

## Maternal and Child Undernutrition 4



# Maternal and child undernutrition: effective action at national level

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80% of the world's undernourished children live in just 20 countries. Intensified nutrition action in these countries can lead to achievement of the first Millennium Development Goal (MDG) and greatly increase the chances of achieving goals for child and maternal mortality (MDGs 4 and 5). Despite isolated successes in specific countries or for interventions—eg, iodised salt and vitamin A supplementation—most countries with high rates of undernutrition are failing to reach undernourished mothers and children with effective interventions supported by appropriate policies. This paper reports on an assessment of actions addressing undernutrition in the countries with the highest burden of undernutrition, drawing on systematic reviews and best-practice reports. Seven key challenges for addressing undernutrition at national level are defined and reported on: getting nutrition on the list of priorities, and keeping it there; doing the right things; not doing the wrong things; acting at scale; reaching those in need; data-based decisionmaking; and building strategic and operational capacity. Interventions with proven effectiveness that are selected by countries should be rapidly implemented at scale. The period from pregnancy to 24 months of age is a crucial window of opportunity for reducing undernutrition and its adverse effects. Programme efforts, as well as monitoring and assessment, should focus on this segment of the continuum of care. Nutrition resources should not be used to support actions unlikely to be effective in the context of country or local realities. Nutrition resources should not be used to support actions that have not been proven to have a direct effect on undernutrition, such as stand-alone growth monitoring or school feeding programmes. In addition to health and nutrition interventions, economic and social policies addressing poverty, trade, and agriculture that have been associated with rapid improvements in nutritional status should be implemented. There is a reservoir of important experience and expertise in individual countries about how to build commitment, develop and monitor nutrition programmes, move toward acting at scale, reform or phase-out ineffective programmes, and other challenges. This resource needs to be formalised, shared, and used as the basis for setting priorities in problem-solving research for nutrition.

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This is the fourth in a Series of five papers about maternal and child undernutrition

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### Introduction

Each of the first three papers in this Series on maternal and child undernutrition has important but different implications for those working at national and subnational levels in countries where the burden of undernutrition is high. Black and colleagues report<sup>1</sup> that more than a third of deaths of children under the age of 5 years and disability-adjusted life-years worldwide can be attributed to undernutrition. These estimates make undernutrition the largest risk factor in any age-group for the global burden of disease.<sup>2</sup>

Victora and colleagues' findings<sup>3</sup> are a wake-up call to finance ministries and development agencies in countries with a high burden of undernutrition, showing that adequate nutrition in early life is essential for human capital formation. Undernourished children are more likely to be below average height when they reach adulthood, to have lower educational achievement, and to give birth to smaller infants than are those who are nourished adequately. Maternal and child undernutrition is also associated with lower economic status in adulthood, with effects that spill over to future generations.<sup>3</sup> These findings reinforce existing assertions about the positive economic outcomes of good nutrition and its importance as a prerequisite for economic development.<sup>4,5</sup>

### Key messages

- 80% of the world's undernourished children live in just 20 countries. Intensified nutrition action in these countries can lead to achievement of the first Millennium Development Goal (MDG) and greatly increase the chances of achieving goals for child and maternal mortality (MDGs 4 and 5)
- Nutrition should be a priority at national and subnational levels because it is central for human, social, and economic development
- The period from pregnancy to 24 months of age is a crucial window of opportunity for reducing undernutrition and its adverse effects. Programme efforts, as well as monitoring and assessment, should focus on this segment of the continuum of care
- There is a reservoir of important experience and expertise in individual countries about how to build commitment, develop and monitor nutrition programmes, move towards acting at scale, reform or phase-out ineffective programmes, and other challenges. This resource needs to be formalised, shared, and used as the basis for setting priorities in problem-solving research for nutrition
- Interventions with proven effectiveness that are selected by countries should be rapidly implemented at scale
- Nutrition resources should not be used to support actions unlikely to be effective in the context of country or local realities
- In addition to health and nutrition interventions, economic and social policies addressing poverty, trade, and agriculture that have been associated with rapid improvements in nutritional status should be implemented

### Search strategy and selection criteria

A systematic search of PubMed and Cochrane databases, as well as World Bank websites, for programmes with a nutrition component that were intended to reach large populations was commissioned for the Series (see webextra material associated with Bhutta and colleagues' contribution to this Series). Inclusion criteria were based on the quality of the evaluation design, and a full report is available at [www.lancet.com](http://www.lancet.com). 28 programmes in 18 countries were identified and reviewed.

### Survey of nutrition policies and programmes

In August, 2006, a structured questionnaire was sent simultaneously from UNICEF and WHO headquarters to the staff members responsible for nutrition in the 20 countries with stunting prevalence over 20%, that together account for over 80% of stunted children worldwide. These individuals were asked to convene a group representing government, academic institutions and other organisations working in nutrition and nutrition-related areas in the country. The composition of each country team is shown in webtable 1. Each country team reported on nutrition plans and the extent of implementation for nutrition interventions and nutrition-related actions in other sectors, as well as country capacity for, and commitment to, undernutrition. All countries were contacted again in June, 2007, to update information on plans and implementation. Results were analysed by the writing team in meetings held at the UNICEF Innocenti Centre in Florence and the Rockefeller Foundation conference centre in Bellagio.

### Qualitative study of national nutrition leaders

This paper draws on preliminary results from analysis of 30 recorded interviews or written accounts from nutrition practitioners from 12 developing countries, including government, donor agency and non-governmental organisation respondents interviewed alone and together. This work was done as part of a larger exercise to improve understanding of the nutrition policy process. Senior nutrition managers from Bangladesh, Bolivia, Guatemala, and Malawi also met in a focus group during the 2007 meeting of the UN Standing Committee on Nutrition in Rome to discuss barriers and strategies for success relative to maternal and child undernutrition at national level. Authors JB and DP participated in this session.

### Sources of coverage data

All coverage estimates are taken from the 2007 UNICEF State of the world's children report, available at [http://www.unicef.org/publications/index\\_36602.html](http://www.unicef.org/publications/index_36602.html).

### Limitations

The information presented here might be biased by the composition of the country teams or the other key informants who participated in the review.

See Online for webtable 1

In the third paper, Bhutta and colleagues summarise<sup>6</sup> the evidence about interventions with proven effectiveness in addressing undernutrition. These actions span interventions directed at mothers, babies, and young children, and include direct nutrition interventions (eg, provision of micronutrients) as well as behaviour change interventions directed at feeding practices and accompanied by supportive measures such as conditional cash transfers. Together these interventions could reduce the burden of undernutrition in young children by about 25% in the 36 countries with the highest burden of undernutrition if implemented universally.

There are some surprises in these findings for national nutrition leaders. For example, interventions to reduce malaria infection in pregnant women are effective in reducing undernutrition and should be addressed in

national and subnational nutrition strategies. Some long-standing strategies promoted as benefiting nutrition, such as school feeding and stand-alone growth monitoring, are not supported by evidence showing a direct effect on undernutrition.<sup>6</sup> Programme managers can review their strategies in light of this new evidence, taking local needs, contextual factors, and opportunities into account.

This paper seeks to define strategies for improving maternal and child undernutrition in countries where the burden of undernutrition is high. The challenge is to make recommendations that are specific, actionable, and based on the best evidence, while recognising the limitations in the available evidence, the distinctions between efficacy, effectiveness, and transferability, the need to adapt action strategies to national contexts, and the dynamics of the nutrition policy process.

### Learning from success

Over the past 50 years, countries of low and middle income have witnessed many changes in international thinking with regard to strategies for reducing malnutrition, driven by a variety of forces beyond their control. During the past half century, we have had the protein era, the energy gap, the food crisis, applied nutrition programmes, multisectoral nutrition planning, nutrition surveillance, food insecurity and livelihood strategies, and the micronutrient era, among others. These fashions generally do not end abruptly, instead bleeding into one another and leaving relics in place within countries and organisations long after their heyday has passed. Only rarely do these fashions reflect changes in the nature of nutrition problems on the ground in poor countries. Panel 1 describes some of these shifts in the context of Latin America and the Caribbean.<sup>7</sup>

Much can be learned through the analysis of country settings in which the burden of undernutrition has been reduced. Countries that are industrialised once faced many of the challenges that are limiting progress in nutrition today. The UK developed its first nutrition programme based on Lord Boyd Orr's 1936 report, *Food, Health and Income*, that revealed the appalling amount of malnutrition among the population, affecting even the upper classes, and which later served as the basis for the British policy on diet.<sup>9</sup> In the USA, a similar exposé led to the fortification of flour over 60 years ago.<sup>10</sup>

More recent examples of particular interest here are countries that have improved nutritional status despite fairly low income per head—eg, Costa Rica, Cuba, and Sri Lanka.<sup>11,12</sup> Other successes include improvements in nutrition that occurred concurrent with development in the 1950s, such as South Korea and Thailand, and more recently China (panel 2).

Subnational nutrition projects that were externally planned and funded (eg, Iringa in Tanzania, BINP in Bangladesh and Tamil Nadu) showed striking declines in

malnutrition and improvements in service delivery, but few evaluation designs have been able to attribute nutritional outcomes exclusively to project actions. Where rigorous assessments are available there is generally at least some evidence of improvements in nutritional status that can be attributed to project activities.<sup>13</sup> One of the best evaluated is *Oportunidades* (formerly known as *Progresa*) in Mexico, where a combined approach of the provision of a fortified weaning food supplement, nutritional counselling, and conditional cash transfers was found to have an effect of over 1 cm in the height of infants exposed to the programme during the first 2 years of life. The effect on height was restricted to infants of lower socioeconomic status, who had the highest prevalence of stunting. An overall reduction of 20% in the rates of anaemia was also documented.<sup>14</sup>

There are also examples of specific interventions that have been scaled up successfully in low-income and middle-income countries. The iodisation of salt, for example, became the focus of a global programme in 1990 after the dangers of iodine deficiency and the benefits of iodine supplementation had been fully established through research.<sup>15</sup> Today, salt iodisation is one of the most widely available nutrition interventions, even in poor countries,<sup>16</sup> supported by an informal global partnership involving governments, the UN and bilateral agencies, and salt producers. Another recent success story is vitamin A supplementation, which has achieved dramatic gains in coverage through links with immunisation services and integration with child health packages (eg, child health days) in poor countries.<sup>17</sup> More recently some countries have achieved major increases in rates of exclusive breastfeeding.<sup>18</sup>

These historical experiences are important because they show that the nutrition of mothers and children can be improved fairly quickly, given the right combinations of political commitment, strategic programming, and resources. Not all of the lessons learned are generalisable, and few systematic evaluation data are available. Still, there is a rich reservoir of experience and expertise among people working to improve nutrition in communities, regions, and countries that can be codified and used as a basis for action.

