and counselling on breastfeeding and complementary feeding. The time periods used to estimate case management needs for each intervention are given in the table below, and correspond to health workers working at 80% capacity.

By multiplying the estimated case management time for each intervention with the number of children requiring medical care at the health facility level by year 2015, the total time required for a scaled up case management of under-fives to 95% coverage was obtained for each intervention on a per-country basis. To calculate the incremental staff time needed, the total time was multiplied by the estimated coverage gap for each intervention, calculated by subtracting current coverage (f) from the 95% coverage target.

B. Estimating total person-years required for under-five case management at the health facility level

The total estimated need for health worker time in minutes to deal with incremental coverage (including follow-up visits) in this case was 10,447,170,588 minutes. In order to determine available staff working hours, data on the number of hours per day worked, and the number of working days per year, are required. We used the assumption that health staff will work a regular 8 hour day at 80% capacity, which translates into \(8 \times 60 \times 0.8 = 384\) minutes of actual working time per day. To estimate the number of working days per year we assumed that a health worker would work five days/week, have four weeks annual leave per year and on average 15 days of public holiday, resulting in an average of \(5 \times 48 - 15 = 225\) working days per year.

Adjusting for current inefficiencies
Taking current inefficiencies into account, the level of capacity utilization at current coverage was estimated at 65%. Some of the additional patient time required can therefore be accounted for by

---

\(^{121}\) IMCI-MCE findings from Bangladesh, Tanzania and Uganda (personal communication Eleanor Gouws, UNAIDS).
increasing the capacity of current health workers. The total unutilized capacity per country was based on the assumption that there is currently at least one health worker per health facility who is capable of increasing his or her capacity from 65% to 80%. The thus estimated unutilized capacity at health facility level in terms of minutes per year was calculated as follows:

We assumed that current capacity of staff is 65%, and that their full capacity will be 80%. The number of additional minutes available from current health workers if capacity is scaled up from 65% to 80% will then be $8 \times 60 \times (80\%-65\%) = 72$ minutes per day per health worker.

Current staff members at health facilities are most likely multi-purpose health workers. Studies have shown that multi-purpose health workers on average devote 40% of their time to under-five health. This implies that a currently employed health worker can devote $40\% \times 72$ minutes = 28.8 minutes per day to incremental child-specific health care if capacity is increased. Total slack time was added per country using the assumption that one health worker per health facility is capable of devoting 28.8 minutes per day (6480 minutes per year) to under-five care. The unused time currently available for child health at the facility level per country was estimated at 1-47% of the total incremental time needed.

Estimating the need for additional full-time child health workers

To calculate the need for incremental human resources in terms of working years for professional staff at health facility level, the estimated slack time that can be devoted to child health was subtracted from the total number of incremental minutes needed to scale up under-five care, which gives a total of 8,338,520,959 minutes i.e. the equivalent of some 96,500 full-time child health worker person years required at the health facility level for outpatient management of selected interventions in the 75 countries included.

The calculations suggest that to scale up child health interventions as suggested would necessitate that current health workers increased on average by 19% in CMH1 countries (in some countries almost a doubling of health workers would be required), and by 7% in CMH2 countries. In CMH 3 and 4 the estimates correspond to an average 3% and 1% increase respectively in the registered number of current nurses and doctors.

For the 75 countries in total, on average an additional 4% full-time health workers are needed to cope with the estimated increase in staff time for case management of under-fives at the health centre level.

Estimating the need for additional multi-purpose health workers

---

122 This was the fraction of time spent by health workers on under-five care at the facility level in the Multi-Country Evaluation of the Integrated Management of Childhood Illness (IMCI): Analysis Report on the Costs of IMCI in Tanzania. Department of Child and Adolescent Health and Development, WHO.

123 Slack time was calculated using data on the number of health facilities per country. It was assumed that at least one health worker per health facility would be able to increase their capacity from 65% to 80%. This has to some effect skewed the results so that countries which have large numbers of health facilities have benefited in the calculations from being able to (hypothetically) absorb much of the incremental case management time needed through this underutilized capacity. Estimates should be interpreted with caution as they are very specific to the assumptions made in this model.

