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Human Development

Scaling Up Nutrition

What Will It Cost?

Susan Horton
Meera Shekar
Christine McDonald
Ajay Mahal
Jana Krystene Brooks



THE WORLD BANK

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THE WORLD BANK
Washington, D.C.

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1818 H Street NW
Washington DC 20433
Telephone: 202-473-1000
Internet: www.worldbank.org
E-mail: feedback@worldbank.org

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Foreword

They stand as a silent rebuke to us: millions of young children around the world who are sick, dying, wasted, or stunted by inadequate nutrition. Even in times of abundance, they wait at the end of the line for their share. Now, as food, fuel, and financial crises continue to spread hardship across rich and poor nations alike, they are the most vulnerable.

Action against malnutrition is needed more than ever. An additional US\$10.3 billion a year is required from public resources to successfully mount an attack against undernutrition on a worldwide scale. This would benefit more than 360 million children in the 36 countries with the highest burden of undernutrition—home to 90 percent of the stunted children worldwide—and prevent more than 1.1 million child deaths. Since early childhood offers a special window of opportunity to improve nutrition, the bulk of the investment needs to be targeted between pre-pregnancy and two years of age.

This report offers suggestions on how to raise these resources. It is an investment we must make. It will yield high returns in the form of thriving children, healthier families, and more productive workers. This investment is essential to make progress on the nutrition and child mortality MDGs and to protect critical human capital in developing economies. The human and financial costs of further neglect will be high.

This call for greater investment in nutrition comes at a time when global efforts to strengthen health systems provide a unique opportunity to scale up integrated packages of health and nutrition interventions, with common delivery platforms, and lower costs.

The report has benefited from the expertise of many international agencies, nongovernmental organizations, and research institutions. The cooperation of so many practitioners is evidence of a growing recognition of the need to invest in nutrition interventions, and a growing consensus about how to deliver effective programs.

Graeme Wheeler
Managing Director
World Bank

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About the Authors

Susan Horton is the Centre for International Governance Innovation chair in Global Health Economics and associate provost, graduate studies, at the Balsillie School of International Affairs, University of Waterloo. Susan has written widely on nutrition, health, and labor markets in developing countries, and has served as a consultant to the World Bank, Asian Development Bank, UNICEF, and WHO, among others. Her proposed solution for using micronutrient supplements ranked as the top solution at the 2008 Copenhagen Consensus.

Meera Shekar is the lead health and nutrition specialist at the World Bank. She is recognized globally as a policy and technical expert in nutrition and health. She guides the World Bank's work on nutrition and was the lead author for the flagship report "Repositioning Nutrition as Central to Development," among others. She has extensive expertise and strong interests in policy and program development, partnership management, monitoring information systems, and program evaluation.

Christine McDonald received a Master of Science degree in food policy and applied nutrition from Tufts University and is currently a doctoral student in nutritional epidemiology at the Harvard School of Public

Health. Her research interests include child undernutrition, micronutrient deficiencies, and infectious disease.

Ajay Mahal is an associate professor of international health economics at the Harvard School of Public Health. His main areas of research interest are the financing of health interventions, the economic implications of disease, and the relationship between economics and human rights, primarily in developing country settings.

Jana Krystene Brooks received a Master of Public Health degree from the George Washington University and is currently a consultant to the World Bank. Her public health interests include developing culturally integrative interventions and health communication strategies to positively influence individual- and population-level behavior change.

Abbreviations

AFR	Africa Region (of the World Bank)
BF	breastfeeding
BMGF	Bill and Melinda Gates Foundation
CCTs	conditional cash transfers
CDC	U.S. Centers for Disease Control and Prevention
CGD	Center for Global Development
CMAM	community-based management of acute malnutrition
CTC	community-based therapeutic care
DALY	disability-adjusted life year
DCPP	Disease Control Priorities Project
DHS	demographic and health surveys
EAP	East Asia and Pacific Region (of the World Bank)
ECA	Europe and Central Asia Region (of the World Bank)
EDTA	ethylenediaminetetraacetic acid
GAM	global acute malnutrition
GDP	gross domestic product
HAZ	height-for-age z score
ICDDR,B	International Centre for Diarrhoeal Disease Research, Bangladesh
IFA	iron-folic acid

ILSI	International Life Sciences Institute
IMR	infant mortality rate
INGO	international nongovernmental organization
LAC	Latin America and the Caribbean Region (of the World Bank)
LNS	lipid-based nutrient supplement
MBB	marginal budgeting for bottlenecks
MDG	Millennium Development Goal
MENA	Middle East and North Africa Region (of the World Bank)
MGRS	Multicentre Growth Reference Study
MMS	maternal micronutrient supplement
MSF	Médecins Sans Frontières
NCHS	U.S. National Center for Health Statistics
NMR	neonatal mortality rate
ODA	official development assistance
OECD	Organisation for Economic Co-operation and Development
ORT	oral rehydration therapy
REACH	Renewed Efforts Against Childhood Hunger
RUF	ready-to-use food
RUTF	ready-to-use therapeutic food
SAM	severe acute malnutrition
SAR	South Asia Region (of the World Bank)
UN	United Nations
UNHCR	United Nations High Commissioner for Refugees
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development
USI	universal salt iodization
WAZ	weight-for-age z score
WB	World Bank
WFP	World Food Programme
WHZ	weight-for-height z score
WHO	World Health Organization
WHO CHOICE	World Health Organization—Choosing Interventions That Are Cost Effective

Glossary

Community-based management of acute malnutrition	The management of acute malnutrition through (a) in-patient care for children with severe acute malnutrition with medical complications and infants under six months of age with visible signs of severe acute malnutrition; (b) out-patient care for children with severe acute malnutrition without medical complications; and (c) community outreach.
Community nutrition program	A community-based program intended to prevent growth-faltering, control morbidity, and improve survival of children by promoting breastfeeding, providing education and counseling on optimal feeding practices, preventing diarrheal disease, and monitoring and promoting growth (Mason et al., 2006).
Global acute malnutrition (wasting)	Weight-for-height of -2 z scores or more below the median of the World Health Organization's child growth standards (includes moderate wasting and severe wasting, i.e. moderate acute malnutrition and severe acute malnutrition).

Low birth weight	Birth weight less than 2,500 g.
Malnutrition	A broad term commonly used as an alternative to undernutrition, but technically it includes both undernutrition and overnutrition.
Moderate malnutrition (underweight)	Weight-for-age between -2 and -3 z scores below the median of the WHO child growth standards.
Multiple micronutrient powders	Sachets containing a blend of vitamins and minerals in powder form, which can be added to foods at home. They are intended to prevent and treat micronutrient deficiencies.
Ready-to-use therapeutic foods	High-energy, fortified, ready-to-eat foods suitable for the treatment of children with severe acute malnutrition.
Severe acute malnutrition (severe wasting)	Weight-for-height of -3 z scores or more below the median of the WHO child growth standards.
Stunting	Height-for-age of -2 z scores or more below the median of the WHO child growth standards.
Undernutrition	Defined as the outcome of insufficient food intake and repeated infectious diseases. It includes being underweight for one's age, too short for one's age (stunted), dangerously thin for one's height (wasted), and deficient in vitamins and minerals (micronutrient malnutrition).
Underweight	Weight-for-age of -2 z scores or more below the median of the WHO child growth standards.

Executive Summary

Undernutrition imposes a staggering cost worldwide, both in human and economic terms. It is responsible for the deaths of more than 3.5 million children each year (more than one-third of all deaths among children under five) and the loss of billions of dollars in forgone productivity and avoidable health care spending. Individuals lose more than 10 percent of lifetime earnings, and many countries lose at least 2–3 percent of their gross domestic product to undernutrition. The current economic crisis and its potential impact on the poor make investing in child nutrition more urgent than ever to protect and strengthen human capital in the most vulnerable developing countries.

What resources are needed to fight undernutrition? This report offers a preliminary answer by estimating the cost of scaling up a minimal package of 13 proven nutrition interventions from current coverage levels to full coverage of the target populations in the 36 countries with the highest burden of undernutrition. These countries account for 90 percent of all children whose growth has been stunted by inadequate nutrition. Adding another 32 smaller high-burden countries with levels of stunting and/or underweight exceeding 20 percent would increase these cost estimates by 6 percent.

A Program of Proven Interventions

The 13 direct nutrition interventions selected for this costing exercise have demonstrated effectiveness in many countries by reducing child mortality, improving nutrition outcomes, and protecting human capital. The interventions fall into three broad groups:

- ***Behavior change interventions*** that include promotion of breastfeeding, appropriate complementary feeding practices (but excluding provision of food), and proper hygiene, specifically handwashing. It is assumed that the majority of these services are delivered one-on-one at the community level through platforms such as community nutrition programs (Mason et al. 2006).
- ***Micronutrient and deworming interventions*** that provide a range of supplements for children under the age of five (periodic vitamin A supplements, therapeutic zinc supplements to manage diarrhea, multiple micronutrient powders, and deworming drugs); for pregnant women (iron-folic acid supplements, as well as iodized oil capsules where iodized salt is not available); and for the general population (iron fortification of staple foods and salt iodization).
- ***Complementary and therapeutic feeding interventions*** that provide micronutrient-fortified and/or -enhanced complementary foods for the prevention and treatment of moderate malnutrition among children 6–23 months of age, and community-based management of severe acute malnutrition among children under five years of age.