### Key challenges for effective nutrition action at national level

The central message of this Series is that effective nutrition actions exist but have not been implemented at scale and assessed, especially in countries where high proportions of the burden of disease are attributable to undernutrition. This section presents seven challenges that must be met to achieve this goal.

#### Challenge 1: Getting nutrition onto the list of priorities, and keeping it there

One popular explanation for why nutrition programmes are weak is the lack of political commitment,<sup>19–21</sup> defined

#### Panel 1: Experience in Latin American and the Caribbean—responding to changing needs

Stunting, being underweight, and wasting dropped precipitously in Latin America and the Caribbean between 1980 and 2005. However, differences within and across countries in the region remain among the largest in the world. Within the region, for example, Central America has the highest estimated prevalence of stunting (23.5%) and the lowest rate of improvement (0.10% per year), while South America has lower levels of stunting and the highest rates of improvement.

In Brazil, one of the largest countries in the region, there were substantial improvements in coverage for primary health care, water and sanitation services, and women's education, with resulting declines in stunting. These improvements seem to have occurred despite economic stagnation and important losses in purchasing power—especially among the poorest—that occurred at the same time.<sup>7</sup>

During the 1970s, Latin America was home to large food and nutrition institutes such as those of Brazil, Mexico, and Venezuela, and there were several large-scale supplementary feeding programmes with little or no assessment of effect. The 1980s and 1990s have been characterised by a drastic reduction in the budget and scale of supplementary feeding programmes, and more biologically targeted interventions addressing child survival in general and undernutrition in particular. Resources and efforts were refocused to address the control of micronutrient deficiencies, substantially reducing the scope of the nutrition agenda in the region.

Since 2000, demand-type conditional cash transfer programmes have dominated the food and nutrition policy environment in the region, usually accompanied by supply-side interventions to increase access to health services and public education. Assessment of the effects of such programmes has become more common. Promising results have been reported on child diet diversification (Brazil) and child growth (Brazil and Mexico).

The recent food and nutrition policy debate in Latin America addresses the growing mismatch between the political discourse on one hand and some public policies and the nutritional epidemiological profile on the other. Ending hunger or undernutrition are the current policy priorities in countries such as Brazil (where overweight mothers and children presents a much greater problem than does undernutrition), Bolivia, and Peru. These initiatives have to be designed with a clear nutritional and public-health focus and should aim at improving linear growth and decreasing stunting, avoiding rapid weight gain and children being overweight. If they are not so designed, they might lead to an increase in the prevalence of non-communicable diseases such as diabetes, cardiovascular diseases, and some cancers, which already account for the major part of the burden of disease in the region.

here as the allocation of human, financial, and organisational resources for effective actions at sufficient scale and intensity to improve nutrition in populations of women and children. Multi-agency assessment teams in the 20 countries with the highest burden of undernutrition (figure 1) were asked to identify the public-health area that receives the highest priority in their country. If that area was deemed to be of highest priority on a scale of 1 (lowest) to 5 (highest), they were then asked to assign a number reflecting the relative importance assigned to nutrition. Of the 15 countries that responded, Madagascar and the Philippines reported that nutrition was the highest priority; the remaining 13 reported that nutrition was a low priority relative to HIV, malaria, or tuberculosis (five countries), childhood immunisation (three countries), or broader

areas such as strengthening of health systems or maternal and child health (three countries). The results suggest that perceived commitment to nutrition is low in most countries.

The presence of nutrition policies and plans, although not sufficient to guarantee political commitment and action, can also contribute to making nutrition a priority. National policies are written documents, endorsed by the

#### **Panel 2: Rapid nutritional improvement in China through multisectoral action**

##### **Major achievements**

Broad economic reforms initiated in 1978 brought rapid economic growth and poverty reduction in China, and there were major changes in policies that gradually shifted from central planning to more reliance on market mechanisms. Today, China maintains a dual system of a so-called socialist economy with an increasing role of markets and limited state controls in some industries. China has achieved impressive progress towards achieving the Millennium Development Goals (MDGs) and there has been a dramatic reduction in hunger and undernourishment. The number of undernourished people fell from 194 million (16% of the population) in 1990–92 to 150 million (12% of the population) in 2001–03.

The reduction in undernourishment mirrors the reduction in poverty in China. By 2001, only 17% of the Chinese population fell below the US\$1/day poverty line; down from a third of the population in 1990. The number of poor Chinese dropped by about a quarter, from 375 million to 212 million, during that 11-year period. China will probably achieve most of the MDGs by 2015. Indeed, some targets such as primary education and halving extreme poverty have already been reached, a decade ahead of schedule. However, available information indicates that major challenges remain for others—eg, in halting and reversing HIV/AIDS, tuberculosis, and malaria, promoting sexual equality, providing safe drinking water to the rural population, and ensuring environmental sustainability.

Unfortunately, the economic progress achieved in China has been achieved partly at the expense of environmental deteriorations. Current efforts to assure sustainability in future economic growth and poverty alleviation need to be enhanced.

##### **Lessons learned**

China's success in securing a substantial reduction in the prevalence of poverty, hunger, and undernourishment is directly linked to its ability to increase agricultural production, which in turn has benefited from its strategies and policies on agricultural and rural development. A combination of factors including infrastructure, technology, and institutions underlie China's rapid progress.

##### *Anti-poverty policies*

Both central and local governments are committed to poverty alleviation in rural China. Since the early 1980s, tremendous progress has been made in addressing China's poverty problem with much of the credit attributed to the rapid rural economic growth resulting from better incentives and the government's rural reform programmes. China's Township and Village Enterprises have had a major role in raising rural income, absorbing labour surplus, promoting rural market development, and stimulating structural changes in the rural economy.

##### *Land tenure reform*

The establishment of the Household Responsibility System in 1981 granted production decision-making power to farm households and allowed farmers to sell surplus crops freely at market-determined prices after they had fulfilled their obligations under the state order system. The system has generated substantial incentives for farmers, linking rewards closely with their performance. As a result, China's agriculture has been dramatically revived and agricultural production has substantially increased.

##### *Public investments in agriculture*

China has emphasised the importance of public investment in agriculture, including investments in rural infrastructure and loans and credits for agricultural production. Irrigation, land reclamation, and flood controls have been the top priorities of government investments. Additionally, public investment in agricultural research and extension has contributed to agricultural growth. Technological advances, in particular the development of high-yielding seed varieties and improved farming practices, have increased agricultural productivity substantially.

##### *Market and price liberalisation*

Although initial reforms in agriculture centred on decollectivisation and increasing incentives to farmers, later reforms have attempted to gradually liberalise markets and prices. China now allows most agricultural prices to be set by market forces, although the government intervenes occasionally to stabilise markets. Greater market liberalisation reduces price distortions and brings about improved incentives for market participants.

##### *Open door policy*

China's open door policy has contributed to the rapid growth of its economy. Trade liberalisation coupled with a falling exchange rate has stimulated agricultural exports, especially value added and labour-intensive commodities. China has also encouraged foreign direct investment, which introduces capital, advanced technology, and management and marketing skills to assist in transition of agriculture from traditional to modern operations.



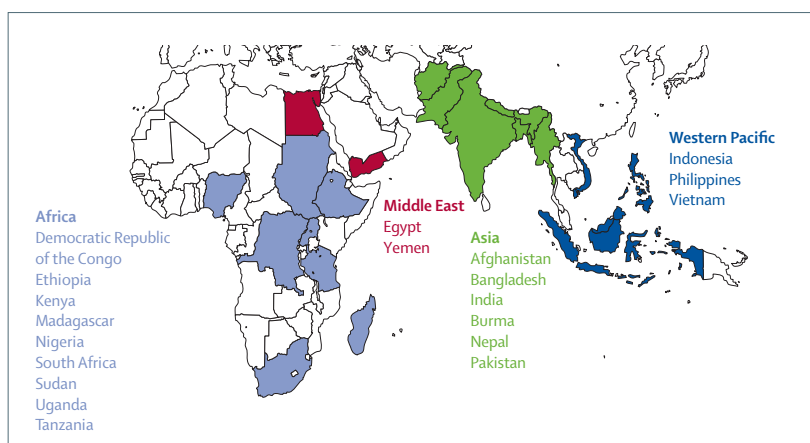
government, that define what will be done in the nutrition arena. National plans specify actions and are generally accompanied by timelines and budgets. Teams in 16 of the 20 countries with the highest burden of undernutrition report the existence of a national nutrition policy. Four others (Egypt, Ethiopia, Kenya, and Burma) report that the development of such a policy is in process. No national nutrition policy was reported to exist in South Africa and Yemen. By contrast, national plans for nutrition were reported to be present in all countries except Yemen. In Uganda, WHO reports that there is a nutritional plan, but the team on the ground believes that it is still being developed. In summary, a formal basis for accelerating nutrition action—whether a national policy or plan—seems to exist in almost all the countries with the highest burden of undernutrition.

Actions designed to increase political commitment must increasingly take into account that key decisions about priorities and resource allocation are also made at subnational levels, and capacity must be built there as well as at national level in how to choose and generate support for contextually appropriate interventions. Many countries are grappling with these complexities but as yet there is little nutrition research to guide strategy development.

