Child survival III

Reducing child mortality: can public health deliver?

*Jennifer Bryce, Shams el Arifeen, George Pariyo, Claudio F Lanata, Davidson Gwatkin, Jean-Pierre Habicht, and the Multi-Country Evaluation of IMCI Study Group**

This is the third paper in the series on child survival. The second paper in the series, published last week, concluded that in the 42 countries with 90% of child deaths worldwide in 2000, 63% of these deaths could have been prevented through full implementation of a few known and effective interventions. Levels of coverage with these interventions are still unacceptably low in most low-income and middle-income countries. Worse still, coverage for some interventions, such as immunisations and attended delivery, are stagnant or even falling in several of the poorest countries. This paper highlights the importance of separating biological or behavioural interventions from the delivery systems required to put them in place, and the need to tailor delivery strategies to the stage of health-system development. We review recent initiatives in child health and discuss essential aspects of delivery systems, including: need for data at the subnational level to support health planning; regular monitoring of provision and use of health services, and of intervention coverage; and the need to achieve high and equitable coverage with selected interventions. Community-based initiatives can extend the delivery of interventions in areas where health services are hard to access, but strengthening national health systems should be the long-term aim. The millennium development goal for child survival can be achieved, but only if strategies for delivery interventions are greatly improved and scaled-up.

The public health community can take pride in the number of child deaths that have been prevented over the past 10 years through use of a few effective interventions, coupled with broader development.[1] Average rates of child mortality have fallen from 93 per 1000 livebirths in 1990, to 83 per 1000 livebirths in 2000.[2] The potential to save children's lives continues to expand with scientific and technological advancements such as vaccines and diagnostic methods.[3] New attention and resources for international health and development[4,5] also make this a time of opportunity for children and mothers.

Despite improved interventions, increased overall resources, and a history of success, the gap between what can be done to reduce child mortality and what is actually being done is growing. The first paper in this series[6] presented an unacceptable scenario: more than 10 million children dying every year, all but a small fraction in developing countries. The second paper[3] identified both existing and new interventions that could have prevented 63% of these deaths. Effective interventions, however, are not enough unless they reach the children and mothers who need them (figure 1, panel 1).

This paper draws on the systematic assessment of an integrated child health delivery strategy in 12 countries.[7] These findings are buttressed by results of other programme assessments where available, case studies, and reported programme experience. Our aim is to examine previous experience in delivering child survival interventions, to contribute to the search for ways of doing better in the future.

Lancet 2003; **362:** 159–64

*Members listed at end of report

Department of Child and Adolescent Health and Development, WHO, 1211 Geneva, Switzerland (J Bryce EdD)**; International Centre for Diarrhoeal Diseases Research, Dhaka, Bangladesh** (S Arifeen DrPH)**; Makerere University Institute of Public Health, Kampala, Uganda** (G Pariyo DrPH)**; Instituto de Investigación Nutricional, Lima, Peru** (C F Lanata MD)**; The World Bank, Washington, DC, USA** (D Gwatkin MPA)**; Division of Nutritional Sciences, Cornell University, Ithaca, NY, USA** (Prof J-P Habicht)

Correspondence to: Jennifer Bryce, Department of Child and Adolescent Health and Development, WHO, 1211 Geneva, Switzerland
(e-mail: brycej@who.int)

We must do better

Child survival interventions are not reaching the children who need them most. For the effective and affordable interventions shown in figure 2,[3] a review of coverage in the 42 countries with 90% of child deaths in 2000 shows that breastfeeding of infants aged 6–11 months was the only intervention to reach nearly all children. Measles vaccine was received by two-thirds of children younger than 5 years, and all other interventions had coverage of less than 60%. Among 22 sub-Saharan African countries with endemic malaria, results of surveys[8] between 1999 and 2001 showed that a median of less than 2% of children slept under an insecticide-treated net the previous night.[9] Integrated management of childhood illness, a delivery strategy adopted by over 100 low-income and middle-income countries by the end of 2002, had moved into the phase of scaling-up to higher levels of coverage in only 48 of those 100 countries.[10] Coverage is lowest in poor countries and among poor populations.[11] Even among poor rural children in Tanzania, 22% of the poorest received four or more child survival interventions, compared to 42% of the least poor.[12] The next paper in this series[13] addresses these inequities.