Most of these interventions need to be implemented in partnership with the health sector and will complement the efforts at health systems strengthening that are currently underway in many countries. Further, these selected interventions represent a modified package of the interventions listed in the 2008 *Lancet* undernutrition series. Some new interventions have been added based on emerging evidence since the *Lancet* series was published. Other interventions have been deferred for now because there are no clear protocols for the interventions, data on compliance and delivery mechanisms are unclear, no cost data exist to estimate scaling-up costs, or because capacities for scaling up are still to be developed. As these interventions are added, additional benefits can be expected.

A Methodology Based on Experience

Our estimates are based on a programmatic approach to scaling up nutrition interventions. While there is a focus on what should be implemented, we also give due consideration to how programs should be delivered and scaled up. These estimates are based on the actual costs of current programs, adjusted to allow for cost variations across regions using multipliers based on WHO data. As far as possible, delivery costs for the proposed interventions are based on documented field-generated numbers and experience. A little less than half of the total US\$11.8 billion is needed for nutrition education and delivery mechanisms (of which salaries are a large component); less than half is for targeted food supplements, micronutrients, and deworming medication; and the rest is for capacity development, monitoring and evaluation, operations research for program delivery, and technical assistance.

The majority of interventions costed here can be delivered using the primary health care system, supplemented through outreach efforts, community nutrition programs, and child health days. For these programs and interventions, it is critical to build strong links with ongoing efforts for health systems strengthening. Other costed interventions, such as food fortification, use market-based mechanisms for delivery, but will need some investment through the public sector for regulation and policy changes.

We do not cost other potentially critical direct and indirect interventions that impact nutrition outcomes, such as maternal food supplementation (for which programming guidance is still awaited), or gender interventions to empower women to make the right caring decisions for their children. Nor do we include some new technologies (such as biofortification) or other food security interventions through the agriculture sector. There are also potential entry points for nutrition improvements through the education sector—for example, deworming medication for school-aged children and iron-folic acid supplementation for adolescents. Many other indirect interventions can be implemented through other sectors, such as agriculture, education, and rural development, that will produce nutrition impacts, often referred to as the “longer routes” to improving nutrition. These are not costed here. Furthermore, we do not cost special nutrition interventions needed in HIV/AIDS-endemic contexts.

Other interventions that may impact nutrition have been excluded in these estimates, either because they lack a firm evidence base (in the case

of interventions still being debated or not yet tested), because the delivery mechanisms are unclear, or because they may be financed through other sectors (for example cross-cutting issues such as indoor air pollution, or programs to provide bed nets) or through health systems strengthening efforts. Although conditional cash transfers can be used to support nutrition improvement, we have included the supply-side costs of these programs, but have not included the cost of the actual cash transfers in our estimates, because they often aim to address multiple objectives. However, in situations where conditional cash transfers are instituted, incorporating components that strengthen the demand for nutrition services is highly desirable.

Adding all of these interventions to move to a full scale-up will put an additional burden on fragile country capacities for program delivery, and will likely take time, but will also greatly enhance expected impacts. The financing needs for scaling up these additional direct and indirect interventions should be estimated in follow-up work.

Some Assumptions about Coverage and Delivery

The financing needs estimated here are based on increasing coverage from current levels to 100 percent of the target populations (except treatment of severe acute malnutrition for which 80 percent is considered the currently feasible maximum). We recognize that in practice these investments are, at best, likely to reach only 90 percent of the target populations, because it is difficult and expensive to reach the last 10 percent of households. However, we also believe that stronger links with health systems strengthening efforts will allow for greater coverage than previously feasible. Furthermore, in line with the Paris and Accra declarations, all interventions delivered through the health system are expected to be able to ride on and complement the efforts at strengthening health systems currently underway in many countries. This approach should achieve higher coverage.

Estimated Resource Needs

We estimate the total financing needs to scale up the selected interventions to be US\$11.8 billion per annum, of which US\$1.5 billion is expected to be borne by private household resources. This leaves a total financing gap of US\$10.3 billion to be raised from public resources (both

national and global) to support the scale-up. We propose that the scale-up process occurs in two steps:

- **Step 1**, which will distribute slightly less than half of the total annual investment (US\$5.5 billion), comprises US\$1.5 billion for micronutrients and deworming (US\$5 per child), US\$2.9 billion for behavior change interventions (US\$7.50 per child), and an additional US\$1.0 billion to build capacities to start the scale-up of more complex and targeted food-based programs for delivering these services, starting with areas that have especially high rates of undernutrition. US\$0.1 billion is added for rigorous monitoring and evaluation of large-scale programs and operations research for delivery strategies, and for technical support.
- **Step 2**, in which the remaining US\$6.3 billion will be spent, will scale-up complementary and therapeutic feeding programs after capacities to deliver these interventions in resource-poor settings are built up in the previous step. The largest single cost item in this step is complementary food to prevent and treat moderate malnutrition among children under two years of age (US\$40–80 per child; US\$3.6 billion per year). The most resource-intensive intervention per child treated (US\$200 per episode per child; US\$2.6 billion per year) is treatment of severe acute malnutrition. Prevention is preferable to treatment; however, the human and economic costs involved make addressing current levels of severe acute malnutrition imperative to save lives. As with step 1, an additional US\$0.1 billion will be needed for stepping up rigorous monitoring and evaluation of large-scale programs and operations research for delivery strategies.

This two-step process is neither meant to be a straightjacket, nor to be suggestive of a linear “one-size-fits-all” approach to scaling-up. Country situations are diverse and they need to follow diverse paths. Those with stronger implementation capacities are likely to proceed to the second step faster than countries where capacities and political will lag behind. However, in countries where program delivery capacities are constrained, an explicit investment in capacity development is a prerequisite to the proposed scale-up. This is one of the key recommendations from the High Level Taskforce on Innovative International Financing for Health Systems to *strengthen the capacity of governments to secure better performance and investment from private, faith-based, community, NGO and other non-state*

actors in the health sector. It also reiterates the critical role of governance arrangements for maximizing the impact of health spending and ensuring poor, vulnerable, and marginalized groups benefit most from increased resources. Strengthened leadership and stewardship backed by stronger management systems including financial and human resources management is vital in public organizations. Addressing these issues as part of the capacity development efforts will take time, but it will help maximize the development effectiveness of this scale-up effort.

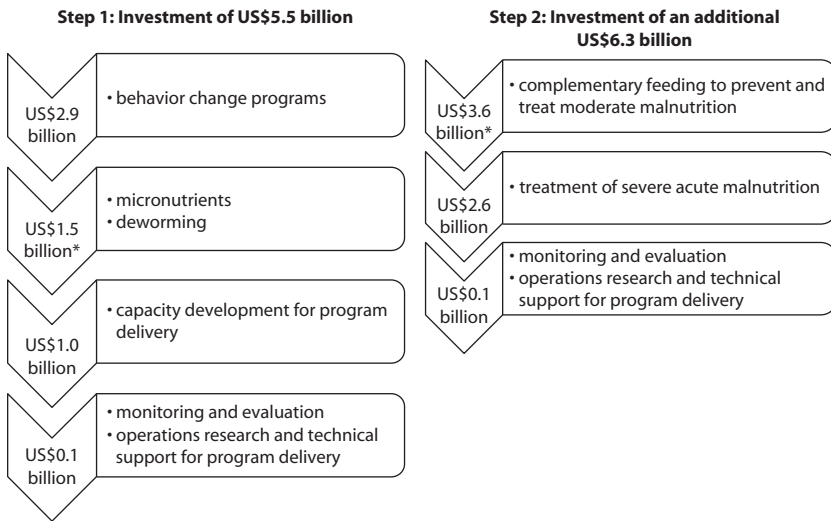
South Asia accounts for more than half of the annual estimated financing needs (US\$5.90 billion), followed by Sub-Saharan Africa (US\$2.78 billion), with the balance for East Asia and Pacific (US\$1.07 billion), Latin America and the Caribbean (US\$0.15 billion), Middle East and North Africa (US\$0.56 billion) and Europe and Central Asia (US\$0.13 billion). In addition, US\$0.5 billion is required for technical assistance for iron fortification of staple foods and salt iodization, US\$1.0 billion for regional and country-level capacity development for program delivery, US\$0.2 billion for monitoring and evaluation and operations research and technical support for program delivery across all regions. Thus, the total estimated financing needs are of the order of US\$11.8 billion, of which approximately US\$1.5 billion is expected to be raised from private resources (see figure ES.1), and the financing gap of US\$10.3 billion would be needed from public resources, including national governments and donors.

Since current global spending on nutrition is minimal (US\$0.25 to 0.3 billion) and coverage rates are low for most interventions, these estimates are the costs needed to scale up from these very low current coverage levels to full coverage for the 13 interventions. The US\$10.3 billion therefore represents the total additional financing needs for this scale-up, to be raised from national and international resources. Further, these estimates include the cost of instituting community nutrition programs and some investments in market-based delivery strategies, but depend on complementary and critical investments from the health sector to build stronger health systems to support delivery of several of the 13 interventions.

Expected Outcomes

This investment would signal a call to action against undernutrition on a global scale such that each year

- Households covering 356 million children under five years of age will be reached by preventive community nutrition programs for behavior change.

Figure ES.1 A Two-Step Process for Scaling Up Direct Nutrition Interventions

Source: Authors' calculations.

Note: Of the total financing needs of US\$11.8 billion, US\$1.5 billion is expected to be available from wealthier private household resources to cover costs for complementary and fortified foods. The total financing gap is therefore US\$10.3 billion.