There are many hypotheses about why political commitment to nutrition has been weak in most countries. Ignorance or a lack of recognition of the causes and implications of undernutrition and its importance as a determinant of health and development are a barrier, and the intersectoral nature of nutritional issues can lead to situations in which no group takes responsibility or advocates effectively.<sup>19,21,22</sup> For example, government and other national policymakers sometimes justify nutrition's low visibility on the national health agenda by saying that it is—or should be—handled through broader poverty alleviation programmes. Reasons for the lack of attention to nutrition at the national level also include the absence of clear guidance about what can and should be done, and how it will benefit the population.<sup>23</sup>

The presence of nutrition champions and entrepreneurs has been identified as crucial to developing and sustaining political commitment.<sup>20</sup> The success of these spokespersons, however, depends on their skills and ability to position themselves and nutrition in broader health and development contexts, on the quality of the interaction they establish with other nutrition leaders, and on their capacity to add political strength to the formal and informal structures and processes supporting nutrition actions.

Additionally, undernutrition is only one of many threats to maternal and child health in these countries, and must compete for political attention with armed conflict,<sup>24</sup> natural disasters,<sup>25</sup> and other health issues such as HIV/AIDS.<sup>26</sup> There are too few resources in these countries, both human and financial, to address all threats simultaneously. 14 of the 20 countries with the



**Figure 1: The 20 countries with the highest burden of undernutrition**

Countries with stunting prevalence  $\geq 20\%$  in children under the age of 5 years that together account for  $>80\%$  of the world's undernourished children.

highest burden of undernutrition are among the poorest in the world,<sup>27</sup> with at least 40% of the population living on less than US\$1 per day.<sup>28</sup>

Irrespective of the reasons used to justify a lack of attention to nutrition in the past, new evidence about the many consequences of undernutrition for human, social, and economic development constitutes a powerful reason for nutrition to move up on national and subnational agendas. Nutrition represents over a third of the overall burden of disease of mothers and young children.<sup>1</sup> Ignoring undernutrition puts the longer-term health and development of populations at risk, at least as much as that posed by other threats, and perhaps more.<sup>3</sup>

Gaining and sustaining political attention requires a stable and technically sound nutrition agenda that can survive political and administrative changes in governments. Maintaining effective national and subnational programmes during political shifts was identified as a major challenge by national nutrition managers participating in the qualitative studies. A promising—if partial—solution, and one being applied in several countries for iodine and other food fortification interventions, is to enact legislation to protect technical advances from the forces of political change once they have proven effective in a national context. Legislation is useful, but will not be sufficient without accompanying regulations and enforcement. Use of advocacy and communication to create, reinforce, or sustain civil society demand for sound nutritional programmes is another promising strategy used in Kerala in India and in Thailand.<sup>29</sup> In all efforts to generate commitment, the choice of politically influential messengers is crucial.<sup>30</sup> For instance, respected national leaders are more likely to be successful than are public-health advocates, and those who control national financial resources are more likely to be successful than are technical staff from donor or UN agencies, even if both promote the same message. Finally, national leaders should seek not only to build

stronger nutrition strategies and programmes, but also to include nutrition goals into all appropriate sectors and their policies and operations.<sup>31,32</sup>

Action steps that can be taken now to push nutrition up on national and subnational agendas have been described elsewhere<sup>33</sup> and could be used in the context of this Series to organise gatherings of local nutrition actors to review current nutrition actions in light of the results. Development of networks within or across countries can help build momentum for the inclusion of nutrition in the spate of recent initiatives designed to accelerate progress toward the Millennium Development Goals (MDGs) and ensure that nutrition is not left behind. As political commitment to lower maternal and child mortality builds, nutrition leaders should be prepared to highlight the essential role of nutrition in achieving national goals in these areas, as well as its central role in human, social, and economic development.

### Challenge 2: Doing the right things

Strong political commitment will result in improved nutritional status only if the supported interventions and approaches are effective and able to be implemented at high and sustained levels of coverage. Table 1 lists some of the proven interventions reported earlier in the Series<sup>6</sup> to have sufficient evidence for implementation and shows the reported extent of their implementation in the 20 countries with the highest burden of

undernutrition. Many interventions are present in the national nutrition plan but are not being delivered to target populations throughout the country, or even in selected geographic areas within a country. By contrast, in some countries interventions to prevent malaria are being implemented despite not being included in the plan of action.

Iron supplementation, universal salt iodisation, vitamin A supplementation for children aged 6–59 months, and breastfeeding promotion strategies based on individual and group counselling are explicitly included in all nutrition plans and are being implemented nationwide in all or a high proportion of countries. Zinc in the management of diarrhoea, iron fortification and supplementation, treatment of severe acute malnutrition in hospitals, behaviour change communications to improve complementary feeding, and interventions to improve hygiene are explicitly included in the plans of between eight and 15 of these countries, but rates of implementation vary widely. For example, only five countries (Afghanistan, Bangladesh, India, Madagascar, and Nigeria) report nationwide implementation of behaviour change communications to improve complementary feeding. A third group of interventions are neither included in nutrition plans nor implemented widely in the countries with the highest burden of undernutrition. Balanced energy-protein supplementation for pregnant women is included in the plans of 10 countries

	Explicitly included in national nutrition plan? (N=19)*		Implementation		
	Yes	No	Not implemented	Implemented nationwide	implemented only in selected districts
<b>Interventions to address undernutrition in mothers and to improve birth outcomes</b>					
Maternal balanced energy-protein supplementation	10	9	7	0	13
Iron-folate supplementation	19	0	0	18	2
Universal salt iodisation†	19	0	1	19	0
Intermittent preventive treatment for malaria‡	3	7	3	4	3
Insecticide-treated bednets‡	4	6	3	4	4
<b>Interventions to address undernutrition in neonates, infants, and children</b>					
Promotion of breastfeeding (individual and group counselling)	19	0	0	14	6
Vitamin A supplementation, 6–59 months	19	0	0	20	0
Zinc supplementation	2	17	16	2	2
Zinc in management of diarrhoea	8	11	9	7	4
Iron fortification	13	5	8	8	4
Iron supplementation	14	5	5	13	2
Treatment of severe acute malnutrition in children under 5 years in hospital consistent with WHO guidelines§	9	10	5	5	8
Behaviour change communication for improved complementary feeding	13	6	8	5	7
Conditional cash transfer programmes (with nutritional education)	1	18	17	1	2
Interventions to improve hygiene	15	4	4	13	3

See Online for weblink 2

See reference 6 for specifics on target populations. For listing of specific countries see weblink 2. \*Yemen does not have an officially approved plan. †Also benefits infants and children. ‡Democratic Republic of the Congo, Ethiopia, Indonesia, Kenya, Madagascar, Nigeria, Philippines, Sudan, Tanzania, Uganda, Vietnam, and Yemen only. §Information missing for two countries on implementation.

**Table 1: Reported implementation status for selected interventions with proven efficacy in reducing undernutrition by countries where applicable (n=20)**

	Explicitly included in national nutrition plan? (N=19)*		Implementation		
	Yes	No	Not implemented	Implemented nationwide	Implemented only in selected districts
Investments in rural infrastructure	8	11	5	13	2
Measures to increase agricultural productivity†	11	8	4	14	1
Irrigation schemes†	8	11	4	8	6
Producer subsidies†	6	13	10	6	3
Consumer food subsidies	3	16	14	3	3
Girls'/women's education‡	6	11	7	4	3

For listing of specific countries and missing data see webtable 2. \*Yemen does not have an officially-approved plan. †Information missing for one country. ‡Information on nutrition plans missing for two countries and on implementation for six countries.

**Table 2: Implementation of national actions in sectors other than health and nutrition that best practice suggests can reduce undernutrition**

but is not being implemented at scale in any country. Zinc fortification is both included in the plan and being implemented nationwide in Indonesia and South Africa only. Madagascar is the only country that reported both planning for and implementing conditional cash transfer programmes at scale nationwide.

National actions in sectors other than health also have important implications for nutritional status.<sup>34,35</sup> Experience in the Democratic Republic of the Congo<sup>36</sup> and China (panel 2) illustrates how economic policies addressing poverty, trade, and agriculture can be associated with rapid improvements in nutritional status. These distal inputs to maternal and child undernutrition are important and are reflected in the conceptual model underpinning this Series.<sup>1</sup> Country assessment teams were asked to report on the status of selected food, agriculture, and rural infrastructure activities, but due to space limitations only five specific areas are reported on here: investments in rural infrastructure, measures to increase agricultural productivity, irrigation schemes, and producer and consumer food subsidies.

13 country assessment teams report nationwide investments in rural infrastructure, such as roads, health clinics, schools, markets, and institutions (table 2). These investments are a necessary but not sufficient precondition for reduced food insecurity and undernutrition in both rural and urban areas.<sup>37</sup> 14 countries report that inputs such as fertilisers and plant protection measures are being used to increase agricultural productivity nationwide. Public investment in irrigation systems was also reported by 14 of the 20 countries with the highest burden of undernutrition, of which eight reported that these efforts were being implemented nationwide. For all of these strategies, effectiveness depends on the presence of complementary inputs related to such things as health, education, and dietary diversity and choice. Three countries—Egypt, India, and Indonesia—report nationwide consumer food subsidies, with an additional four countries reporting these subsidies only in selected subnational areas. Low agricultural productivity implies

high costs of production, high prices for consumers, and low incomes for farmers. In addition to inputs, productivity can be improved through the application of available technology and production practices developed and adapted to local contexts through research. The potential of agricultural research to reduce poverty and undernutrition by improving crop yields and quality has been shown in many countries,<sup>31,38,39</sup> yet few countries report such programmes. In part to compensate for the absence of longer-term investments in rural infrastructure and agricultural research that would lead to improved productivity and farmers' incomes, nine of the 20 countries report the use of producer subsidies either nationwide or in selected areas.