Evidence that improved coverage is possible can be drawn from the fact that higher levels have been achieved in the past. Rates of diphtheria-pertussis-tetanus immunisation coverage decreased in both sub-Saharan Africa and South Asia since 1995[14] (see figure 3). Measles

Search strategy

The authors undertook full searches of published work when developing the design and preparing the site-specific proposals for the multi-country evaluation of IMCI. The authors also drew from their own expertise and experiences with delivery of interventions in developing countries.

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Figure 1: **Empty health facility in Cambodia**
Photograph by Cesar Victora.

immunisation coverage in sub-Saharan Africa is estimated to have dropped from an average of 62% in 1990 to 50% in 1999.[15] Other key coverage indicators, such as the proportion of women who were attended by a trained health-care worker during delivery, have stagnated.[16] Understanding the reasons for our inability to increase coverage, especially among the poorest people, is a first step towards recouping what we have lost and moving towards universal coverage.

Poor coverage is clearly a result of weaknesses in both the provision of and demand for services, and a consequence of malfunctioning health systems. In the next sections we address the need to improve delivery of child survival interventions.

Assessing delivery of interventions

Even new delivery strategies for improving coverage of child survival interventions can face major obstacles when scaled-up. Integrated management of childhood illness (IMCI), launched in the mid 1990s,[17–19] is now being introduced in more than 100 countries[10] (panel 2).

Training of health workers in countries with IMCI implementation has been shown to have positive effects if training includes clinical practice, sufficient facilitators, and use of materials relevant to local culture and language.[21] The table[22] shows selected results from the systematic multi-country evaluation of IMCI (panel 2). Health-worker training led to improved performance (table), but there were exceptions. For example, there were no differences between IMCI and non-IMCI facilities in the proportion of children who left the facility with all needed vaccines. In Brazil, although IMCI-trained workers were more likely to assess immunisation status, vaccination only took place on specific days of the week, so most children in need could not be vaccinated during their visit.

The assessment also showed that, in most countries, fewer than 10% of all health workers providing child care had been trained, and the rate of training was not sufficient to achieve high coverage in the foreseeable future. Major barriers to scaling-up included the cost of training courses, the need to take health workers away from their facilities for up to 11 days, and limited availability of trainers.

Early assumptions that the introduction of IMCI would lead to improvements in the health system[18] have not been supported by evidence. Health-system constraints extend well beyond the purview of child health, and could not be addressed by ministry of health staff working on IMCI. For example, lack of regular supervision by IMCI-trained supervisors, and extremely high rates of staff turnover—up to 40% in a 2-year period in some countries—made it difficult to deliver high-quality care consistently over time. In some of the poorest countries, children younger than 5 years had, on average, less than one contact per year with health services, severely limiting the potential effect of strategies.

At least part of the explanation might be that the effort devoted to implementation has not been sufficient, especially in relation to strengthening health systems and changing key behaviours at the family and community level. The multi-country assessment showed that efforts to develop and implement activities to improve key family practices related to child mortality were limited, and those attempted took far longer and achieved much lower coverage than anticipated. In some countries, health-worker training and community IMCI activities were being delivered to different communities, thus restricting the expected synergy. Often, programmes delivered many different messages simultaneously with low intensity, rather than concentrating on reaching high coverage with the few most relevant key messages in each context.

These findings are not specific to IMCI. This strategy has a strong technical basis that should lead to effects on mortality, and the obstacles faced in taking it to scale are certainly common to other child survival interventions, including immunisations, insecticide-treated materials for the prevention of malaria, and activities to improve child

Panel 1: **Separating interventions from delivery strategies**

Saving a child's life requires both an effective biological agent (the intervention) and a way to get the agent to mothers and children who need them (the delivery strategy). The intervention—antimalarial drugs, for example—may be delivered through health facilities in settings where these are accessible and utilisation rates are high, or through community-based workers where the health facility infrastructure is not yet fully adequate.