124 Average values were calculated by adding population-weighted required increases in human resources. Note that data availability on health workers per level of care is limited, and that these numbers refer to staff at both primary and secondary levels of care.
The additional number of multi-purpose health workers required to scale-up can be estimated by multiplying the numbers of full-time child health equivalents by 40%. This assumes to some extent that other programmes scale up simultaneously and that the epidemiology remains constant as a proportion of the total number of cases. This would give the equivalent of more than 240,000 multi-purpose health workers required in year 2015 at the health facility level for outpatient management of selected interventions for child health in the 75 countries included. For the 75 countries in total, this translates into an average requirement of 10% additional multi-purpose health workers needed at the health facility level, with a 47% increase for the CMH1 countries.

**Notes on the methodology used:**
The objective of these calculations was to give a rough estimate of the number of health workers required to scale up interventions as in the costing model. The methodology does however have a number of limitations, as follows:
- It does not take into account interactions, nor changes in epidemiology such as a decreased incidence of illness during the scale-up of preventive interventions.
- It does not include the estimated time required for anti-retroviral prophylaxis and infant feeding counselling.
- The projected under-five population by 2015 is used to estimate the need for treatment by 2015. The baseline used to calculate the human resource gap was the current coverage in 2005. The methodology is thus based on the assumption that current coverage can be maintained in all countries and does not consider actual and projected population size.\(^{125}\)
- The attrition rate of nurses as estimated by WHO's Department of Human Resources for Health (HRH) ranges from 3.5-10% (10% in developing countries).\(^{126}\) Since this analysis was an attempt to estimate the health worker gap by 2015 in sheer numbers, attrition was not accounted for in the analysis.
- Follow-up visits were included in this time estimate, but not in the cost estimate of US$ 52.4 billion.

---

\(^{125}\) Another way of calculating the human resource gap would have been to use estimates of current case management time (based on current population and current coverage) as a baseline for the human resource gap rather than coverage level (2015 population and current coverage). This would have produced a higher estimate for additional health workers required.

\(^{126}\) Personal communication Hugo Mercer (WHO/HRH).
Table A9. Assumptions used for staff time per intervention scaled up at facility level

Note that the following visits are not included in the table below:
- case management and counselling time for PMTCT.
- healthy child visits. These were assumed to be included under the other intervention categories.  

<table>
<thead>
<tr>
<th>Intervention</th>
<th>Incidence / population in need</th>
<th>Provided during</th>
<th>% of cases managed at health facility level</th>
<th>Staff time required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Breastfeeding counselling</td>
<td>All newborns</td>
<td>Three follow-ups (first week after birth; 6 weeks; and 5-6 months).</td>
<td>Assumed that 20% of counselling occurs at facility level</td>
<td>One full-time session (20 minutes) and two shorter sessions (5 minutes each)</td>
</tr>
<tr>
<td>Counselling for Complementary feeding</td>
<td>All newborns</td>
<td>Two sessions: one at 9 months and 12 months.</td>
<td>Assumed that 50% of counselling occurs at facility level</td>
<td>Two full sessions: each 20 minutes</td>
</tr>
<tr>
<td>Case management of non-severe pneumonia</td>
<td>Region-specific WHO estimates for ALRI incidence. 86% is the estimated incidence for non-severe pneumonia. When ill.</td>
<td>20% of population in rural areas and 100% of urban population are assumed to seek treatment at the facility level for non-severe pneumonia.</td>
<td>Use IMCI assumption 3.8 minutes per visit (=7.6 minutes divided by the average number of disease classifications, 2)</td>
<td></td>
</tr>
<tr>
<td>Follow-up visits for ARI / pneumonia</td>
<td>According to IMCI guidelines, 25% of all cases treated at facility level will need to come for a follow-up visit</td>
<td>Same as above</td>
<td>Use IMCI assumption 3.8 minutes per visit</td>
<td></td>
</tr>
<tr>
<td>Diarrhoea case Management (non-severe dehydration)</td>
<td>Region-specific estimates</td>
<td>When ill</td>
<td>20%</td>
<td>Use IMCI assumption 3.8 minutes per visit</td>
</tr>
<tr>
<td>Antibiotics for dysentery</td>
<td>5% of region-specific diarrhoea incidence.</td>
<td>When ill</td>
<td>100%</td>
<td>Use IMCI assumption 3.8 minutes per visit</td>
</tr>
<tr>
<td>Follow-up visits for diarrhoea (including dysentery)</td>
<td>According to IMCI guidelines, 10% of all diarrhoea cases treated at facility level will need to come for a follow-up visit</td>
<td>20% (as above for diarrhoea)</td>
<td>Use IMCI assumption 3.8 minutes per visit</td>
<td></td>
</tr>
</tbody>
</table>