In summary, most countries with high levels of undernutrition are not implementing the interventions and strategies shown to be effective in addressing the problem at scale. Some interventions are the result of recent advances in research and technology, so implementation is only beginning. Others, however, have been promoted for years or even decades and are still being implemented in only a few areas or not at all, even in countries where the interventions are included in national policies and plans. Broad food system policies that can contribute to longer term alleviation of the undernutrition burden are also rare in these countries. Focusing of agricultural and food system policies on human health and nutrition goals is an under-exploited opportunity with great potential.<sup>31,32</sup> For example, breeding of resistant crops with improved yields and micronutrient content could benefit local populations. National nutrition decision makers must rationalise their strategies to reflect this new evidence, emphasising effective interventions and key support strategies in other sectors.

Leaders in nutrition at country and subnational levels can now review and, if necessary, revise their strategies and programmes to ensure that available resources are being used to increase the proportion of mothers and children who benefit from proven interventions to address undernutrition.

### Challenge 3: Not doing the wrong things

Strong policies and programmes focus not only on actions with a proven potential to be effective; they also exclude ineffective actions to avoid dilution of focus and the waste of human and financial resources. Ineffective actions in this context refer to those that are unlikely to improve nutritional status or any of its underlying determinants. Ineffectiveness of actions could be indicated because well-designed studies in varied contexts have shown them to lack efficacy, because the requirements for successful implementation are unlikely to be met in any or most settings, or because the assumptions underlying the pathways from implementation to effect are flawed or incomplete (panel 3).<sup>6,40,41</sup>

Table 3 reports on the status of three strategies that the Series reviews found to be ineffective as direct contributors to reducing undernutrition in mothers or young children: growth monitoring (unless linked to adequate nutrition counselling and referrals); preschool feeding programmes targeting children over 24 months of age; and school feeding programmes targeting children

older than 5 years of age.<sup>6</sup> All three of these strategies were reported as being implemented in many of the countries with the highest burden of undernutrition, and 12 of the 20 countries reported nationwide implementation of growth monitoring. Other strategies reviewed and found to have limited evidence supporting a direct effect on stunting include food-for-work and microcredit programmes.<sup>6</sup> Although a recent review of interventions to promote animal production concluded that such efforts seem to be associated with some improvement in dietary intake, evidence of an effect on nutritional status is limited and shows mixed results.<sup>42</sup> Research is needed urgently to identify the types of incentives and specific programme design features that could be included in other community development and poverty alleviation strategies to improve their effectiveness in reducing undernutrition directly or addressing its underlying causes. Such research is especially urgent in the case of growth monitoring, which has been an important element of successful programmes in a few settings but has been poorly implemented in a much larger number of other settings.<sup>43</sup>

If nutrition resources are being used to support ineffective actions at national level, with no realistic prospect of strengthening them to the extent required, a politically sensitive strategy will be needed to phase them out. If resources from sources other than those intended to improve nutritional status are supporting these actions, the reasons for this situation should be discussed, and any justifications based on their nutritional effect removed. Some of these actions, such as school feeding programmes, could have important, albeit non-nutritional, benefits for education, and countries might decide to continue these programmes with support from the education sector.<sup>44</sup> However, school feeding programmes are targeted to children after the age at which stunting generally occurs and can be prevented,<sup>6</sup> and in fact might have adverse effects if they result in excess calorie intake in children in this age-group.<sup>3</sup>

International food aid is a major resource that dominates national nutrition actions.<sup>21</sup> The World Food Program reported a total of US\$2.7 billion in food and related resources in 2006, including about \$1.5 billion to the 20 countries with the highest burden of undernutrition. No direct expenditures were made in Nigeria and Vietnam; in the remaining 18 countries a median of about \$20 million was spent per country, ranging from \$893 000 in South Africa to \$558 million in Sudan. Although not assessed systematically, food aid can be an effective input into nutrition programmes if it complements other health, water, and sanitation activities. However, to the extent that food aid is used to support untargeted food distribution, school feeding programmes, or other strategies in the absence of a proven effect on nutritional status, it does not represent a nutritional intervention and should not be labelled as such. Over half of the food aid provided by the USA,

#### Panel 3: Right things and wrong things—the importance of context

The choice and design of actions to reduce undernutrition in a given country should consider two key features—efficacy and effectiveness, both of which can be affected by context.<sup>39</sup> The previous paper in the Series<sup>6</sup> distinguished universal interventions, which are expected to be efficacious in all contexts, and situational interventions that might be efficacious only in certain contexts. The number of interventions in these two categories is similar, reflecting the fact that even interventions that are mainly biological are affected by contextual factors such as life stage, effect modifiers such as infection, dietary inhibitors, or facilitators of absorption, and so on. An even larger set of contextual factors can affect the effectiveness of interventions, including characteristics of the delivery system, communities, and households that ultimately affect coverage, quality, and use of interventions. In light of these realities, the choice and design of interventions and delivery strategies must take into account actions that have worked elsewhere and have the potential to be efficacious in the present context, as well as factors in a particular country (or smaller geographic area) that could have a positive or negative effect on delivery, quality, and use. An explicit impact model that specifies the administrative, sociocultural, and other factors likely to affect coverage, quality, and use, can be used to help make this choice, as can findings from formative research aimed at elucidating these factors. The bottom line is that judgments about “right and wrong” (or “effective and ineffective”) are contextual. An important priority is to strengthen research, operational capacities, and institutional mechanisms for making these judgments, assessing the results, and sharing experiences.

	Implemented at all?		If implemented, where?	
	Yes	No	Nationwide	Selected districts
Growth monitoring	20	0	12	8
Preschool feeding programmes targeting children >24 months of age	10	10	3	7
School feeding programmes targeting children >5 years of age	20	0	4	16

For listing of specific countries see webtable 2.

**Table 3: Current status of selected interventions with no evidence of a direct effect on undernutrition**



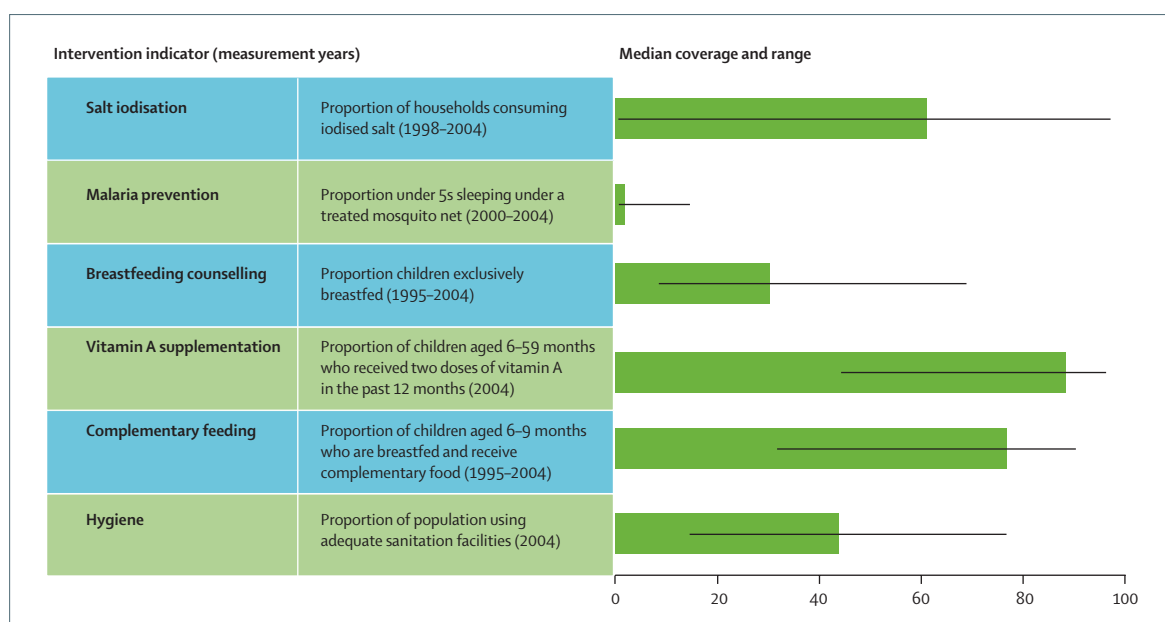


Figure 2: Best available estimates of coverage with effective interventions in the 20 countries with the highest burden of undernutrition

which accounts for most of international food aid, is monetised or sold in countries to generate cash that is then used to fund a range of food security and nutrition-related programmes. Although the cash from monetisation is reportedly used to support local health and nutrition programming, poorly timed and managed monetisation programmes could affect the livelihoods of low-income farmers because of the potential negative effect on food prices in the recipient country.<sup>44</sup> If not properly linked to nutrition actions, the presence of food aid in a country can have a distorting effect on the national nutrition agenda, channelling scarce human and organisational resources to stand-alone food-delivery activities rather than the design and implementation of more comprehensive and effective nutrition strategies. The latter can include initiatives designed to improve feeding practices that include a food aid or cash transfer component.

In their review of policies and programmes, nutrition leaders at country and subnational levels should examine actions taking place in the name of nutrition and the extent to which they are likely to improve the nutritional status of mothers and children under 24 months of age. National policymakers can ask hard questions about new initiatives, ensuring that they contribute to the country's nutrition goals.

#### Challenge 4: Acting at scale

Figure 2 shows median coverage estimates and ranges in the 20 countries with the highest burden of undernutrition for six proven interventions for which population-level coverage estimates are available. The non-availability of coverage estimates for the nine remaining interventions is a finding in itself, because it means that countries will

have difficulty in tracking their progress. New efforts to improve monitoring by the Health Metrics Network,<sup>45</sup> WHO, UNICEF, and others should help address this gap. Even the six interventions with available coverage data include three indicators that are proxies because there are no data on which to base estimates for the intervention itself. For breastfeeding counselling, exclusive breastfeeding to 6 months of age is used as a proxy representing the major intervention outcome. For the two proven interventions aimed at increasing the prevalence of appropriate complementary feeding, a single proxy that again represents one of the intended outcomes is used: the proportion of children who are breastfed and given complementary food between the ages of 6 and 9 months. For hygiene interventions the proxy used is the proportion of the population using adequate sanitation facilities. Figure 2 shows wide variation in current coverage levels for those interventions; a fair assumption is that the interventions without indicators or data are even less widely available.