- 103 million additional children 6–59 months of age will receive twice-yearly doses of life-saving preventive vitamin A supplements.
- 40 million additional pregnant women will receive iron-folic acid tablets as part of their antenatal care.
- 319 million children 6–59 months of age will receive zinc supplements as part of diarrhea management.
- 2.8 billion more people will be able to consume staple foods fortified with iron.
- 1.2 billion people who do not currently use iodized salt will be covered.
- 226 million more children 12–59 months of age will receive deworming medication.
- 34 million children 6–23 months of age will receive vitamins and minerals through multiple micronutrient powders.
- 72 million children 6–23 months of age will receive micronutrient-fortified and/or -enhanced complementary foods.
- 14 million more children 6–59 months of age will be treated for severe acute malnutrition using community-based management practices.

Scaling up of this select group of nutrition interventions is expected to have huge payoffs every year by reducing child mortality and morbidity, promoting child growth and development, improving the health of mothers, and preserving human capital. Through this action

- More than 1.1 million of the estimated 8 million deaths among children under the age of five in the 36 countries would be prevented.
- An estimated 30 million disability-adjusted life-years (DALYs) would be saved.
- 30 million fewer children under the age five would be stunted (about 150 million children under five years of age are currently stunted), representing a 20 percent reduction.
- Severe acute malnutrition would be halved from the current prevalence of 19 million; an estimated 138,000 of the current 276,000 annual deaths would be averted by preventive measures, and a further 50,000 would be averted by treatment of severe acute malnutrition.
- The drop in mortality of 1.1 million child deaths per year would achieve one-fifth of the desired progress toward Millennium Development Goal (MDG) 4, which aims to decrease child mortality by two-thirds (i.e., by 6 million deaths per year).
- The decreases in stunting and wasting would potentially reduce the number of underweight children by one-fifth to one-third and hence substantially assist with progress toward reaching MDG 1c, which aims to halve the number of underweight children.

Although we have not yet quantified the precise impact of this scale-up on human capital, the evidence base for these benefits is strong. For example, we know that boys in Guatemala who participated in a nutrition program before the age of three grew up to have wages that were 46 percent higher than controls. The effects of iron and iodine fortification alone outweigh the cost of scaling up the delivery of all micronutrients and behavior change interventions. Thus, in addition to the reduced mortality and nutritional benefits listed above, we also expect significant productivity benefits, particularly because these investments include community-based preventative programs to reduce relapse rates and prevent the irreversible effects of early undernutrition. Further work is needed to estimate more precisely the overall gross domestic product impact of this package of interventions.

As detailed programming guidance becomes available for new interventions, and as in-country capacities and delivery systems are built to scale-up

these additional interventions, these impacts will be further multiplied. Links with social safety nets and food security programs, and with health systems strengthening will add to the expected impacts. Therefore, these estimates err on the conservative side.

Financing

Although US\$11.8 billion annually is a large investment, there are at least four potential financing sources: private resources within households, national governments, private sector corporations, and innovative financing options being explored by international partners such as the High Level Taskforce on Innovative Financing for Health Systems.¹ All sources have compelling reasons and resources to contribute to the financing gap of US\$10.3 billion. Follow-on work is needed to identify the opportunities for financing the proposed scale-up.

Households are accustomed to bearing most of the recurrent costs of market-based strategies, such as salt iodization (estimated at US\$400 million) and food fortification from private resources. Data from many countries show that undernutrition rates are surprisingly high even among the wealthiest populations. For example, in India, Bangladesh, and Ethiopia, respectively 20, 30, and 37 percent of children under the age of five in the highest-income quintiles are underweight (World Bank 2007). If appropriate complementary foods are delivered through market-based strategies, US\$0.9 billion (or almost one quarter of the estimated US\$3.6 billion required for complementary foods) can be directly covered by private household resources, thereby reducing the burden on public resources. An additional US\$0.6 billion for fortification of staple foods with iron, and for salt iodization, can be borne by wealthier households, such that approximately US\$1.5 billion of the proposed US\$11.8 billion annually can come from wealthier private household resources.

Developing country governments already contribute substantial amounts to nutrition programs. India, for example, allocated nearly US\$1.3 billion for its Integrated Child Development Services program in 2007–08. Other developing countries are also making such allocations. If current government funds were reallocated to more effective evidence-based strategies, they could meet some of the financing needs for scaling up.

As private corporations become more innovative and competitive in the food sector, they have good reason to invest in better and more nutritious

products with greater sales potential. Private foundations and philanthropies such as the Bill and Melinda Gates Foundation and the Children's Investment Fund are also emerging as a significant financing source for nutrition.

International emergency food aid, estimated at US\$2 billion in 2007 by the Development Assistance Committee of the Organisation for Economic Co-operation and Development (OECD), is an important potential financial source for improving child nutrition. Efforts to use in-kind food aid to prevent and treat moderate malnutrition have been successful in several settings, including Haiti and Niger. Food aid is being used as part of safety net programs in a number of countries, including Ethiopia. However, to have a greater impact on nutrition outcomes, aid resources need to be nutritionally appropriate, specifically targeted to young children and mothers, and accompanied by other preventive services such as nutrition education, behavior change interventions, and hygiene promotion. This is not the case at the moment.

Industrialized country governments could respond to the suggestion of putting 0.7 percent of their domestic stimulus packages into international assistance, and additional innovative financing sources could be identified. The High Level Taskforce on Innovative International Financing for Health Systems is exploring new options. The Taskforce specifically aims to raise additional resources for the health-related MDGs, including MDG 1c (hunger and undernutrition). Its challenge states, "More and better resources are needed if the health-related MDGs are to be reached in 2015. The aim is to *raise additional resources that are provided to countries* in an effective way and linked to results." It also recommends that the allocation of funds in countries be made more efficient by filling gaps in costed and agreed-upon national strategies.

Last, although OECD data show that current aid flows for nutrition are very small, several bilateral partners (Canada, Denmark, France, Ireland, Japan, Norway, Spain, the United Kingdom) and others including the European Commission have either developed new nutrition strategies or position papers on food security, or seem poised to do so. This represents a much-needed potential resource for nutrition financing in the highest burden countries. The recent G8 announcement on an additional US\$20 billion over three years for food security programs (G8 Summit, 2009) and the possibility that Canada will take this agenda further in the coming G8 summit in 2010 by moving forward "from food security to nutrition security," offers yet another opportunity for financing the nutrition scale-up.

All of these sources represent new and potentially viable opportunities for nutrition financing—but more work is needed to explore these financing sources. The challenge is to raise and provide these resources in such a way that they complement, rather than compete with investments in health systems strengthening, food security, social safety nets, and HIV/AIDS programs. The challenge is also to make sure these resources are consolidated and programmed to fill gaps in carefully developed and articulated country strategies, rather than as one-off investments. This is essential for development effectiveness.

Next Steps

Current investments in nutrition are miniscule given the magnitude of the problem. The case for greater investment in nutrition interventions is strong, both ethically and economically. Now is the time to act. These interventions are proven to be cost-effective, have broad public health impacts, and contribute to global public good. Public provision of micronutrients to vulnerable groups is less costly than spending public funds to treat the consequences of micronutrient deficiencies. Public subsidy of deworming drugs has broad public health benefits and is a global public good. Logically, the cost of complementary feeding interventions should largely be the responsibility of individual households, except in nutrition emergencies and for the poorest households. While there is a humanitarian responsibility for public spending to treat severe acute malnutrition, the economic and social savings gained from preventing these cases are better.

Of course, seeking additional funds to increase nutrition interventions is especially difficult in a severe international economic recession. The cost of not intervening, however, is much higher: the benefits from iron fortification of staples and salt iodization alone are estimated at US\$7.2 billion per year. Of the total US\$10.3 billion needed per year from public resources for the proposed scale-up, nearly US\$4.4 billion is for micronutrient and deworming interventions and community-based nutrition interventions that can be scaled up fairly rapidly, either with existing capacities and systems or with some modest investments in capacity-building. Further, because many of the nutrition interventions costed here are delivered through the health system, a close link and complementarity with these efforts is critical. This is suggested for pragmatic reasons (wherein the nutrition interventions ride on strengthened health systems), and in the spirit

of the Paris and Accra declarations for aid effectiveness and for reducing transaction costs for national governments.

Perhaps most importantly, as stated earlier, the scaling up of nutrition financing must be accompanied by a scale-up of in-country political will and capacities, and systems to design, deliver, manage, and evaluate large-scale programs. Building these capacities for a full scale-up will take time but will ensure that countries are ready to take proven interventions to full scale-up effectively and efficiently as new resources become available.

Why now? Recent scientific advances support this proposed approach. The health- and nutrition-related Millennium Development Goals will not be achieved without these additional inputs. The ongoing global food, fuel, and financial crises make it imperative to address undernutrition in the most vulnerable countries, not just to address the impacts of the current crises, but also to prevent vulnerability to future crises. Acting now will protect the health and cognitive development of millions of children who are the future human capital in these countries.

Note

1. For more information refer to <http://www.internationalhealthpartnership.net/en/taskforce>.

CHAPTER 1

Introduction: Why Scale Up?

Why Scale Up Now?

Undernutrition, already one of the world's most serious health problems, is likely to worsen as the global economy tightens its belt in the aftermath of the most severe downturn since the Great Depression. A recent World Bank report shows that the current crises have added an additional 44 million to the ranks of the undernourished (Zaman 2008). Moreover, if the crisis continues as expected, global trade will decline by 2.1 percent in 2009 (Baffes et al. 2009)—a further blow to export-dependent developing countries. Even a 1 percent decline in developing country growth rates could trap an additional 20 million people in poverty (World Bank 2008a).