Although research on interventions is plentiful, little is known about the characteristics of delivery strategies capable of achieving and maintaining high coverage for specific interventions in various epidemiological, health system, and cultural contexts. A systematic programme of research to answer questions about how best to deliver child survival interventions is urgently needed. The first step is a clear conceptual framework describing the contextual factors that affect intervention delivery and achievement of high and equitable coverage.

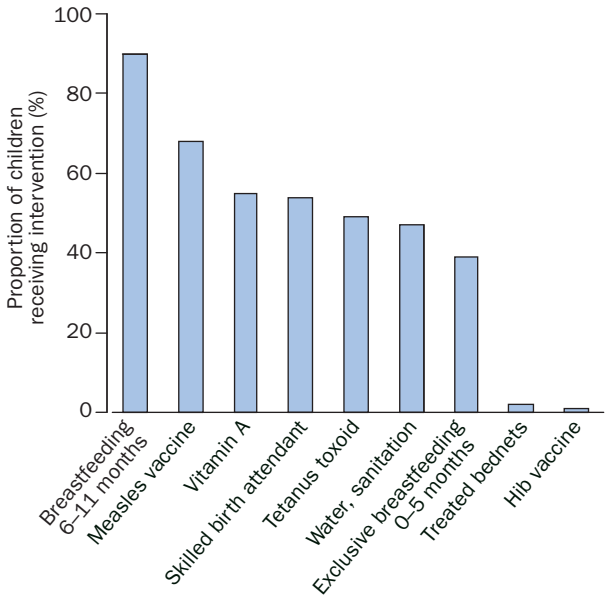

Figure 2: **Estimated proportion of children younger than 5 years who received survival interventions in 42 countries accounting for 90% of under-5 deaths, 2000[3]**

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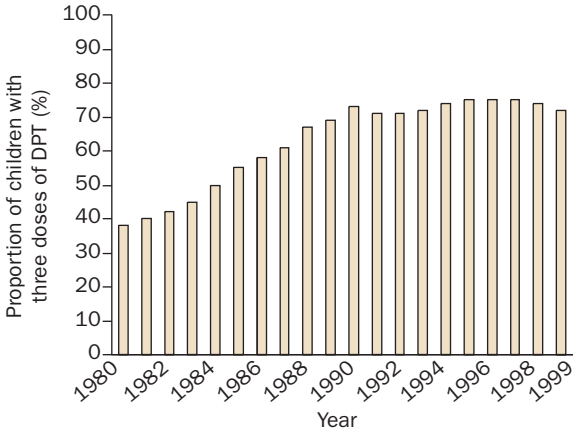

Figure 3: **Estimated proportion of the world's children aged 12–23 months who received three doses of diphtheria-pertussis-tetanus (DPT) vaccine**

nutrition. IMCI is also unusual because a comprehensive assessment was started at the same time as implementation. Evidence of barriers to implementation is therefore available for IMCI, whereas few, if any, previous innovative programmes were assessed so rigorously from the outset. Slow and piecemeal implementation restricts the potential effectiveness of IMCI and other child health delivery strategies, and should be addressed.

The financial investments needed to address health-systems constraints and remove obstacles to effective implementation of IMCI have been inadequate. Although few data on investments in child survival are available, development assistance for IMCI has been well below the level needed to bring it up to scale (Claeson M, personal communication). This difficulty is further discussed in paper five of this series.[23]

Case-studies of successful delivery strategies

Public-health programmes that are planned, implemented, and assessed well, tackling a few diseases, can make a difference. For example, data from Brazil,[24] Egypt,[25] the Philippines,[26] and Mexico[27] show that implementation of diarrhoea-control programmes and promotion of oral rehydration therapy were accompanied by mortality reductions that could not be accounted for by changes in external factors. Another example is the success of vaccination programmes in Latin America, where polio was eradicated and measles has become extremely rare—for example, there have been no autochthonous measles cases in Brazil since early 2000.[28]