Of the interventions for which coverage estimates exist (figure 2), we highlighted earlier the achievements in going to scale for vitamin A supplementation and universal salt iodisation. These interventions have largely been implemented at scale through collaboration with the private sector, and have generally not involved efforts that were labour and resource intensive to change behaviours at individual, community, or health system levels other than effective health communications. These interventions have many of the characteristics found in a recent review to be associated with successful delivery at scale, such as a clearly defined biological pathway and largely vertical delivery strategies.<sup>46</sup>

The challenges of scaling up have received increasing attention in recent years, because achieving high and equitable coverage at population level will determine whether the MDGs are achieved.<sup>47</sup> Despite this renewed interest, the historical bias toward studies of the efficacy of specific interventions and against broader assessments of the effectiveness of programme implementation remains.<sup>48</sup> National decisions about how best to act at scale vary by type of intervention and the extent to which achieving high coverage requires change in individual behaviour, community norms or organisation, the health system, or national or international policies or actions. Some commentators suggest that, unlike vitamin A supplementation and salt iodisation, high-impact interventions such as the promotion of breastfeeding and the improvement of complementary feeding require behaviour changes at many levels, and therefore require greater inputs.<sup>49</sup>

Prescribing the most effective delivery strategies for various interventions is premature in view of the absence of systematic assessments of alternatives.<sup>50,51</sup> Reviews of country-level nutrition experience highlight best practice examples of acting at scale in nutrition that might be useful in specific contexts,<sup>21</sup> but there is a real danger of assuming that what has been done in the past reflects the best options for the future. An example is provided in the next section, where efforts to group interventions to facilitate delivery—referred to as packaging or bundling—have been adopted as logical but have not yet been systematically assessed.

The integration of nutrition interventions into maternal, neonatal, and child health programmes can lead to expanded coverage as described for vitamin A supplementation, and must be pursued urgently so that new initiatives designed to achieve the health-related MDGs do not leave nutrition behind. Country experience shows clearly, however, that this integration and scale-up must be context specific and accompanied by mechanisms to ensure and sustain intervention quality.<sup>41</sup> Preliminary assessments of the UNICEF-supported Accelerating Child Survival and Development programme in west Africa, for example, reported that implementing districts often neglected the nutrition-related interventions included in the implementation packages and highlighted nutrition as a priority in continuing child survival efforts.<sup>52</sup>

It is time to think in new ways about acting at scale to address undernutrition. The debate about the choice between vertical and integrated approaches to public-health delivery is moving towards a more rational approach that recognises the need to scale-up high-impact interventions and strengthen the health system simultaneously, within a broader framework that incorporates both aims. The dominant paradigm for scaling up, however, proposes an incremental approach derived from the biomedical world that begins with testing an intervention for safety and efficacy through

randomised controlled trials, followed by small-scale implementation in demonstration or pilot projects, leading over time—lots of time—to stepwise, district by district expansion. This model need not apply to many of the interventions found effective in this Series. Governments and funders bemoan slow progress in achieving coverage, while simultaneously standing behind the existing processes for scaling up, even for interventions known to be effective and feasible for large-scale implementation. It is time for a paradigm shift aimed at achieving universal access from the start for proven interventions to address maternal and child undernutrition.

Many of the effective interventions described in this Series lie within the scope of action and service delivery of the health sector. Nutrition must be an integral part of countries' efforts to develop their health sectors and strengthen their health systems. There are powerful synergies between nutrition and primary health care, including the focus on community-based approaches and growing interest in the use of performance-based financing mechanisms as an incentive for rapid scale-up. Country-level nutrition leaders can be proactive in defining how nutrition interventions can be integrated into delivery channels for other public-health interventions, and developing locally generated investment cases supporting the integration of nutrition interventions in broader initiatives targeting the health MDGs. The private sector is an inextricable part of the national nutrition system (panel 4). The importance of involving the commercial sector in positive ways has been demonstrated, but additional effectiveness assessments and documentation of best practices are needed in this area.

#### Challenge 5: Reaching those in need

Achieving high coverage is not enough if the process of scaling up either systematically excludes the people in need or wastefully misdirects services to those who cannot benefit or are not in need. Appropriate and equitable targeting are important components of successful large-scale programmes. Within nutrition, health and nutritional counselling and feeding interventions have frequently been characterised by inappropriate targeting and a resulting failure to reach intended groups (see webextra for third paper in this Series<sup>6</sup>).

The assessment teams from the 20 countries with the highest burden of undernutrition provided incomplete and sometimes confusing reports about whether the proven interventions were being appropriately targeted, even in personal follow-up interviews. Respondents reported that they were not clear about appropriate target populations for specific interventions, and frequently indicated that the international nutrition system determined the targeting through their funding guidelines.

Socioeconomic inequities are rife within undernutrition programme efforts. Tracing the pathways in the conceptual

See Online/Series  
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model for the Series,<sup>1</sup> poor children are more likely than their wealthier peers to have less diversified and nutritious diets,<sup>1</sup> to report episodes of infectious disease, including fever and diarrhoea,<sup>67</sup> to live in food-insecure households,<sup>68</sup> and to be exposed to unhealthy household environments with reduced access to health services.<sup>69</sup> The exception here is care and feeding, because children in low-income households are reported in many settings to have higher rates of exclusive breastfeeding than in those in wealthier

households.<sup>49</sup> By the age of 6 months, however, disparities in nutritional intake offset this advantage.<sup>1</sup>

Decision makers at national and subnational levels can address these inequities by documenting disparities in the populations for whom they are responsible, and planning activities that are designed to redress them. One recent development is packaging of interventions for delivery to specific populations or through existing channels.<sup>70,71</sup> Grouping of interventions to promote their

#### Panel 4: The role of the private sector in improving nutrition in developing countries

##### Why the private sector is important

The size and influence of the private sector are expanding in all domains, and nutrition is no exception. The agricultural and food industries increasingly determine food availability and choices. For most poor households in developing countries, the private sector in its broadest sense has a presence far greater than that of governments. These households depend on the private sector for their income; they also use the private sector for all the inputs that directly affect nutritional status: food, health care, and a safe household environment.

Poor households are highly vulnerable to rising food prices. When a regional drought caused increases in maize prices in Lusaka, Zambia, infant length decreased significantly.<sup>53</sup> The devaluation of the currency in Brazzaville, Congo, in 1994, with resulting increases in food prices, had a similar effect.<sup>36</sup> In Bangladesh, household expenditure for rice, which is largely determined by price, has been positively correlated with the percentage of underweight children over the period 1992 to 2000.<sup>34</sup> Keeping food prices low depends not only on governments investing in rural infrastructure and technology, but also on the effective functioning of private markets. Chowdhury and colleagues<sup>54</sup> have shown that deregulation of the rice market since 1992 by the government of Bangladesh prompted a remarkable growth in private sector activity and led to the spatial integration of the national market (ie, the disappearance of geographic pockets of high prices), the dampening of seasonal price spikes, and a downward trend in average prices.

Food product manufacturers, distributors, and retailers also have a huge effect on the nutritional quality of foods that poor women and children eat. Fortification programmes seek to partner with food producers to improve the nutritional quality of commonly consumed foods. In Guatemala, sugar fortification with vitamin A became mandatory in 1975. Sugar producers were not involved in the initial development of the programme, and brought it to a halt in 1977–78. With their support, the programme was reinstated in 1988, and by 1990 toddlers aged 6–36 months from poor communities in the capital were found to obtain 29% of their non-breastmilk vitamin A from sugar.<sup>55</sup>

##### How the private sector can contribute

The legacy of efforts by food companies to displace breastmilk with marketed substitutes for children less than 6 months of age—which continues in at least 69 countries<sup>56</sup>—is a lingering distrust of the private sector. This distrust has hampered efforts to capitalise on the extraordinary power of the private sector to contribute to the fight against undernutrition at country level. Private distributors can use their market power to achieve high penetration of beneficial foods and micronutrients by coupling the accessibility of commercial markets with comprehensive social marketing campaigns. The private sector also represents largely untapped financial and human resources that can be mobilised in support of nutrition aims.<sup>57</sup> Efforts by private-public partnerships at the international level—eg, the Alliance for a Green Revolution in Africa (AGRA),<sup>58</sup> or the Global Alliance for Improved Nutrition (GAIN)<sup>59</sup>—can be replicated at national and subnational levels and used to promote local farming,<sup>60</sup> involve local commercial outlets in the distribution of nutritious food products,<sup>61</sup> or support other elements of the national nutrition strategy.

##### Addressing the risks

Involving the private sector in efforts to achieve nutrition goals carries risks—eg, the risk of undue corporate influence on public policy, the risk of distortions in the nutrition agenda toward activities of interest to the private sector, and others.<sup>57</sup> These risks are especially worrisome in countries with weak government capacity, among them many of the countries with the highest burden of undernutrition. Some guidance is available now, emphasising the importance of developing mandatory rather than voluntary codes of conduct,<sup>62,63</sup> and the UN Standing Committee on Nutrition has established a working group to provide guidance to countries on private sector engagement in food and nutrition programmes.<sup>57</sup>

Innovative contractual arrangements with private sector providers can also sometimes be used to extend coverage of key nutrition inputs where public services are weak and failing. In both Madagascar and Senegal, private providers have been mobilised successfully to provide preventive nutrition services to poor communities.<sup>64</sup> In some fragile states—eg, Afghanistan—most basic health care is now contracted out.<sup>65</sup> However, in settings with less oversight of private health care, there is a concern that these providers will not promote the care-giving practices associated with better nutritional outcomes effectively. Innovative solutions such as social franchising have been proposed to tackle these problems,<sup>66</sup> but little is known about whether such approaches can be scaled up.