The economic costs of undernutrition are substantial: productivity losses to individuals are estimated at more than 10 percent of lifetime earnings, and losses to gross domestic product may be as high as 2–3 percent (World Bank 2006). The human costs of undernutrition are tragic, falling hardest on the most vulnerable in the developing world: nearly one-third of children are underweight or stunted, more than 30 percent of the total population suffers from deficiencies of one or more micronutrients, and 35 percent of all child deaths are attributable to undernutrition (Black et al. 2008). It is the largest single contributor to child mortality worldwide.

Unless policies and priorities are changed, the scale of the problem will prevent many countries from achieving the Millennium Development Goals. The risks are greatest in Sub-Saharan Africa, where malnutrition is increasing, and in South Asia, where the number of undernourished is highest and the prevalence is decreasing only slowly (World Bank 2006).

There is a growing recognition of the need to invest in nutrition programs, just as the nutrition community is reaching a consensus about which programs are most effective. Investment now will accelerate the pace of reduction in malnutrition and hence help to achieve the Millennium Development Goals of halving child hunger and reducing child mortality by two-thirds. It will also reduce the impact of the ongoing crises, especially on the most vulnerable. How much investment is needed remains an unanswered question of fundamental importance.

The recent *Lancet* undernutrition series (Black et al. 2008), the earlier World Bank report *Repositioning Nutrition* (World Bank 2006), and recent publications on the treatment of severe acute malnutrition (Ashworth 2006) list several known interventions that could potentially improve global nutrition and health outcomes if implemented at a national scale in the countries that bear the highest burden of undernutrition (Leroy et al. 2007). Nonetheless, while we know a lot about what to do, we know less about how to deliver these interventions through large-scale programs and what resources are needed to launch a worldwide assault on malnutrition in the highest-burden countries (Shekar et al. 2008). These lessons can only be learned through experience when additional financing is available to scale up nutrition programming and when impacts of large scale programs and alternative delivery mechanisms are rigorously and systematically documented.

The Objectives of This Report

This report estimates the costs and financial resources necessary to scale up delivery of a package of 13 proven nutrition interventions from current coverage to 100 percent of the target populations in 36 countries that carry 90 percent of the burden of stunting. We also estimate the costs for covering an additional 32 smaller countries that have high underweight or stunting rates. These estimates represent the cost of going to full scale for these interventions from the current (low) coverage levels (see figures 2.1 and 3.2). We recognize, however, that full coverage will take time, since building developing country capacities for full coverage is a slow process.

These estimates will contribute toward the Global Action Plan for scaling up nutrition programming—a collaborative multipartner effort that is evolving. The Global Action Plan will highlight the urgency and the rationale for investing in nutrition, the kinds of evidence-based actions that can be implemented in real-life programmatic settings, the high-burden countries where these actions are needed, and the initial financing needs for a scale-up. The Global Action Plan is being developed through an inclusive process that will create a movement, generate champions, and ensure a consistent message across partners. The initial estimates contained in this paper are an integral building block of the Global Action Plan to provide a considered response to the question: “How much will it cost to scale up proven nutrition interventions?”

CHAPTER 2

Methodology: Estimating the Costs

The Scope of These Estimates

Our estimates focus on the costs of scaling up nutrition programs in the 36 countries identified by the 2008 *Lancet* series on maternal and child undernutrition (Black et al. 2008). These 36 countries are home to the vast majority (90 percent) of moderately or severely stunted children worldwide. While we limit the cost estimations to these 36 countries, we recognize and fully support the need for programmatic action in many more countries. Further, we include additional cost estimates for scaling up these interventions to include the 32 smaller countries where 20 percent or more of all children under the age of five are stunted or underweight (mainly in Sub-Saharan Africa). These 32 countries were identified in *Repositioning Nutrition* (World Bank 2006), but were not included in the country list put forth by the 2008 *Lancet* undernutrition series. Our estimates show that this expansion of coverage would increase the target population by 6 percent and hence raise overall costs by a comparable amount. Both groups of countries are listed in table 2.1 and displayed in map 2.1.

The cost of different delivery platforms is calculated separately to allow for increased flexibility in applying these estimates to different settings. To the extent possible, these estimates are accompanied by

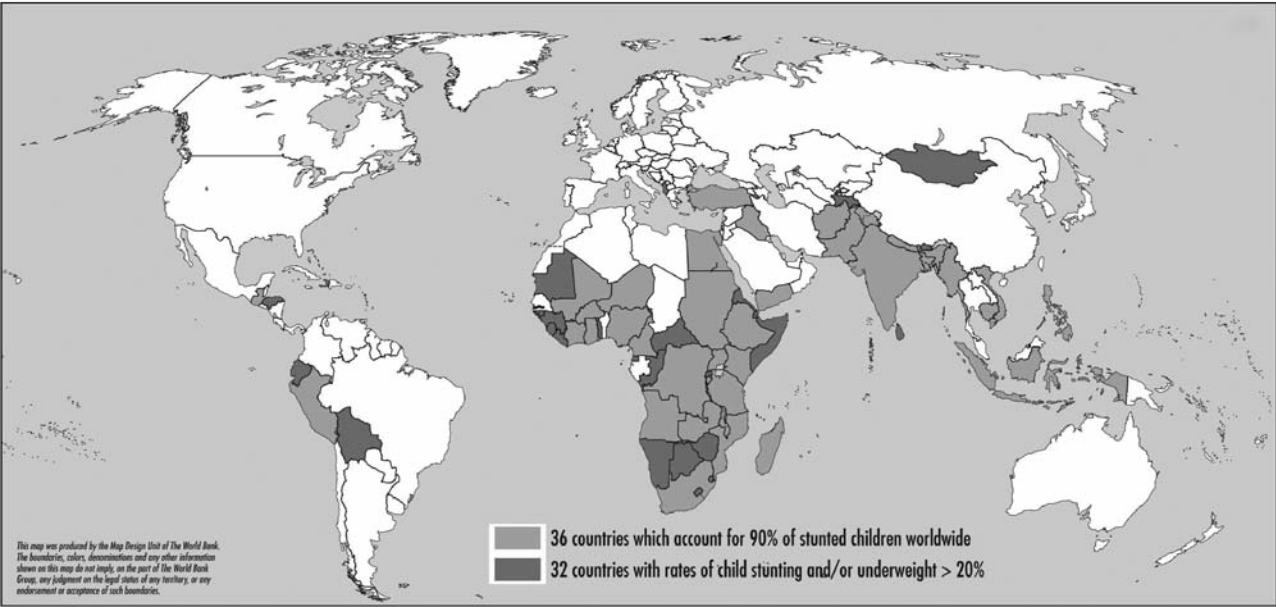
Table 2.1 The 36 Countries with 90 Percent of the Global Burden of Stunting and an Additional 32 High-Burden Countries with Underweight or Stunting Rates Greater Than 20 Percent

<i>36 countries identified in Lancet that carry 90% of the stunting burden for which financing needs are estimated</i>	<i>32 smaller countries with rates of child stunting and/or underweight >20% that could be added to these estimates at an additional cost of 6%</i>
Afghanistan	Albania
Angola	Bhutan
Bangladesh	Bolivia
Burkina Faso	Botswana
Burundi	Central African Republic
Cambodia	Comoros
Cameroon	Congo, Republic of
Congo, Democratic Republic of	Ecuador
Côte d'Ivoire	Equatorial Guinea
Egypt, Arab Republic of	Eritrea
Ethiopia	Djibouti
Ghana	Gambia, The
Guatemala	Guinea
India	Guinea-Bissau
Indonesia	Haiti
Iraq	Honduras
Kenya	Lesotho
Madagascar	Liberia
Malawi	Maldives
Mali	Mauritania
Mozambique	Mongolia
Myanmar	Namibia
Nepal	Rwanda
Niger	São Tomé and Príncipe
Nigeria	Sierra Leone
Pakistan	Somalia
Peru	Sri Lanka
Philippines	Swaziland
South Africa	Tajikistan
Sudan	Timor-Leste
Tanzania	Togo
Turkey	Zimbabwe
Uganda	
Vietnam	
Yemen, Republic of	
Zambia	

Sources: For column 1, Black et al. 2008; for column 2, World Bank 2006.

Note: If the countries in column 2 were added to those in column 1, population coverage and financing needs would increase by approximately 6 percent. Column 1 is similar to the 42 countries covered in a costing exercise for child mortality, which account for 90 percent of child deaths (Bryce et al. 2005); the 42 countries include the 36 here, excluding Burundi, Guatemala, and Peru, but including Brazil, Chad, China, Guinea, the Islamic Republic of Iran, Mexico, Rwanda, Sierra Leone, and Somalia. As interventions are scaled up in these countries, even stronger links will need to be forged with health systems strengthening efforts.

Map 2.1 The 36 Countries with the Highest Burden of Undernutrition and 32 Smaller High-Burden Countries with Rates of Child Stunting or Underweight Greater Than 20 Percent



Sources: 36 countries (Black et al. 2008); 32 countries (World Bank 2006).

estimates of the cost of inaction (benefits forgone by pursuing a “business as usual” scenario) based on a review of the literature. Cost-effectiveness estimates (or the cost of a given health outcome) of known interventions are also documented.