Further encouraging results have come from small-scale projects and programme assessments. For example, the Kilombero and Ulanga treated net (KINET) project in two districts in Tanzania successfully applied social marketing to promote coverage and use of insecticide-treated mosquito nets, involving shop owners and the public-health sector. The result was an increase in the proportion of infants reported to have slept under a treated net from 10% to 50% in 3 years, leading to a 27% reduction in mortality among children who used the nets.[29] Coverage increased among poor people as well as those who were better off (Schellenberg JA, personal communication).

Another experience, which is especially relevant in view of the results from the assessment of IMCI, is the success of a small-scale project in Guatemala, based on principles similar to IMCI, that resulted in major improvement in child survival within 2 years.[30,31] This study, undertaken more than 20 years ago, shows some of the characteristics of a successful child health programme. Health workers with secondary education were trained in the management of common childhood illnesses with locally-adapted protocols. All training was done on the job, pairing less experienced with more experienced health workers until satisfactory performance was attained. Supervision was tailored, in frequency and content, to the needs of the worker; supervisors independently re-examined a sample of patients to assess the health workers. Additionally, diagnostic and therapeutic steps were assessed for all patients by inspection of a book where these steps were noted. High proportions of patients (95% or higher) were correctly managed once the system was established. Regular monitoring activities included results from supervision visits, immunisation coverage, audit of all under-5 deaths (deaths in children aged less than 5 years), and assessments of patients' needs and expectations. These results were reviewed periodically in feedback designed not to find fault but to resolve problems. The cost of care was about US$5 per person treated per year, including all personnel and capital costs—equivalent to the cost of one primary health visit in governmental facilities. Mortality in infancy fell from about 139 per 1000 births to 55 per 1000, and from 28 per 1000 children to six per 1000 in those aged 1–4 years within 3 years—compared with very little change in comparable mortality rates for Guatemala as a whole. These findings contrasted

	Correct delivery of therapeutic interventions		**Correct education: mothers knowing how to administer oral drugs**	**Comprehensive care of child: mean index of correct treatment and counselling among children who had more than one illness‡**	**Correct delivery of preventive interventions**	
	Needing antibiotics and received correct dose	Needing antimalarials and received correct dose			Leave facility with all needed vaccines	Weighed and weight checked against growth chart
Country						
Brazil (2002)*						
With IMCI	67% (22 of 33)	No malaria in states	68% (48 of 71)	0·689 (n=131)	39% (37 of 96)	77% (228 of 295)
Without IMCI	51% (18 of 35)	included in Brazil	79% (85 of 107)	0·451 (n=169)	38% (40 of 105)	36% (130 of 358)
p	0·293	study	0·163	<0·001	0·968	<0·001
Tanzania (2000)[21]						
With IMCI	77% (53 of 69)	88% (149 of 169)	72% (163 of 225)	0·822 (n=153)	12% (8 of 69)	77% (178 of 230)
Without IMCI	43% (25 of 58)	25% (34 of 135)	56% (100 of 179)	0·157 (n=117)	0% (0 of 27)	5% (10 of 188)
p	0·004	<0·001	0·020	<0·001	0·101	<0·001
Uganda (2000)†						
With IMCI	41% (28 of 68)	48% (68 of 142)	27% (43 of 160)	0·358 (n=103)	0% (0 of 83)	28% (59 of 207)
Without IMCI	25% (21 of 83)	24% (53 of 224)	19% (43 of 233)	0·187 (n=156)	3% (5 of 147)	4% (12 of 290)
p	0·105	0·0003	0·078	<0·001	0·438	0·0001

*J Amaral, personal communication. †G Pariyo, personal communication. ‡The construction and use of this index is described at http://www.who.int/imci-mce.[21,22]

Comparison of proportions of children who received appropriate interventions and counselling at first-level health facilities with and without health workers who had received high-quality training in IMCI