	Adequate (>3.5)*	Adequate but needs strengthening (2.5-3.4)*	Minimal or none (<2.5)*
<b>Capacities</b>			
Identifying and analysing nutrition problems (mean score on four items)	6	11	2
Designing effective programmes and policies (mean score on eight items)	2	10	7
Implementing and managing programmes (mean score on seven items)	1	9	9
Monitoring and assessing programmes?	2	8	9
Advocacy, negotiation, and mobilisation of allies and support?	4	7	8
Resource generation and mobilisation?	4	5	10
Convening and facilitating effective policy dialogue	4	10	5
Effectively overseeing the overall nutrition agenda	1	9	9
<b>Capacity building</b>			
High quality training opportunities available in national institutions?	1	8	10
Opportunities (including funding) available for good quality short-term training	1	3	15
Opportunities (including funding) available for good quality advanced degree training (MS or PhD)	1	2	16

Data are number of countries. \*Index of Self-Assessment of Capacity for Leadership and Strategic Management of National Nutrition Agendas; 1=minimal to none; 5=adequate.

**Table 4: Self-reports of national capacity for designing, implementing, and monitoring nutrition actions, and commitment to nutrition**

delivery through existing contact points with mothers and children seems to be practical and efficient, if the strategy is designed to address inequities or reach universal coverage rapidly so that the poor are not left behind.<sup>72</sup>

At national and subnational levels, both political commitment and operational effort will be needed to monitor and address inequities in nutrition programmes. A first step is to insist that monitoring results are disaggregated to allow examination of potential inequities—whether socioeconomic or based on ethnic group or sex—and then to develop delivery strategies that reach the underserved followed by tracking of the extent to which this is achieved. Those working in nutrition internationally can contribute by developing clear guidelines on the technical aspects of targeting for adaptation to specific country settings.

#### Challenge 6: Data-based decision making for nutrition

Effective management of national nutrition actions requires monitoring and assessment of both process and results. Process is certainly important, including the use of sound design principles, broad participation by—and development of ownership among—key nutrition leaders, and regular monitoring that produces timely information useful in programme decision making. But what counts is results, and for that national leaders need trustworthy reports on coverage and nutritional effect for both direct nutrition actions and broader intersectoral efforts. National efforts to address

nutrition have been hampered in the past by initiatives that address one part of the pathway from planning to effect without ensuring appropriate attention to other aspects. Examples of incomplete initiatives include the UN emphasis on developing national plans of action for nutrition without budget or operational plans, training nutrition staff without strengthening their home institutions, or implementing a single strategy such as growth monitoring without ensuring that the additional interventions needed to make it effective—eg, nutrition counselling—are in place. Each of these actions could have an important role in addressing maternal and child undernutrition, but to do so they must be part of a coherent national strategy that includes regular monitoring and the use of monitoring results to improve programme effectiveness. National efforts must be devoted to the entire policy continuum, including agenda setting and commitment building, choice and design of actions, quality of implementation, adjustment of actions based on monitoring and assessment, and human and institutional capacity building.

Public accountability for improvements in nutritional status at both national and subnational levels is another important element of the policy continuum, and weak attention to this has been a barrier to progress in most countries, especially in those with the highest burden of undernutrition. The push to achieve the MDGs can strengthen accountability, as can the involvement of country nutrition leaders in efforts such as the Countdown to 2015, a supra-institutional effort designed to focus public attention on achieving and sustaining high and equitable coverage with interventions that are effective in reducing maternal and child mortality in 60 countries.<sup>73</sup> A first step in this direction is for countries to review existing international consensus indicators related to nutrition,<sup>74</sup> several of which are presented in figure 2. These indicators are not perfect—eg, the infant and young child feeding indicators are currently being revised—but provide a good starting point for national decision makers. Most of the 20 countries with the highest burden of undernutrition have data for these indicators available through their collaboration with the Demographic and Health Survey (DHS) programme<sup>75</sup> or the programme of Multiple Indicator Cluster Surveys (MICS), which is supported by UNICEF.<sup>76</sup> National monitoring of the quality and coverage of nutrition interventions with special attention to pregnant women, children under the age of 2 years, and under-served groups can serve as the basis for improving programmes over time.

True commitment is reflected in financial flows to nutrition action at national and subnational levels. Efforts to track these flows must be included as discrete areas in both research on financial flows to child survival<sup>77</sup> and in not only the national health accounts but also the overall national accounts processes.<sup>78</sup>

### Challenge 7: Building strategic and operational capacity

The availability of adequate capacity for leadership and strategic management of the national nutrition agenda will be an important determinant of efforts to accelerate nutrition. Table 4 shows the results of self-assessments of capacity in the 20 countries with highest burden of undernutrition. Few countries reported the availability of adequate strategic capacity, and only one country reported that capacity to oversee the nutrition agenda effectively was available.

The operational capacities needed to design, implement, and manage nutrition programmes were also reported to be weak in these countries (table 4), in general weaker than the strategic capacities described above. Weakest of all was reported capacity for training. The integration of nutrition programming within broader efforts to achieve the health MDGs requires training programmes that build skills in programme management, including monitoring and strategies for the integration of nutrition into other health programmes and sectors. Such training does not exist at present.

National nutrition leaders provided important context for these findings in the qualitative studies. They agreed that both strategic and operational capacities could and should be expanded, but that rapid turnover of staff—technical, managerial, and political—poses a substantial challenge. A careful balance must be struck between building the capacity of individuals and that of institutions.

Constraints and opportunities related to acting at scale for undernutrition also vary across geographic regions. Panel 1 provides a historical overview of experience in Latin America, but there are other important differences as well. In much of Africa, for example, training curricula in nutrition are narrowly focused on clinical and dietetic skills, whereas in many countries of Asia they have been broadened to include essential skills in programme management and monitoring. In southeast Asia, there are many more private-sector health providers than in most countries in Africa. There could be opportunities for regional support to individual countries, particularly in addressing region-specific challenges.

Major changes are needed in the international and national nutrition systems to strengthen the strategic and operational capacities that will allow countries and districts to achieve sustainable and equitable improvements in maternal and child undernutrition. Strategic capacities that are needed urgently include the knowledge, skills, leadership, and human resources for envisioning, shaping, and guiding the national and subnational nutrition agendas, and especially the capacity to broaden, deepen, and sustain the commitment to nutrition. The operational capacities include the rest of the policy continuum: programme and policy design, monitoring, and assessment and adapting implementation and management to the country context; policy and programme oriented research and analytical

capacities; pre-service and in-service training and orientation for cadres and professionals from community to national level and in multiple sectors; and the ability to access, manage, adapt, and use international knowledge, norms, guidance, and expertise. Strengthening these capacities is needed to ensure sustainable financing for effective nutrition programmes and policies.

Effective leadership and strategic capacity at country level are increasingly recognised as prerequisites for development. Building this capacity goes beyond training of individuals to include broader sets of changes in institutions, policies, and behaviours.<sup>79</sup> The international nutrition system can take a leading role in this area, despite the limited attention paid to it in the past.

Attempts to define the best institutional context for nutrition programmes at national level have not been successful, highlighting instead that key functions and capacities must be available.<sup>80,81</sup> Country experience suggests that locally generated solutions to questions about how best to organise nutrition are most likely to be successful. International prescriptions for national nutrition institutes or institutional arrangements should be avoided, and replaced by clear guidance on the need for functioning mechanisms to develop and manage programmes, train various cadres of workers, do research, employ future graduates, and so forth.

### The role of the international nutrition system

Results from the country assessments, supplemented by qualitative interactions with nutrition policymakers and programme managers in selected countries, documented the effect of international agreements, resources, and priorities on national nutrition actions. One example of this influence is the role of poverty reduction strategy papers (PRSPs) in national nutrition actions. PRSPs were established in 1999 by the World Bank and the International Monetary Fund as a prerequisite for concessional lending or debt relief to countries with especially high indebtedness. The intention of the PRSP is to serve as the framework for domestic policies and programmes to reduce poverty as well as for coordinating development aid.<sup>80</sup> As of September, 2006, 16 of the 20 countries with the highest burden of undernutrition had PRSPs in place. 13 of the 16 were reported by country teams to address nutrition. Only eight of the 13 reported that there was a budget for the nutrition component and that it was being implemented, and in these eight countries the assessment teams reported that the PRSP had had a positive effect on national nutrition or food policies. The results of a recent review were consistent with country reports, indicating that few PRSPs actually include substantive support for robust and sustainable action to address undernutrition.<sup>81</sup>

In the qualitative studies, senior nutrition leaders from five countries spoke with one voice in saying that vacillating priorities and a lack of respect for locally



**Panel 5: Research priorities to support national nutrition actions**

- Research on strengthening leadership and strategic capacity for advancing national nutrition agendas and actions. Positive experiences in Madagascar, Senegal, Thailand, Chile, Costa Rica, and other countries have shown that leadership and strategic capacity are key ingredients for advancing the national nutrition agenda and action. Among other roles, these capacities are crucial for leveraging commitment and resources from government, international partners, and the private sector. Research is needed to document the capacities, strategies and, tactics present in successful countries, to guide international investments, and to facilitate the exchange of experience between developing countries learning in this important area
- Large-scale effectiveness assessments that can expand the evidence base for strategies and tactics to achieve high, sustained, and equitable coverage with proven interventions to address undernutrition are also needed
- Development and assessment of valid indicators and methodologies that can be used at national level and below to provide rapid feedback on progress in generating political commitment, strategic and operational capacities, coverage, and effect
- Links between nutritional status and broader initiatives such as food for work and microcredit initiatives need to be substantiated and used as the basis for assessing their effect on nutrition outcomes

generated solutions were the major problems in the interface between the national and international nutrition systems. National managers called for co-responsibility for nutrition among the national and international systems. In the words of one national manager:

“The country and all the partners and all the multilaterals are co-responsible for what happens at country level, because they have been there for 50 years, sometimes since the inception of the country, and they have been beside us. And they have come in and said ‘Well, the recipe today, or for the next 10 years, is called blah. And the recipe now is re-engineering, and then the recipe now is globalisation. And the recipe now is agri-reform and the recipe now is terrorism and the recipe now is blah, blah, blah, blah. And we are being fed that, because if we don’t dance that tune...we get a cold shoulder.’ So there has to be legitimate recognition of co-responsibility.”