The current exercise does not directly estimate the full social resource requirements of the proposed scale-up effort. Instead, the emphasis is on estimating the costs in financial or budgetary terms (i.e., it does not try to capture the opportunity costs of time of households in accessing services) to estimate the financing needs. Estimating the full resource requirements for these interventions could be the subject of future work. Furthermore, this exercise does not estimate the cost of reaching the Millennium Development Goal on hunger and undernutrition (1c), since progress toward this goal is measured primarily by the underweight and food security indicators rather than stunting and micronutrient deficiencies.

The majority of interventions costed here can be delivered using three main delivery platforms—primary health care, market-based mechanisms, and community nutrition programs. The primary health care system includes antenatal and delivery care, neonatal programs and extension efforts such as child health days. To deliver these interventions successfully, it is critical to build strong links with ongoing efforts for health systems strengthening. We do not cost the needs for health systems strengthening here since it is covered through other complementary health sector investments and since it is the major focus of the High Level Taskforce on Innovative Financing for Health Systems. Other interventions such as food fortification use market-based mechanisms for delivery, but will need some investments through the public sector for regulation and policy changes. A third critical delivery platform for nutrition is community nutrition programs. We include here costs for the market-based mechanisms and for community nutrition programs, because these costs are not covered by other sectors or programs (see table 2.3 for details).

We do not cost other potentially critical direct and indirect interventions that impact nutrition outcomes, such as maternal food supplementation (for which programming guidance is still awaited), or gender interventions to empower women to make the right caring decisions for their children. Nor do we include some new technologies (such as biofortification) or other food security interventions through the agriculture sector. There are also potential entry points for nutrition improvements through the education sector—for example, provision of deworming medication for school-aged children and iron-folic acid supplementation for adolescents through schools. Additionally, there are

many other indirect interventions that can be implemented through other sectors such as agriculture, education, and rural development that will produce nutrition impacts, often referred to as the “longer routes” to improving nutrition. These are not costed here. Furthermore, we do not cost special nutrition interventions needed in HIV/AIDS-endemic contexts, albeit they are critical.

Other interventions that may impact nutrition have been excluded in these estimates, either because they lack a firm evidence base (in the case of interventions still being debated or not yet tested), because the delivery mechanisms are unclear, or because they may be financed through other sectors (for example, cross-cutting issues such as indoor air pollution, or programs to provide bed nets or maternal cord-clamping). Although conditional cash transfers can be used to support nutrition improvement, we have covered the supply-side costs of these programs, but have not included the cost of the actual cash transfers in our estimates, since they often aim to address multiple objectives. However, in situations where conditional cash transfers are instituted, incorporating components which strengthen the demand for nutrition services is highly desirable.

A full list of the interventions that are costed here and a comparison with the *Lancet* series interventions list are included in appendix B. Adding all of these interventions to move to a full scale-up will put an additional burden on fragile country capacities for program delivery and will take time, but will also greatly enhance expected impacts. The costs and financing needs for scaling up these additional direct and indirect interventions should be estimated in follow-on work.

A Methodology Based on Experience

Two principal methodologies have been used to estimate the costs of health interventions: the “ingredients approach” and the “program experience approach.” In the “ingredients approach,” the selected activities are outlined, bundled into appropriate delivery packages (for example, number of visits to a health center), and then estimates of costs are constructed using unit costs of specific activities such as clinic visits, outpatient visits, and hospital days from a comprehensive source (such as the WHO CHOICE database at <http://www.int/choice/costs/en>). This was one of the costing approaches used by the High Level Taskforce on Innovative Financing for Health Systems.

Bryce et al. (2005) provided an estimate based on the ingredients approach for the package of child survival interventions proposed in the

2003 *Lancet* series (Jones et al. 2003). They estimate the cost of saving six million child lives per year using 23 interventions, of which four (breastfeeding, zinc supplements, complementary feeding, and vitamin A supplements) are nutrition interventions. Their methodology is explained in detail in World Health Organization (2005) and covered the 42 countries, which, at the time, accounted for 90 percent of deaths among children under five years of age. Their estimates suggested a need for US\$5.1 billion in additional funding to provide universal coverage (99 percent, except for breastfeeding which was 90 percent) in the 42 countries. This translates to US\$1.23 per capita in these countries, and the estimated cost per life saved was US\$887.

An alternative methodology is called the “program experience” approach such as the one used for the Marginal Budgeting for Bottlenecks (MBB) approach referred to by the High Level Taskforce on Innovative Financing for Health Systems. In this approach, estimates of per unit costs are taken from actual programs operating in countries, carefully analyzing the context in which the estimates are derived (for instance, whether the costs come from stand-alone programs, components of primary health services, or one of a small group of interventions in an outreach program). The services are then packaged into appropriate delivery mechanisms and the total cost of the basket of services is calculated. The program experience approach tends to yield somewhat higher costs than the ingredients approach. The ingredients method assumes that programs are running in an efficient manner, while the program experience method takes the median of actual field experience, where there may be inefficiencies.

Renewed Efforts Against Childhood Hunger, or REACH (2008), uses the program experience approach to estimate nutrition program costs. Their estimate for a dozen interventions (five direct nutrition interventions, five interventions to improve diarrhea/parasite control, plus two measures directed at household food security) is US\$36 per year per child under five years of age, excluding the conditional cash transfers needed to increase household food security. When full program costs are included, this estimate increases to US\$47 per year per child (i.e., when fortification costs, which benefit the whole population, are attributed only to children under five years of age). With conditional cash transfers included, the costs rise to US\$47–104 per child under five years of age (“direct costs”) and US\$75–217 (“full program costs”).

This report uses the “program experience” method to estimate the cost of expanding the nutrition interventions considered here. This method

tends to generate realistic cost estimates of the services. We then combine the program experience approach with the methodology that both the World Health Organization and the Disease Control Priorities Project use to generate cost estimates for different regions. Our approach is to take cost estimates for the regions where the programs are most widely employed (South Asia, East Asia and the Pacific, and Sub-Saharan Africa, where costs are approximately comparable), and use a standard multiplier to calculate the estimates for the other relevant regions: Latin America and the Caribbean, the Middle East and North Africa, and Europe and Central Asia (table 2.2). The measure we use for scaling costs is the relative cost per health center visit for the different regions (at 80 percent coverage), from Mulligan et al. (2005). For Turkey, we examined the country-level costs using WHO data to ascertain that the estimates for the Europe and Central Asia region were indeed appropriate for Turkey. We assume that the cost-scaling factor applies to the community-level services where salaries are important, but not to food fortification or complementary feeding programs where costs are often fixed externally. In well-established programs, around 95 percent of the cost of food fortification goes to the micronutrient premix; food costs also predominate in complementary feeding efforts.

Thus, this report extends the unpublished REACH estimates: first, by allowing for regional variations and therefore making the cost estimations

Table 2.2 Regional Cost Multipliers and Countries Covered

<i>Region</i>	<i>Cost multiplier</i>	<i>Countries covered</i>
Africa	1	Angola, Burkina Faso, Burundi, Cameroon, the Democratic Republic of Congo, Côte d'Ivoire, Ethiopia, Ghana, Kenya, Madagascar, Malawi, Mali, Mozambique, Niger, Nigeria, South Africa, Sudan, Tanzania, Uganda, Zambia
East Asia and the Pacific	1	Cambodia, Indonesia, Myanmar, Philippines, Vietnam
Latin America and the Caribbean	2.35	Guatemala, Peru
Middle East and North Africa	2.20	The Arab Republic of Egypt, Iraq, the Republic of Yemen
South Asia	1	Afghanistan, Bangladesh, India, Nepal, Pakistan
Europe and Central Asia	1.35	Turkey

Source: Authors' estimates using Mulligan et al. (2005), and country-specific estimates for Turkey (accessed at <http://www.who.int/choice/en>).

more rigorous; second, by using demographic data for individual countries (whereas REACH uses a representative country approach); third, because the costing of the interventions for moderate and severe malnutrition is much more detailed, by incorporating the latest information from a fast-growing area of the literature; fourth, by estimating the additional financing needs for some of the smaller high-burden countries (beyond the *Lancet* list of 36 countries); fifth, by adding sensitivity analyses to provide a range of costs under different assumptions to mitigate the uncertainty inherent in cost projections; and last, by adding additional resources for rigorous monitoring and evaluation for large-scale investments, for operational research for program delivery, and for technical assistance.

A Program of Proven Interventions

We estimated the costs for scaling up 13 interventions that fall into 3 broad groups:

- ***Behavior change interventions*** that include promotion of breastfeeding, appropriate complementary feeding practices (but excluding provision of food), and proper hygiene, specifically handwashing. It is assumed that the majority of these services are delivered one-on-one at the community level through delivery platforms such as community nutrition programs (Mason et al., 2006).
- ***Micronutrient and deworming interventions*** that provide a range of supplements for children under the age of five (periodic vitamin A supplements, therapeutic zinc supplements for the management of diarrhea, multiple micronutrient powders, and deworming drugs); for pregnant women (iron-folic acid supplements, as well as iodized oil capsules where iodized salt is not available); and for the general population (iron fortification of staple foods and salt iodization).
- ***Complementary and therapeutic feeding interventions*** that consist of provision of vitamin- and mineral-fortified and/or -enhanced complementary foods for the prevention and treatment of moderate malnutrition among children 6–23 months of age, amounting to approximately 50 percent of the age group in Sub-Saharan Africa, 80 percent in South Asia, and 10 percent in the other regions, and

community-based management of severe acute malnutrition among children under five years of age.