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Panel 2: **A stepwise assessment shows constraints to delivery of child survival interventions**

Integrated management of childhood illness (IMCI) is a strategy for improving child health and development through the combined delivery of essential child health interventions. IMCI began with a set of case management guidelines for the management of a sick child in a first-level health facility, designed for adaptation at country level and below. Over time, the strategy expanded to include a range of guidelines for delivering child survival interventions at household, community, and referral levels. Detailed reviews of IMCI and early experience with its implementation are available.[17-19]

The multi-country evaluation of the integrated management of childhood illness (MCE-IMCI)[7] includes studies of the effectiveness, cost, and effect of the IMCI strategy in Bangladesh, Brazil, Peru, Tanzania, and Uganda. MCE-IMCI selected countries by applying standard selection criteria, including the current and expected strength of IMCI implementation. Site visit teams consisting of staff from MCE-IMCI, WHO, and ministries of health, undertook 24 visits to 12 countries (Bangladesh, Bolivia, Brazil, Cambodia, Kazakhstan, Kyrgyzstan, Morocco, Niger, Peru, Tanzania, Uganda, and Zambia) between August, 1998, and February, 2002. These countries were in different stages of IMCI implementation, and this fact was taken into account in assessment of progress and constraints. Findings from these visits,[20] combined with later results from the five impact study sites, are described in the text.

favourably with care given by trained physicians in similar settings, studied concurrently. These remarkable results were obtained in a setting with high under-5 mortality and a health system that was struggling to establish basic services, similar to many of the places where child mortality is highest today. In addition to the use of integrated case management guidelines, the success of the project was attributed to its appropriate adaptation to the local epidemiological and community circumstances, to continued training and encouragement of the primary health-care workers, and to the increases it engendered in the use of health services. This experience suggests that approaches similar to IMCI can deliver high quality care with low costs.

Other projects have focused on expanding coverage of health facilities—by building new ones, by making use of community-based service delivery, or through the use of outreach from existing facilities. In the Matlab Maternal Child Health and Family Planning (MCH-FP) project in Bangladesh, services were delivered through a mixture of government and non-governmental facilities and mobile workers, supported by fieldworkers from non-governmental organisations.[32] Between 1982 and 1996 (the programme began in 1977) child mortality fell by just over 40% in both the project district and the comparison region, but in the latter the largest percentage reduction was in the richest group, whereas in the programme areas the largest reductions were among the poorest people.[32] The use of outreach was also a key feature of the Bamako Initiative in west Africa,[33] which led to a substantial increase in immunisation coverage in Benin and Guinea.[34]

Success has also been noted in cases in which principles of quality assurance have been applied. For example, in the Democratic Republic of Congo (then called Zaire), a systematic review of problems with the immunisation system led to measures that raised coverage from 66% to 84%.[35] Similar efforts to improve quality in treatment of acute respiratory infection in Indonesia reduced inappropriate use of antibiotics from 55% to 26%.[35] In Peru, a programme was implemented in an area covering half of the country and about 2500 health facilities, with the aim of reducing maternal and early infant deaths.[36] Training of multidisciplinary teams, introduction of care standards, use of information and small-scale monitoring to support local decision making, and an independently assessed stepwise system of accreditation resulted in improvements within 1 year of implementation; and routine reports showed a 25% reduction in maternal deaths in the project areas, compared with the remainder of the country, within 2 years of implementation.[36,37]

In Arua District in Uganda in 1994, the number of measles cases was increasing despite an active immunisation programme. District health managers identified several problems in the cold chain, diagnostic accuracy, and the health information system. They instituted measures that resulted in a four-fold reduction in reported measles cases over an 8-month period.[38] Another positive example is the African Programme for Onchocerciasis Control,[39] which has virtually removed this disease from seven countries in west Africa. Nine million children born since the programme started have been spared the risk of blindness. Vector control activities were combined with the distribution of ivermectin by national staff, in collaboration with non-governmental organisations. The distribution is gradually being taken over by the communities themselves. In 1996, more than 2·6 million people were treated with ivermectin.[39]