From the perspective of national nutrition leaders, the international nutrition system provides inconsistent and fluctuating guidance—both across organisations and over time. Country-level decision makers in nutrition perceive the international nutrition system as lacking in clear priorities, and insensitive to the political realities and timetables at country level. Inconsistent, popular strategies are proposed and supported, even in settings where solutions have been generated locally.

Links between national and international nutrition systems must be strengthened. The operational experiences of national nutrition leaders must be brought to centre stage in discussions about the global architecture for nutrition and how to support priority actions at country levels. A renewed and more functional international nutrition system should be structurally

connected to national systems, and serve their needs. National systems should be the building blocks of the international system.

**What can be done at national level to address maternal and child undernutrition?**

The problem of maternal and child undernutrition at national level is multifaceted. The burden is high, and concentrated in poor communities in poor countries facing huge burdens of disease and low capacity and human resources. Coverage rates for interventions and support strategies found in this Series to be effective in addressing undernutrition are often not being widely measured or monitored, and those that are monitored suggest that, with the exception of vertical, centrally driven and delivered interventions such as vitamin A and universal salt iodisation, coverage is far from universal. Some national-level efforts are being directed to strategies with no direct or plausible effect on undernutrition. Coordination between people working in nutrition at national level is weak or non-existent, and this situation is exacerbated by an international nutrition system that has little respect for country-generated plans and local timetables for planning or the political process.

As shown in the seven challenges presented here, the reasons why nutrition programmes at national level and below have been ineffective are complex. The combination of weak leadership and vision at the international level is an important contributor, as is the lack of evidence from scientific and programme assessments leading to a nutrition community that speaks in one voice about what needs to be done.

What can be done? What does the enormous amount of new information included in this Series suggest should be the priorities at national level to address undernutrition? Is it possible to suggest a set of generic priority actions, despite the clear evidence that effective solutions must be generated and implemented at national level and below, and which could vary widely in their specifics? There are no simple prescriptions to reduce undernutrition, although achievement of high coverage with four or five of the proven interventions would certainly have a sizeable effect. In many areas, further research is needed to support effective nutrition actions at national and subnational levels (panel 5). The charge to nutrition leaders at country level is to review their existing strategies and programmes to ensure that priority is given to interventions with a proven effect on undernutrition in pregnant women and children younger than 2 years of age, and then to develop feasible strategies for increasing public demand for these interventions and delivering them at scale. The charge to nutrition leaders at international level is to act immediately to support countries in assessing their readiness to act at scale, to identify gaps, and to build sufficient capacity at national level to develop and maintain a functional nutrition system able to accept responsibility for accelerating progress.

### Contributors

All authors contributed to the conceptualisation of the paper and the development and review of the country assessments. Primary responsibility for specific topics was as follows: DC and ID-H did the country assessments; PP-A prepared and drafted sections related to agricultural and food policies; DP coordinated and summarised the qualitative work with national nutrition leaders; JB prepared sections on coverage and scaling up. JB prepared drafts which were then reviewed, revised, and approved by all authors.

### Maternal and Child Undernutrition Study Group

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### Conflict of interest statement

ID-H was acting chief of nutrition for UNICEF during the period this manuscript was prepared, and DC was Director of Nutrition for WHO. This paper reflects their individual views and does not necessarily reflect the views of their respective organisations. The remaining authors declare that they have no conflict of interest.

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### References

- Black R, Allen L, Bhutta Z, et al, for the Maternal and Child Undernutrition Study Group. Maternal and child undernutrition: global and regional exposures and health consequences. *Lancet* 2008; published online Jan 17. DOI:10.1016/S0140-6736(07)61690-0.
- Ezzati M, Lopez AD, Rodgers A, Vander Hoorn S, Murray CJ. Selected major risk factors and global and regional burden of disease. *Lancet* 2002; **360**: 1347–60.
- Victora CG, Adair L, Fall C, et al, for the Maternal and Child Undernutrition Study Group. Maternal and child undernutrition: consequences for adult health and human capital. *Lancet* 2008; published online Jan 17. DOI:10.1016/S0140-6736(07)61692-4.
- Sachs JD. Macroeconomics and health: investing in health for human development. Geneva: World Health Organization, 2001.
- Sen A. Inequality reexamined. Boston MA: Russell Sage Foundation Books, Harvard University Press. ISBN 13: 978-0-674-45255-8. 1995.
- Bhutta ZA, Ahmad T, Black RE, et al, for the Maternal and Child Undernutrition Study Group. What works? Interventions for maternal and child undernutrition and survival. *Lancet* 2008; published online Jan 17. DOI:10.1016/S0140-6736(07)61693-6.
- Brazil, Ministry of Health. Avaliação do Programa Bolsa Alimentação segunda fase. Brasília, 2005. [http://dtr2004.saude.gov.br/nutricao/documentos/av\\_pba2.pdf](http://dtr2004.saude.gov.br/nutricao/documentos/av_pba2.pdf) (accessed July 1, 2007).
- Boyd Orr J. Food, health and income. London: Macmillan, 1936.
- Allen L, Benoist B, Dary O, Hurrell R. Guidelines on food fortification with micronutrients. [http://www.who.int/entity/nutrition/publications/guide\\_food\\_fortification\\_micronutrients.pdf](http://www.who.int/entity/nutrition/publications/guide_food_fortification_micronutrients.pdf) (accessed Nov 5, 2007).
- Bishai D, Nalubola R. The history of food fortification in the United States: its relevance for current fortification efforts in developing countries. *Econ Devel Cultural Change* 2002; **51**: 37–53.
- Birn AE. Gates's grandest challenge: transcending technology as public health ideology. *Lancet* 2005; **366**: 514–19.
- UN Millennium Project 2005. Halving hunger: it can be done. Task Force on Hunger. London and Sterling, VA: Earthscan Publications, 2005.
- Hossain SMM, Duffield A, Taylor A. An evaluation of the impact of a US\$60 million nutrition programme in Bangladesh. *Health Pol Plan* 2005; **20**: 35–40.
- Rivera JA, Sotres-Alvarez D, Habicht J-P, Shamah T, Villalpando S. Impact of the Mexican programme for education, health and nutrition (PROGRESA) on rates of growth and anemia in infants and young children: a randomized effectiveness study. *JAMA* 2004; **291**: 2563–70.
- Carpenter KJ. David Marine and the problem of Goiter. *J Nutr* 2005; **135**: 675–80.
- UNICEF. State of the world's children 2007. New York: UNICEF, 2007.
- UNICEF. Vitamin A supplementation: a decade of progress. New York: UNICEF, 2007.
- UNICEF. The state of the world's children 2008. New York: UNICEF, 2007.
- United Nations Standing Committee on Nutrition. Fifth report on the world nutrition situation: nutrition for improved development outcomes. <http://www.unsystem.org/scn/Publications/html/RWNS.html> (accessed July 17, 2007).