This set of interventions, described in table 2.3, was agreed upon with partners in a side meeting organized at the UNICEF Innocenti Research Centre in September 2008 (appendix A), although the detailed implementation issues were subsequently elaborated on. The rationale for selection of these interventions is available in appendix B. Furthermore, because the costs of nutrition programs depend extensively on the systems through which they are delivered, attention to the delivery mechanisms in different settings is essential. In general, the appropriateness and cost of the delivery system in a given country (or region) varies depending on the type of intervention and available infrastructure and capacities. Therefore, while potential delivery platforms are outlined in table 2.3, these are expected to be implemented differently in diverse country settings and contexts. Table 2.4 groups the interventions together into “packages” for initial costing. All of the above are assumptions for costing purposes. None is meant to be prescriptive, or to convey a “one-size-fits-all” approach to country programming. We also recognize that achieving these high coverage levels for a full scale-up will require increased country capacities that need time to build up. Furthermore, in line with the Paris and Accra declarations, all interventions delivered through the health system are expected to be able to ride on the efforts at strengthening health systems currently underway in many countries. To that effect, these resources will need to be programmed in ways that are complementary rather than duplicative or competitive.

Some Assumptions about Coverage

As a first step in calculating costs, we must estimate the number of individuals in the appropriate target populations (as defined in the third column of table 2.3). Scaling up to full coverage of the population in the 36 countries with the highest burden of undernutrition would potentially reach some 2.8 billion people, of which 356 million are children under five years of age (table 2.5). That is a dramatic expansion over current coverage, as illustrated in figure 2.1. See appendix C for a more detailed explanation of the population estimates and country-specific data.

We make some assumptions about the feasible coverage of the population in order to make the costing exercise tractable. First, it is rarely

Table 2.3 Nutrition Interventions, Target Populations, and Delivery Platforms Used to Estimate Financing Needs

<i>Intervention</i>	<i>Description</i>	<i>Target population</i>	<i>Potential delivery platforms^a</i>
<i>Behavior change interventions</i>			
1. Breastfeeding promotion and support	<ul style="list-style-type: none"> • Early initiation of breastfeeding • Exclusive breastfeeding for six months and continued breastfeeding until two years of age 	Pregnant mothers and parents of infants under six months of age	<ul style="list-style-type: none"> • Community nutrition programs • Antenatal and delivery care • Neonatal outreach programs, including those that advocate delayed cord-clamping after delivery • Mass media approaches • Conditional cash transfers
2. Complementary feeding promotion (provision of food is outlined in intervention 12)	<ul style="list-style-type: none"> • Behavior change promotion to follow international best practices 	Pregnant mothers and parents of infants and young children under two years of age	<ul style="list-style-type: none"> • Community nutrition programs
3. Handwashing with soap and promotion of hygiene behaviors	<ul style="list-style-type: none"> • Delivery of educational messages 	Pregnant mothers and parents of young children under five years of age	<ul style="list-style-type: none"> • Community nutrition programs • Market-based delivery systems plus social marketing • Hygiene promotion programs
<i>Micronutrient and deworming interventions</i>			
4. Vitamin A supplementation	<ul style="list-style-type: none"> • Semiannual doses for children 	Children 6–59 months of age	<ul style="list-style-type: none"> • Child health days • Vitamin A campaigns • Routine health care visits combined with outreach
5. Therapeutic zinc supplements	<ul style="list-style-type: none"> • As a part of diarrhea management 	Children 6–59 months of age	<ul style="list-style-type: none"> • Primary health care system • Child health days • Market-based delivery systems plus social marketing

6. Multiple micronutrient powders	<ul style="list-style-type: none"> • Micronutrient powders for in-home fortification of complementary foods 	Children 6–23 months of age	<ul style="list-style-type: none"> • Community nutrition programs • Child health days • Primary health care system
7. Deworming	<ul style="list-style-type: none"> • One round of treatment per year in areas where the prevalence of soil-transmitted helminthiasis is ≥ 20 percent; two rounds per year where the prevalence is > 50 percent 	Children 12–59 months of age	<ul style="list-style-type: none"> • Child health days • Vitamin A campaigns • Primary health care system
8. Iron-folic acid supplements for pregnant women	<ul style="list-style-type: none"> • Iron-folic acid supplements 	Pregnant women	<ul style="list-style-type: none"> • Antenatal care • Community nutrition programs • Neonatal outreach and safe motherhood programs, including those that advocate delayed cord-clamping after delivery • Child health days • Conditional cash transfers
9. Iron fortification of staples	<ul style="list-style-type: none"> • Fortification of wheat and maize flour and other centrally processed staples with iron, (folic acid and zinc could also be added where desired) 	Entire population	<ul style="list-style-type: none"> • Market-based delivery systems • Social marketing, particularly if voluntary
10. Salt iodization	<ul style="list-style-type: none"> • Salt iodization 	Entire population	<ul style="list-style-type: none"> • Market-based delivery systems
11. Iodine supplements	<ul style="list-style-type: none"> • Iodized oil capsules 	Pregnant women in highly endemic pockets if iodized salt is unavailable	<ul style="list-style-type: none"> • Antenatal care • Community nutrition programs

(continued)

Table 2.3 Nutrition Interventions, Target Populations, and Delivery Platforms Used to Estimate Financing Needs (Continued)

<i>Intervention</i>	<i>Description</i>	<i>Target population</i>	<i>Potential delivery platforms^a</i>
Complementary and therapeutic feeding interventions			
12. Prevention or treatment of moderate malnutrition in children 6–23 months of age	<ul style="list-style-type: none"> • Identification of circumstances in which food supplementation is needed • Provision of complementary food in these circumstances 	Populations with high prevalence of children 6–23 months of age with weight-to-age z scores <–2	<ul style="list-style-type: none"> • Service delivery through community nutrition programs or primary health care system or market-based delivery systems (e.g., using coupons)
13. Treatment of severe acute malnutrition	<ul style="list-style-type: none"> • Identification of severe acute malnutrition • Community/clinic-based management • Therapeutic feeding with ready-to-use foods 	Children 6–59 months of age with weight-to-height z scores <–3 (with or without edema) or with mid-upper arm circumference <110mm	<ul style="list-style-type: none"> • Identification of children through primary health care; referral through community nutrition programs or child health days • Service delivery via community-based management of acute malnutrition, referral to primary health care system if necessary

Source: Authors.

a. The delivery platform used in the cost estimates is shown in bold. Many of these platforms are financed through complementary investments in health systems strengthening.

Table 2.4 Some Delivery Platforms Used in Programmatic Settings for Nutrition Interventions

<i>Initial delivery platform</i>	<i>Target population</i>	<i>Components</i>
Antenatal and delivery care or safe motherhood programs	Pregnant women	<ul style="list-style-type: none">• Breastfeeding promotion and support• Iron-folic acid supplements• Iodized oil capsules where iodized salt is unavailable
Community nutrition programs (including, where appropriate, growth monitoring)	Children under five years of age and their parents ^a	<ul style="list-style-type: none">• Breastfeeding promotion• Promotion of appropriate complementary feeding practices• Handwashing promotion• Initial identification of children with potential severe acute malnutrition, referral to health system• Distribution of multiple micronutrient powders for children 6–23 months of age• Distribution of iron-folic acid supplements for pregnant women
Community outreach via child health days or similar (where primary health care coverage is incomplete)	Children 6–59 months of age	<ul style="list-style-type: none">• Vitamin A supplements• Therapeutic zinc supplements as a part of diarrhea management• Distribution of micronutrient powders for children 6–23 months of age• Deworming drugs for children 12–59 months of age
Primary health care system (linked with outreach campaigns)	Children 6–59 months of age	<ul style="list-style-type: none">• Vitamin A supplements• Therapeutic zinc supplements as a part of diarrhea management• Deworming drugs for children 12–59 months of age• Identification of severe acute malnutrition• Supervision of community-based management of acute malnutrition• Provision of complementary food or coupons for selected children under two years of age• Provision of multiple micronutrient powders for children under two years of age not receiving food• Provision of iron-folic acid supplements for pregnant women
Market-based delivery	Entire population	<ul style="list-style-type: none">• Salt iodization• Iron fortification of staple foods (such as wheat flour, rice, maize)• Fortified complementary foods for children 6–23 months of age

Source: Authors.

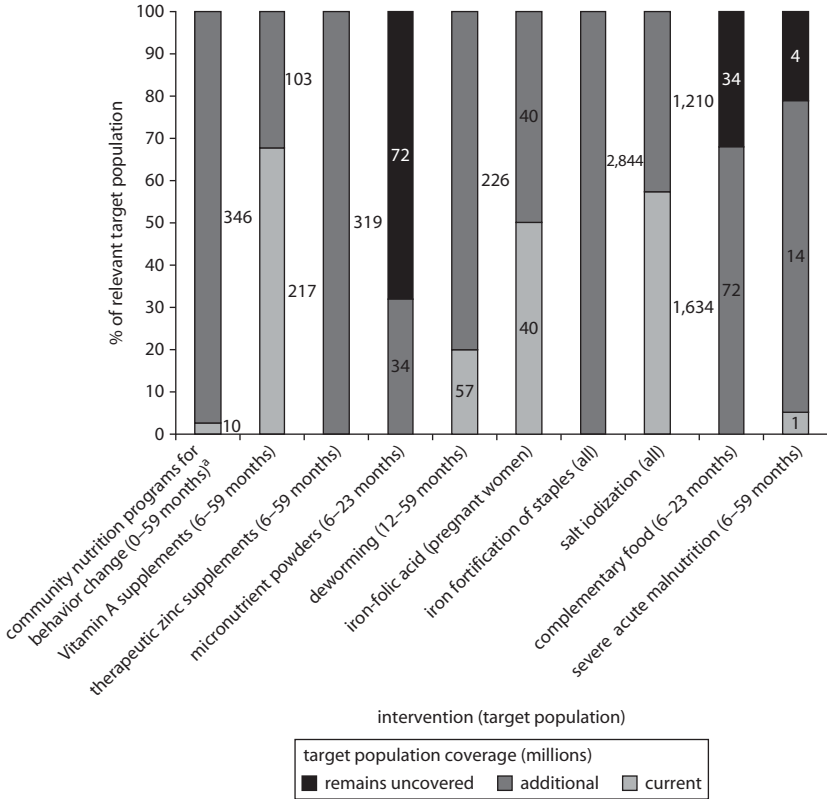
a. Due to current methodology, this costing exercise uses the target population under five years of age and their parents. However, programmatic guidance suggests that future programs must target children under two years of age.