We have not undertaken an exhaustive review of successful child-survival case-studies and associated project or programme characteristics; such a study is under way by the Disease Control Priorities Programme.[40] Our aim is to show that the coverage gap in child survival interventions is a choice, not a necessity. The examples of successful national programmes and smaller-scale projects described here show that there is no one way to achieve high coverage and reduce child deaths. Very different approaches can be effective, efficient, and sustainable when they fit well within the settings in which they are implemented, and are managed by capable and motivated people. The rest of this paper incorporates the lessons learned from the multi-country assessment of IMCI and from the examples discussed, to show essential features of effective delivery systems.

Defining opportunities and challenges based on epidemiological and health-system profiles

The first paper in this series presented a typology of five epidemiological profiles for child mortality, arguing that these profiles should inform the selection and prioritisation of interventions at country level.[6] Factors affecting intervention delivery are also likely to vary from country to country, albeit perhaps in patterns different from those based on causes of death. A sensible typology could therefore be constructed to help decision makers and programme planners to design high-coverage strategies. This system would take into account indicators of health-system strength and infrastructure, current coverage and utilisation, careseeking patterns, public and private health infrastructure, financing options, and human resources. Although work in this area has begun,[41,42] a common conceptual framework and much further research are needed.

Achieving and maintaining high and equitable coverage

Child survival programmes should use effective, efficient, and equitable delivery strategies to reach those most in need. New efforts need to build on existing programmes and systems. We highlight five fundamental directions for improving delivery.

First, planning of sound child health programmes requires relevant data at the subnational level (state or province, district, etc) to assess local epidemiological

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profiles, health-system capacity, and community preferences. In many countries, health managers will need training in data collection and analysis. In the absence of local data, planning should rely on information from similar settings. Regular monitoring of the provision and quality of health services and of health outcomes (coverage and impact indicators) will help improve and assess programmes. Monitoring of inequities at all levels is essential to ensure that those most at need are being reached.[13] The need for data to be presented, or packaged, in a useful format for planners is often overlooked.

Second, selection of effective interventions to be implemented at the level of community and health facilities should be based on the local epidemiological profile and other locally-defined key criteria, including the feasibility of achieving high, sustained, and equitable coverage.[3] Combined delivery and technical integration of interventions can lead to greater efficiency, increasing cost-effectiveness and potential effectiveness through synergies between interventions in the face of co-morbidity.[3,18] Improved integration of child survival and reproductive health services will probably help to increase effectiveness.

Third, alternative delivery strategies need to be assessed. An issue that has not received sufficient attention is whether achieving high coverage with a few selected interventions will be more efficient than reaching inadequate coverage with several interventions (figure 2). In the latter case, the same children often receive several interventions while others fail to receive any.[43] Analytical work is under way to understand how best to combine interventions to achieve maximum effect,[44,45] and how to build capacity for making these decisions at country level and below.[44,46]

Fourth, supply must be tailored to meet demand and respond to needs. For example, community activities aimed at ensuring appropriate careseeking practices must complement delivery of interventions based in health facilities. Making best use of every contact with mothers and children to deliver appropriate interventions (a basic tenet of the IMCI guidelines) also requires new levels of coordination between programmes. Monitoring of the coverage of key interventions will help to assess the extent to which the target population is being reached, and also help to assess progress on the intermediate determinants of child mortality.

Fifth, strengthening of national health systems needs to be the medium-to-long-term aim. Without adequate manpower, drug and vaccine management and supply, information systems, and functioning referral, child health programmes cannot be sustained. Simplified technologies, such as pre-packed single-dose injection devices,[47] can allow delivery at the community level of interventions that were previously restricted to health facilities, such as tetanus toxoid vaccination of pregnant women or vaccines for young children. However, community-based strategies must be linked to health systems and integrated with efforts to strengthen their capacity. The private sector should be involved whenever possible, especially in monitoring and ensuring quality and equity.[48] Continuing problems with incentive structures and staffing policies must be addressed,[38] and the effects of reform policies monitored and used as the basis for improving intervention delivery.