127 In the first three months the frequency of immunization visits (birth, 6 weeks, 10 weeks, i.e. 3 visits) is the same as the growth monitoring (GM) visits (once/month, 3 visits). In the next three months there will be 1 immunization visit (at 14 weeks) and 3 growth monitoring visits. 2 more GM visits are needed before the end of the year, 4 GM visits in year 2, and 2 GM visits each in year 3-5. This comes to a total of 18 visits for each under five.
<table>
<thead>
<tr>
<th>Interventions</th>
<th>Methodology and assumptions</th>
<th>Expected interval</th>
<th>Population covered</th>
<th>Time per visit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vitamin A supplementation</td>
<td>All under-fives every 6 months up to the age of 5 years</td>
<td>Every 6 months</td>
<td>100% urban + 20% rural population</td>
<td>Use assumption 7.6 minutes per visit (delivered together with deworming)</td>
</tr>
<tr>
<td>Regular Deworming</td>
<td>All under-fives above 12 months age</td>
<td>Once/year</td>
<td>unspecified</td>
<td>No time (assume combined with Vitamin A distribution)</td>
</tr>
<tr>
<td>Case management of non-complicated measles at the health facility level</td>
<td>Estimated cases / country / year given by WHO/IVB model</td>
<td>When ill</td>
<td>100%</td>
<td>Use IMCI assumption 3.8 minutes per visit .</td>
</tr>
<tr>
<td>Case management of malaria</td>
<td>Region-specific incidence estimates.</td>
<td>When ill</td>
<td>Assumed same as malaria.</td>
<td>Use IMCI assumption 3.8 minutes per visit .</td>
</tr>
<tr>
<td>Follow-up visits for malaria</td>
<td>Following IMCI guidelines, 10% of all cases treated at facility level will need to come for a follow-up visit</td>
<td>As above.</td>
<td></td>
<td>Use IMCI assumption 3.8 minutes per visit .</td>
</tr>
<tr>
<td>Follow-up visits for low weight</td>
<td>Children who are low weight for age (i.e. -2SD) need a follow up visit at facility level. A 30% estimate was used.</td>
<td>Assumed that 100% of children with low weight for age are given a follow-up at facility level.</td>
<td>Use IMCI assumption 3.8 minutes per visit.</td>
<td></td>
</tr>
</tbody>
</table>
Annex 10 Breakdown of costs per WHO GBD region

A breakdown per region shows that Sub-Saharan Africa (WHO's African region) accounts for 42% of all under-five deaths globally.\(^\text{128}\) In this cost estimate, 40 countries from this region were included, together accounting for 32% of estimated costs. WHO's South East Asian region accounts for 29% of global under-five mortality, and here the 6 countries included in the costing contribute to 28% of costs. WHO's Eastern Mediterranean region is estimated to have contributed to 13% of under-five deaths in year 2002/2003: here the 9 countries included from this region account for 13% of costs. Latin America and the Caribbean account for 4% of under-five mortality and the 8 countries included give rise to 12% of costs. WHO's Western Pacific Region accounts for another 10% of child mortality and 12% of costs (7 countries included). Finally, WHO's European region contributes to 3% of under-five deaths and the five countries included in the costing account for 4% of costs.

Estimated costs are highest as a total for WHO's South East Asian region (SEAR) D region (figure A10.1), an explanatory factor of which is the large population included in this group. WHO's Eastern Mediterranean region (EMR) D has the second highest total costs, explained by the relatively high price levels in these countries. The regions with the largest relative cost gap between 2011 and 2015 include countries where a great catch-up is assumed to occur in the last years leading up to 2015, whereas high costs in the first years indicates countries with rapid initial scale-up and less lead time.