Table 2.5 Populations in Selected Demographic Groups in the 36 Countries with the Highest Burden of Undernutrition, by Region
(millions)

<i>Region</i>	<i>Total population</i>	<i>Annual births</i>	<i>Children <60 months of age</i>	<i>Children 6–59 months of age</i>	<i>Children 12–59 months of age</i>	<i>Underweight children 6–23 months of age</i>	<i>Children 6–59 months of age with severe acute malnutrition</i>
Sub-Saharan Africa	652.4	25.2	108.8	97.2	65.3	8.5	5.0
South Asia	1499.0	37.9	172.5	155.0	103.5	23.1	10.3
East Asia and the Pacific	457.7	9.8	46.2	41.6	27.7	3.4	1.6
Latin America and the Caribbean	40.0	1.0	5.0	4.5	3.0	0.2	0.0
Middle East and North Africa	122.4	3.6	16.8	15.1	10.1	0.8	0.4
Europe and Central Asia	73.0	1.5	7.2	6.5	4.3	0.1	0.0
Total	2,844.5	79.0	356.5	319.9	213.9	36.1	17.3

Sources: For population: UN data at <http://data.un.org/> with life tables (where needed) created by the authors; for underweight children, UNICEF (2009) (uses rate for 0–59 months of age, applied to population 6–23 months of age); for severe acute malnutrition, WHO Global Database on Child Growth and Malnutrition (<http://www.who.int/nutgrowthdb/en/>).

Figure 2.1 Target Population Currently Covered by Nutrition Interventions and Planned Additional Coverage



Sources: Existing coverage data for salt iodization is from UNICEF (2009); for deworming programs from WHO (2008); for vitamin A from UNICEF (2009); all other data are authors’ estimates as discussed in the text.

Note: Bars show percentages of the relevant target population. The corresponding numbers indicate millions of children or people covered. Age range of children in months is noted next to the name of the intervention. Note that 100 percent of the relevant age group is covered by either micronutrient powders or complementary feeding, but children do not receive both (columns 4 and 9). Authors’ estimates assume that 4 million children with severe acute malnutrition cannot be reached with any intervention.

a. Community nutrition programs for behavior change include promotion of breastfeeding, appropriate complementary feeding practices, and proper hygiene, specifically handwashing.

possible to effectively cover 100 percent of the target population. Most published unit cost estimates are for reaching up to about 80 percent of the target population. The balance is hard to reach, because the people are geographically isolated, not participating in markets, not generally reached by public services, transient, socioeconomically vulnerable, or for other reasons. For example, one study on vitamin A capsule distribution in these

hard-to-reach households hired community workers to identify those households in 12 rural districts in Bangladesh that were not covered by the existing distribution system. They made house-to-house visits to register children and conducted follow-up visits. It cost about three times as much to reach these children as it did to reach those who were not hard to reach, although the authors hoped that with experience this additional cost might decrease (Micronutrient Initiative 2007). Assuming that one can cover about 80 percent of the target population at a constant marginal cost, it is likely that the cost to reach the next 10 percent might double.

Mulligan et al. (2005) provide information on the cost of health center visits by coverage levels which corroborates this estimate. They estimate that for Sub-Saharan Africa, the average cost increases by 30 percent to achieve 90 percent rather than 80 percent coverage, which implies that the marginal cost of the increased coverage above 80 percent is almost four times that of getting to 80 percent coverage. (They also provide estimates of the difference between average costs at 70 percent and 80 percent coverage, where the difference is much smaller.) Similarly, the World Health Organization's CHOICE project has increasing marginal costs as coverage increases, albeit at a less sharp rate (accessed at <http://www.who.int/choice/en>).

We, therefore, cost out coverage for 100 percent of the target population, but recognize that effective coverage is unlikely to exceed 90 percent for most interventions (and we are effectively allowing for the increased unit cost of increasing coverage above 80 percent). Community-based management of severe acute malnutrition is the exception, and coverage is estimated at 80 percent, since no field programs currently have exceeded this coverage rate. Furthermore, we propose a phased approach to scaling up these interventions since the capacities and mechanisms to deliver these interventions are extremely limited in most of the high-burden countries. We also allow for specific resources and time to build these capacities before scaling-up to the next phase of interventions.

Some Assumptions about Delivery of Services

We recognize that unit costs will vary across regions, largely because of differences in the cost of delivering services. Our estimates of unit costs for each type of intervention are derived from experience in South Asia, East Asia and the Pacific, and Africa (table 2.6). Costs for the other three regions (Latin America and the Caribbean, Middle East and North Africa,

Table 2.6 Estimated Unit Costs for Nutrition Interventions^a

<i>Intervention</i>	<i>Cost estimate</i>	<i>Source</i>	<i>Assumptions</i>
<i>Behavior change interventions</i>			
Breastfeeding promotion	Included in community nutrition programs US\$5–15 per participant per year	Mason et al. (1999)	Community nutrition programs cost US\$7.50 per child under five years of age: assume two children under five years of age per participating mother
Promotion of appropriate and timely complementary feeding (does not include actual provision of complementary foods)	Included in community nutrition programs	Mason et al. (1999)	
Handwashing	Nutrition education	Mason et al. (1999)	Assume zero additional cost if included in community nutrition program
<i>Micronutrients and deworming interventions</i>			
Vitamin A supplements	US\$0.60 per child per round, i.e. US\$1.20 per child per year Capsules cost US\$0.02 each	Neidecker-Gonzalez et al. (2007); Fiedler et al. (2008a) Fryars, Micronutrient Initiative, personal communication	Assume supplements are distributed through child health days, with costs shared with another intervention (e.g. deworming), or through the primary health care system with outreach to children 18–59 months of age who have completed routine vaccinations
Therapeutic zinc supplements for management of diarrhea	US\$1 per child per year Each tablet costs about US\$0.02 in blister of 10 tablets	Robberstad et al. (2004) suggest cost US\$0.47 per course; Micronutrient Initiative (2006) estimates US\$0.33 (India)	Assume two to three episodes of diarrhea per year over a child's first five years, with delivery cost and tablet cost each accounting for US\$0.50 per year

(continued)

Table 2.6 Estimated Unit Costs for Nutrition Interventions^a (Continued)

<i>Intervention</i>	<i>Cost estimate</i>	<i>Source</i>	<i>Assumptions</i>
Provision of micronutrient powders (sachets or crushable tablets) to children under two years of age	US\$1.80 per child 6–11 months of age per year, excluding distribution: and US\$3.60 per year per child 12–23 months of age; assume distribution doubles cost	Zlotkin et al. (2005) (cost of sachets: 60 at US\$0.03 each); recent consensus is for 60 sachets between 6–11 months of age, 60 sachets between 12–17 months of age and 60 sachets between 18–23 months of age	Assume distribution doubles cost; no program data currently available
Deworming	US\$0.25 per child 24–59 months of age per round per year	Hall et al. (2009)	Number of required rounds of treatment per year depends on the prevalence of soil-transmitted helminths in the area
Iron-folic acid supplements for pregnant women	US\$2.00 per pregnancy	Horton (1992) with allowance for inflation	Program data are particularly lacking
Iron fortification of staple foods	US\$0.20 per person per year (wheat flour with iron, folic acid, and perhaps zinc)	Fiedler et al. (2008b) using median (there is a misprint in the published version: Fiedler, personal communication)	Fiedler has only two studies also adding folic acid, and authors believe these are overestimates; adding folic acid barely changes cost; estimated US\$300 million one-time costs: Horton et al. (2008)
	US\$0.20 per person per year (other staple fortified with iron)	Wesley, Micronutrient Initiative, personal communication	Cost for adding iron to iodized salt, or iron to soy sauce, including social marketing

Salt iodization	US\$0.05 per person per year	Horton et al. (forthcoming)	Estimated additional US\$200 million one-time-only costs to reach 90 percent coverage target
Iodized oil capsules	US\$2.16 per person per year	Fiedler et al. (2008b)	Median of four studies
Complementary and therapeutic feeding interventions			
Prevention or treatment for moderately malnourished children 6–23 months of age using complementary food	US\$40–80 per child per year; assume need to double prevalence data to get incidence to allow for imperfect targeting	Appendix D	Allows about US\$35–70 for food cost per year; lower amount is for 100–125 kcal per day for most countries; higher amount is for 200–250 kcal per day for countries with global acute malnutrition rates >10 percent; except South Asia, where global acute malnutrition rates >10 percent, use US\$50 per day for food plus distribution using Indian ready-to-use food
Treatment of severe acute malnutrition using a community-based management approach	US\$200 per child per episode; double prevalence figures to obtain incidence estimates	Appendix D	Food cost alone is about US\$50–70 per episode for locally produced food: provides approximately 1,000 kcal per child per day for approximately two months
Related interventions			
Conditional cash transfers with nutrition components	US\$156–432 per household per year, excluding small, ineffective transfers in Honduras	Bassett (2008)	Data for Latin America (programs elsewhere less well studied)

a. Based on program experience in Sub-Saharan Africa and South Asia

and Europe and Central Asia) are increased by the multipliers presented in table 2.2. We include delivery costs in the unit costs and provide information separately on the costs of the capsules, micronutrient powders, and other inputs. Typically, delivery costs account for the majority of expenditures for interventions targeting individuals through public provision of services, but a considerably lower proportion for fortification, which is delivered using markets. A large proportion of the delivery costs for fortification are borne by the private sector and passed on to consumers, families, and communities.