- 20 Heaver R. Strengthening country commitment to human development: lessons from nutrition. Washington DC: World Bank Health, Nutrition and Population Discussion Paper; 2005. [http://www-wds.worldbank.org/servlet/WDSContentServer/WDSP/IB/2005/02/28/000090341\\_20050228153225/Rendered/PDF/31674.pdf](http://www-wds.worldbank.org/servlet/WDSContentServer/WDSP/IB/2005/02/28/000090341_20050228153225/Rendered/PDF/31674.pdf) (accessed July 1, 2007).
- 21 World Bank. Repositioning nutrition as central to development: a strategy for large-scale action. Washington DC: World Bank; 2006.
- 22 Allen LH, Gillespie SR. What works? A review of the efficacy and effectiveness of nutrition interventions. Geneva: ACC/SCN in collaboration with the Asian Development Bank, 2001.
- 23 Morris SS, Cogill B, Uauy R, for the Maternal and Child Undernutrition Study Group. Effective international action against undernutrition: why has it proven so difficult and what can be done to accelerate progress? *Lancet* 2008; published online Jan 17. DOI:10.1016/S0140-6736(07)61695-X.
- 24 Stockholm International Peace Research Institute (SIPRI). SIPRI yearbook 2006. Armaments, disarmament and international security. Stockholm: SIPRI, 2007.
- 25 EM-DAT: the OFDA/CRED international disaster database. <http://www.em-dat.net/disasters/Visualisation/advsearch.php> (accessed Nov 5, 2007).
- 26 Joint UN Programme on HIV/AIDS. Report on the global AIDS epidemic 2006. Annex 2: HIV and AIDS data estimates and data 2005 and 2003. [http://data.unaids.org/pub/GlobalReport/2006/2006\\_GR\\_ANN2\\_en.pdf](http://data.unaids.org/pub/GlobalReport/2006/2006_GR_ANN2_en.pdf) (accessed Oct 17, 2007).
- 27 World Bank. Country classifications. <http://web.worldbank.org/WBSITE/EXTERNAL/DATASTATISTICS/0,,contentMDK:20421402~pagePK:64133150~piPK:64133175~theSitePK:239419,00.html> (accessed Nov 5, 2007).
- 28 World Bank. PovcalNet. <http://iresearch.worldbank.org/PovcalNet/> (accessed Oct 17, 2007).
- 29 World Bank. World development report 2004: making services work for poor people. Washington DC: World Bank, 2004.
- 30 Shiffman J. Generating political priority for maternal mortality reduction in 5 developing countries. *Am J Public Health* 2007; 97: 796–803.
- 31 Pinstrup-Andersen P, Schioler E. Seeds of contention: world hunger and the global controversy of GM crops. Baltimore MD: Johns Hopkins University Press, 2000.
- 32 Pinstrup-Andersen P. Agricultural research and policy for better health and nutrition in developing countries: a food systems approach. 26th Conference of the International Association of Agricultural Economists (IAAE); Brisbane, Australia; August 12–18, 2006.
- 33 Sharma RR. An introduction to advocacy. <http://www.aed.org/ToolsandPublications/upload/PNABZ919.pdf> (accessed Oct 17, 2007).
- 34 Torlesse H, Kiess L, Bloem MW. Association of household rice expenditure with child nutritional status indicates a role for macroeconomic food policy in combating malnutrition. *J Nutr* 2003; 133: 1320–25.
- 35 Bloem MW, de Pee S, Darnton-Hill I. Micronutrient deficiencies and maternal thinness. First chain in the sequence of nutritional and health events in economic crises. In: Bendich A, Deckelbaum RJ, eds. Preventive nutrition. The comprehensive guide for health professionals, 3rd edn. Totowa, NJ: Humana Press, 2005: 689–710.
- 36 Martin-Prevel Y, Delpeuch F, Traissac P, et al. Deterioration in the nutritional status of young children and their mothers in Brazzaville, Congo, following the 1994 devaluation of the CFA franc. *Bull World Health Organ* 2000; 78: 108–18.
- 37 Pinstrup-Andersen P, Shimokawa S. Rural infrastructure and agricultural development. [http://siteresources.worldbank.org/INTDECABCTOK2006/Resources/Per\\_Pinstrup-Andersen\\_Rural\\_Infrastructure.pdf](http://siteresources.worldbank.org/INTDECABCTOK2006/Resources/Per_Pinstrup-Andersen_Rural_Infrastructure.pdf) (accessed June 18, 2007).
- 38 Pinstrup-Andersen, P. Agricultural research policy to achieve nutritional goals. In: de Janvry A, Kanbur R, eds. Poverty, inequality and development: essays in honor of Erik Thorbecke. New York, NY: Springer Science and Business Media, 2006.
- 39 Welch RM, Graham RD. Breeding for micronutrients in staple food crops from a human nutrition perspective. *J Exp Botany* 2004; 55: 353–64.
- 40 Victora CG, Armstrong Schellenberg J, Huicho L, et al. Context matters: interpreting impact findings in child survival research. *Health Pol Plan* 2005; 20 (suppl 1): i18–i31.
- 41 Bryce J, Victora CG, Habicht J-P, Black RE, Scherpbier RW, on behalf of the MCE-IMCI Technical Advisors. Programmatic pathways to child survival: results of a multi-country evaluation of integrated management of childhood illness. *Health Pol Plan* 2005; 20 (suppl 1): i5–i17.
- 42 Leroy JL, Frongillo EA. Can interventions to promote animal production ameliorate undernutrition? *J Nutr* 2007; 137: 2311–16.
- 43 Ashworth A, Shrimpton R, Jamil K. Growth monitoring and promotion: review of evidence of impact. *J Mat Child Nutr* (in press).
- 44 Barrett CB, Maxwell DG. Food aid after fifty years: recasting its role. London, New York: Routledge, 2005.
- 45 WHO. Health metrics network. <http://www.who.int/healthmetrics/en/> (accessed Oct 17, 2007).
- 46 Gillespie D, Karikins S, Creanga A, Khan S, Cho N. Scaling up health technologies. Report to the Bill & Melinda Gates Foundation. March 2007. [http://www.jhsph.edu/gatesinstitute/policy\\_practice/papers/](http://www.jhsph.edu/gatesinstitute/policy_practice/papers/) (accessed July 18, 2007).
- 47 Victora CG, Hanson K, Bryce J, Vaughan JP. Achieving universal coverage with health interventions. *Lancet* 2004; 364: 1541–48.
- 48 Berg A. Sliding toward nutrition malpractice: time to reconsider and redeploy. *Am J Clin Nutr* 1992; 5: 3–7.
- 49 Trussel J, Grummer-Strawn L, Rodriguez G, Vanlandingham M. Trends and differentials in breastfeeding behaviour: evidence from the WFS and DHS. *Popul Stud* 1992; 46: 285–307.
- 50 Bryce J, El Arifeen S, Pariyo G, Lanata C, Gwatkin D, Habicht JP, and the Multi-Country Evaluation of IMCI Study Group. Reducing child mortality: can public health deliver? *Lancet* 2003; 362: 159–64.
- 51 Webster J, Hill J, Lines J, Hanson K. Delivery systems for insecticide treated and untreated mosquito nets in Africa: categorization and outcomes achieved. *Health Policy Plan* 2007; 22: 277–93.
- 52 UNICEF. Accelerating child survival and development: a results-based approach in high under-5 mortality areas. Final report to CIDA. UNICEF, 2005.
- 53 Gitau R, Makasa M, Kasonka L, et al. Maternal micronutrient status and decreased growth of Zambian infants born during and after the maize price increases resulting from the southern African drought of 2001–2. *Public Health Nutr* 2005; 8: 837–43.
- 54 Chowdhury N, Farid N, Roy D. Food policy liberalization in Bangladesh: how the government and markets delivered? MTID Discussion Paper No. 92. Washington DC: International Food Policy Research Institute, 2006.
- 55 Krause VM, Delisle H, Solomons NW. Fortified foods contribute one half of recommended vitamin A intake in poor urban Guatemalan toddlers. *J Nutr* 1998; 128: 860–64.
- 56 International Baby Food Action Network. Breaking the rules, stretching the rules 2004. Evidence of violations of the international code of marketing of breastmilk substitutes and subsequent resolutions. Penang, Malaysia: IBFAN, 2004.
- 57 Shrimpton R. Private sector contributions to ending child hunger and undernutrition. *SCN News* 2007; 34: 32–36.
- 58 Rockefeller Foundation. Alliance for a green revolution in Africa (AGRA). <http://www.rockfound.org/initiatives/agra/agra.shtml> (accessed Sept 30, 2007).
- 59 Global Alliance for Improved Nutrition (GAIN). <http://www.gainhealth.org/gain/ch/EN-EN/index.cfm> (accessed Sept 30, 2007).
- 60 United Nations Conference on Trade and Development. The least developed countries report 2002: escaping the poverty trap. Geneva: UNCTAD, 2002.
- 61 Porter R, Shafritz L. Packaged foods for complementary feeding: marketing challenges and opportunities. <http://www.linkagesproject.org/media/publications/Technical%20Reports/PackagedFood.PDF> (accessed Sept 30, 2007).
- 62 Utting P. Corporate responsibility and the movement of business. *Development in Practice* 2005; 15: 375–88.
- 63 Aguayo VM, Ross JS, Kanon S, Ouedraogo AN. Monitoring compliance with the international code of marketing of breastmilk substitutes in west Africa: multisite cross sectional survey in Togo and Burkina Faso. *BMJ* 2003; 326: 127.

- 64 Marek T, Diallo I, Ndiaye B, Rakotosalama J. Successful contracting out of prevention services: fighting malnutrition in Senegal and Madagascar. *Health Pol Plan* 1999; **14**: 382–89.
- 65 Palmer N, Strong L, Wali A, Sondorp E. Contracting out health services in fragile states. *BMJ* 2006; **332**: 718–21.
- 66 Montagu D. Franchising of health services in low-income countries. *Health Pol Plan* 2002; **17**: 121–30.
- 67 Gwatkin DR, Rutstein S, Johnson K, Suliman E, Wagstaff A, Amozou A. Socio-economic differences in health, nutrition, and population. Washington DC: World Bank, 2007.
- 68 Darnton-Hill I, Coyne ET. Feast and famine: socioeconomic disparities in global nutrition and health. *Public Health Nutr* 1998; **1**: 23–31.
- 69 Victora CG, Wagstaff A, Schellenberg JA, Gwatkin D, Claeson M, Habicht JP. Applying an equity lens to child health and mortality: more of the same is not enough. *Lancet* 2003; **362**: 233–41.
- 70 Bryce J, Black RE, Walker N, Bhutta ZA, Lawn JE, Steketee RW. Can the world afford to save 6 million children from dying each year? *Lancet* 2005; **365**: 2193–200.
- 71 Knippenberg R, Lawn JE, Darmstadt GL, et al, for The Lancet Neonatal Survival Steering Team. Systematic scaling up of neonatal care in countries. *Lancet* 2005; **365**: 1087–98.
- 72 Victora CG, Fenn B, Bryce J, Kirkwood BR. Co-coverage of preventive interventions and implications for child-survival strategies: evidence from national surveys. *Lancet* 2005; **366**: 1460–66.
- 73 Bryce J, Terreri N, Victora CG, et al. Countdown to 2015: tracking intervention coverage for child survival. *Lancet* 2006; **368**: 1067–76.
- 74 WHO, UNICEF. Child survival survey-based indicators: report of a UNICEF/WHO Meeting June 17–18, 2004. [http://www.childinfo.org/areas/mdgmonitoring/Child%20Survival%20Indicators\\_UNICEF%20WHO%20Mtg\\_June2004.pdf](http://www.childinfo.org/areas/mdgmonitoring/Child%20Survival%20Indicators_UNICEF%20WHO%20Mtg_June2004.pdf) (accessed June 16, 2007).
- 75 Measure DHS. Demographic and Health Surveys. About DHS homepage. <http://www.measuredhs.com/aboutdhs> (accessed Nov 5, 2007).
- 76 UNICEF. Monitoring the situation of children and women. <http://www.childinfo.org> (accessed Nov 5, 2007).
- 77 Powell-Jackson T, Borghi J, Mueller DH, Patouillard E, Mills A. Countdown to 2015: tracking donor assistance to maternal, newborn, and child health. *Lancet* 2006; **368**: 1077–87.
- 78 WHO. National health accounts. <http://www.who.int/nha/en/> (accessed Nov 5, 2007).
- 79 Levinson J. Searching for a home: the institutionalization issue in international nutrition. Washington DC, New York: World Bank, UNICEF, 2002.
- 80 Rokz D. Who should implement nutrition interventions? The application of institutional economics to nutrition and the significance of various constraints to the implementation of nutrition interventions. Washington DC: World Bank, 2000.
- 81 Shekar M, Lee Y-K. Mainstreaming nutrition into poverty reduction strategy papers: what does it take? A review of the experience to-date. World Bank Health, Nutrition and Population Discussion Paper, June 2005. Washington DC: World Bank, 2005.