**Figure A10.1 Incremental total costs by GBD region in selected years (in million US$)**

![Bar chart showing incremental total costs by GBD region in selected years](image)

 Estimated additional expenditures required per country were weighted on a population basis in order to retrieve averages for each region, as shown in table A10 and figure A10.2. Average annual required additional expenditure per capita 2006-2015 varies from US$ 0.36 to US$ 2.16.

Table A10. Average cost per capita per WHO GBD region

<table>
<thead>
<tr>
<th>WHO region</th>
<th>Average cost per capita in 2006</th>
<th>Average cost per capita in 2015</th>
<th>Range in average cost per capita over the years 2006-2015</th>
<th>Average cost per capita 2006-2015</th>
<th>Sum of average per capita values over the years 2006-2015</th>
</tr>
</thead>
<tbody>
<tr>
<td>AFR D</td>
<td>$ 1.51</td>
<td>$ 3.32</td>
<td>$1.36-3.32</td>
<td>$2.16</td>
<td>$23.04</td>
</tr>
<tr>
<td>AFR E</td>
<td>$ 1.16</td>
<td>$ 2.82</td>
<td>$1.13-2.82</td>
<td>$1.83</td>
<td>$19.64</td>
</tr>
<tr>
<td>AMR B</td>
<td>$ 0.57</td>
<td>$ 2.01</td>
<td>$0.57-2.01</td>
<td>$1.45</td>
<td>$15.76</td>
</tr>
<tr>
<td>AMR D</td>
<td>$ 1.25</td>
<td>$ 2.54</td>
<td>$1.25-2.54</td>
<td>$1.77</td>
<td>$19.15</td>
</tr>
<tr>
<td>EMR D</td>
<td>$ 0.50</td>
<td>$ 2.69</td>
<td>$0.49-2.69</td>
<td>$1.42</td>
<td>$15.02</td>
</tr>
<tr>
<td>EUR B</td>
<td>$ 0.80</td>
<td>$ 2.39</td>
<td>$0.80-2.39</td>
<td>$1.79</td>
<td>$ 9.39</td>
</tr>
<tr>
<td>EUR C</td>
<td>$ 0.50</td>
<td>$ 1.22</td>
<td>$0.50-1.22</td>
<td>$0.79</td>
<td>$ 8.71</td>
</tr>
<tr>
<td>SEAR B</td>
<td>$ 0.17</td>
<td>$ 0.74</td>
<td>$0.17-0.74</td>
<td>$0.47</td>
<td>$ 5.11</td>
</tr>
<tr>
<td>SEAR D</td>
<td>$ 0.33</td>
<td>$ 1.18</td>
<td>$0.33-1.18</td>
<td>$0.85</td>
<td>$ 9.15</td>
</tr>
<tr>
<td>WPR B</td>
<td>$ 0.17</td>
<td>$ 0.51</td>
<td>$0.17-0.51</td>
<td>$0.36</td>
<td>$ 3.96</td>
</tr>
</tbody>
</table>

Regional average per capita costs are affected by the disease burden as well as by the price levels in the countries included. For example, the costs of prevention and treatment of malaria among under-fives account for 34% of incremental costs in WHO's African region. In other regions where the disease burden is lower, such as Latin America and the Caribbean (AMR), estimated costs per capita are still high due to elevated price levels.

Figure A10.2 Average cost per capita, per WHO GBD region and year
While figure A10.1 illustrated the differences in expenditures needed to scale-up by region, the relative cost per intervention is shown in figure A10.3. Relative regional costs as estimated here depend on current coverage, regional incidence, and price levels. A high proportion of the costs estimated for the WHO’s Eastern Mediterranean region (EMR) D and WHO’s South East Asian region (SEAR) D are related to severe malnutrition, while countries in the European B region will need to spend a high relative proportion of incremental expenditure on vaccinations.

**Figure A10.3 Relative cost per intervention per GBD region**

Notes:
1. Some countries are not included in the disease-specific costing models for malaria, immunizations and PMTCT. This will lower the relative proportion of costs for these interventions in the regions to which the excluded countries belong.
2. Note that immunizations costs shown in the diagram above include some programme cost for technical assistance.
References