Conclusions

At present, too few children are receiving the known and effective interventions that could save their lives. Reducing child mortality and achieving the millennium development goal for child survival[49] depend on whether effective and sustainable interventions can be delivered to high proportions of children and mothers. In this paper we argue that the distinction between interventions and delivery strategies is essential. The knowledge base for designing, implementing, and sustaining effective delivery strategies is scattered and in most cases context-specific. General guidelines can be abstracted from small-scale studies and field experience, but the evidence is not complete and has not yet been synthesised into a coherent whole. A major research priority is how to effectively scale-up the successful experiences of many local projects; this area of research has unfortunately received much less attention than the development or small-scale implementation of new interventions. The WHO-Choosing Interventions that are Cost Effective (CHOICE) project is examining various combinations of interventions and their cost-effectiveness.[44] We must also question current assumptions about how interventions should be delivered—where, when, and by whom—as the basis for development of new strategies that make sense within local epidemiological, health-system, and cultural contexts.

Global, one-size-fits-all delivery strategies may have been adequate in the days of vertical programmes such as the expanded programme on immunisation or control of diarrhoeal diseases. Such approaches can achieve outcomes quickly, even in settings where health-system capacity is weak. They will probably continue to have an important role, but broader child survival and maternal and child health strategies are also needed in every country. We must continue to have clear, consistent, and evidence-based technical guidelines, but we must couple them with expanded capacity to develop, implement, monitor, and assess better combinations of interventions provided through locally-designed delivery strategies. The public-health community is capable of delivering the interventions to reduce child mortality. What is needed is greatly expanded capacity at service-delivery level, combined at all levels with the necessary will, stamina, and appropriate incentives and resources.

Contributors

J Bryce, S el Arifeen, G Pariyo, C Lanata, and J-P Habicht participated in the article conception, data analysis, writing, and discussion. D Gwatkin took part in the writing and discussion of the article. J Bryce saw and approved the final version.

The Multi-Country Evaluation of IMCI Study Group

Federal University of Ceará, Fortaleza, Brazil (J Amaral); Ifakara Health Research and Development Centre, Ifakara, Tanzania (H Mshinda, J A Schellenberg); Instituto de Salud del Niño, Lima, Peru, (L Huicho); International Development Research Centre, Ottawa, Canada (D de Savigny); London School of Hygiene and Tropical Medicine, London, UK (J A Schellenberg, J P Vaughan); Johns Hopkins Bloomberg School of Public Health, Baltimore, MA, USA (R E Black, G Burnham); Universidade Federal de Pelotas, Pelotas, Brazil (C G Victora); WHO, Geneva, Switzerland (T Adam, E Gouws).

Conflict of interest statement

J Bryce and E Gouws are staff members of WHO. S el Arifeen, G Pariyo, J Amaral, R E Black, G Burnham, L Huicho, and H Mshinda are principal investigators of the multi-country evaluation of Integrated Management of Childhood Illness, coordinated by WHO, and R E Black, J P Habicht, J A Schellenberg, D de Savigny, J P Vaughan, and C G Victora are technical advisors for the evaluation. D Gwatkin was employed by the World Bank through May, 2003.

Acknowledgments

Substantial work on this paper was done during a conference supported by the Rockefeller Foundation at the Bellagio Study and Conference Centre. The staff of the Department of Child and Adolescent Health and Development of WHO provided valuable comments on early drafts of the paper. Alice Ryan provided invaluable assistance in coordinating the work and preparing the final manuscript for submission. This paper consists in part of results from the Multi-Country Evaluation of IMCI Effectiveness, Cost and Impact, coordinated by the Department of Child and Adolescent

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Health and Development of WHO, and supported by the Bill and Melinda Gates Foundation and the US Agency for International Development. The sponsors of the study had no role in study design, data collection, data analysis, data interpretation, or writing of the report. The views in this article are those of the individual authors and do not represent the views of their institutions.

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