For micronutrient interventions, we estimate that the delivery costs account for about one-third of the overall cost (96 percent for vitamin A supplements, 90 percent for iron-folic acid supplements, 20 percent for therapeutic zinc supplements, 50 percent for multiple micronutrient powders, and less than 5 percent for iron fortification and salt iodization). For community nutrition programs for behavior change, virtually all costs included are for nutrition education. For complementary feeding (the area with the least developed delivery systems and capacities for implementation) estimated delivery costs are 12 percent of the total (probably an underestimate; further research is needed), and for community-based management of acute malnutrition, 70 percent of the cost is for inputs other than food (Laurent Gadot, Médecins Sans Frontières, personal communication). Overall, a little less than half of the total US\$11.8 billion estimate is for delivery mechanisms and nutrition education, less than half is for targeted food supplements, micronutrients, and deworming medication, and the rest is for capacity development, monitoring and evaluation, operations research, and technical assistance.

CHAPTER 3

What Will It Cost and What Are the Potential Benefits?

Estimated Costs

Table 3.1 summarizes our estimates of the additional annual investments required for the proposed scaling up of nutrition interventions:

For behavior change interventionsUS\$2.9 billion

- **Community nutrition programs:** Additional investment allows for US\$15 per household for community health or nutrition volunteers or similar workers (potentially linked to the primary health care system or similar national structures) to facilitate community organization; educate households about breastfeeding, complementary feeding, and handwashing; and to distribute micronutrient powders and perhaps iron-folic acid supplements. They would also refer cases of faltering growth and severe acute malnutrition to the formal health system. We assume that, on average, households have two children under five years of age, such that the cost per child is US\$7.50 (households likely need the most intensive education for their first child). Although these community workers may use growth monitoring, their focus is on community organization and on nutrition education and growth promotion, rather than on growth monitoring specifically.

Table 3.1 Estimated Annual Financing Needs for Scaling Up Nutrition Interventions to Full Coverage of Target Populations in the 36 Countries with the Highest Burden of Undernutrition, by Region
(US\$ millions)

<i>Intervention</i>	<i>Sub-Saharan Africa</i>	<i>South Asia</i>	<i>East Asia and the Pacific</i>	<i>Latin America and the Caribbean</i>	<i>Middle East and North Africa</i>	<i>Europe and Central Asia</i>	<i>Not allocated by region^a</i>	<i>Total by intervention</i>
<i>Behavior change subtotal</i>	815.9	1,293.8	346.7	87.4	277.1	72.8	n.a.	2,893.7
Community nutrition programs for behavior change (0–59 months) ^b	815.9	1,293.8	346.7	87.4	277.1	72.8	n.a.	2,893.7
<i>Micronutrients and deworming subtotal</i>	402.6	680.4	201.3	43.7	117.9	41.0	50.0	1,536.9
Vitamin A supplements (6–59 months)	33.8	78.8	6.2	3.6	7.3	0.0	n.a.	129.7
Therapeutic zinc supplements (6–59 months)	97.2	155.0	41.5	10.5	33.2	8.7	n.a.	346.1
Multiple micronutrient powders (6–23 months)	80.1	29.0	37.4	14.1	41.2	14.4	n.a.	216.2
Deworming (12–59 months)	23.5	42.9	8.2	4.6	1.2	0.0	n.a.	80.4
Iron-folic acid supplements (pregnant women)	25.3	37.9	9.7	2.4	7.9	2.0	n.a.	85.2
Iron fortification of staples (all) ^a	130.5	299.8	91.5	8.0	24.5	14.6	30.0	598.9
Salt iodization (all) ^a	12.2	37.0	6.8	0.5	2.6	1.3	20.0	80.4
<i>Complementary and therapeutic feeding subtotal</i>	1,562.1	3,922.0	526.5	19.6	160.5	11.9	n.a.	6,202.6
Complementary food (6–23 months)	968.1	2,276.0 ^c	275.5	14.6	101.5	6.9	n.a.	3,642.6

Community-based management of severe acute malnutrition (6–59 months)	594.0	1,646.0	251.0	5.0	59.0	5.0	n.a.	2,560.0
<i>Capacity development for program delivery</i>	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	1,000.0	1,000.0
<i>Monitoring and evaluation, and operations research for program delivery</i>	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.	200.0	200.0
<i>Total</i>	2,780.6	5,896.2	1,074.5	150.7	555.5	125.7	1,250.0	11,833.2 ^d

Source: Authors' calculations, using data in figure 2.1 and tables 2.2, 2.5, and 2.6.

a. In addition to the resources required in individual countries, an additional US\$50 million per year is estimated to be required for technical assistance, initial subsidy for fortificant, and social marketing for iron fortification and salt iodization combined; US\$1.0 billion for capacity development for program delivery, US\$200 million for monitoring and evaluation, and operations research, and technical assistance.

b. Includes delivery of three behavior change interventions — breastfeeding promotion, promotion of complementary feeding, and hygiene behaviors.

c. In South Asia, costing is based on Indian ready-to-use food, which uses locally available foods and is less expensive than the lipid-based nutritional supplementary foods for which cost estimates have been constructed in other regions. Nutritional benefits of Indian ready-to-use food are not quite as high as those for lipid-based supplements. Switching to those supplements in South Asia would add another US\$1.5 billion to total costs.

d. Of the total US\$11.8 billion, we estimate that approximately US\$1.5 billion can be financed from private resources. Therefore, the financing requirement from public resources is US\$10.3 billion. n.a. = not applicable.

Current coverage is low and largely restricted to five countries: Bangladesh, Ethiopia, India, Madagascar, and Uganda. Burkina Faso, Ghana, and Guatemala are also beginning programs. No cost or coverage data are available for countries to estimate current spending, other than Madagascar where current spending is approximately US\$8 million. *Additional annual cost = US\$2.9 billion.*

For micronutrient and deworming interventionsUS\$1.5 billion

- ***Vitamin A supplementation:*** Additional investment allows for US\$1.20 per child 6–59 months of age per year to scale up coverage with vitamin A capsules. Currently 68 percent of children aged 6–59 months of age are covered in 32 of the 36 countries (calculated from UNICEF [2009]). Four countries are excluded from the calculation: South Africa, Peru, Iraq, and Turkey; per capita income or infant mortality rates make Iraq and Turkey ineligible for donated capsules, and no program is planned. Peru has targeted distribution only, and South Africa recently switched from targeted to more broadly based distribution. We assume no increased funding is required for either country. *Additional annual cost = US\$130 million.*
- ***Therapeutic zinc supplementation for management of diarrhea:*** Additional investment allows for US\$1 per child per year for children 6–59 months of age for two to three courses of therapeutic zinc sulfate to reduce diarrhea-related mortality and morbidity, based on negligible current coverage. Cost studies of actual programs are required to refine this figure, as the first at-scale programs begin. *Additional annual cost = US\$346 million.*
- ***Multiple micronutrient powders:*** Additional investment allows US\$3.60 per child 6–23 months of age per 60-day course of micronutrients, which has been shown to be an efficacious approach for micronutrient status (Dewey et al. forthcoming; Zlotkin et al. 2005). Current consensus is that children receive this once between 6 and 11 months of age, once between 12 and 17 months of age, and once between 18 and 23 months of age. The multiple micronutrient powders would be given to children who are not receiving targeted complementary food supplements for moderate or severe malnutrition. As modeled, about one-third of children receive micronutrient powders, and two-thirds receive complementary or therapeutic feeding. We assume current coverage is negligible. Note that multiple micronutrient

powders are not yet included in the World Health Organization's recommendations. *Additional annual cost = US\$216 million.*

- ***Deworming:*** The estimated cost per child 12–59 months of age is US\$0.25 per round of treatment per year (Hall et al. 2009; note that Hall et al.'s estimates are for children 24–59 months of age. There are no cost estimates currently available for the 12–24 month age group, which requires syrups that are more costly both to purchase and to deliver). Deworming is a highly relevant intervention given its close association with micronutrient status and child growth. The benefit:cost ratio is approximately 6:1 (Horton et al. 2008). The World Health Organization recommends one round of treatment per year in areas where the prevalence of any soil-transmitted helminths is equal or greater than 20 percent, and two rounds of treatment per year in areas where the prevalence exceeds 50 percent. Given the range of national prevalence rates, our estimate assumes an average of 1.5 rounds of treatment per year in Africa and South Asia. Since all countries included here in the East Asia and Pacific and Latin America and Caribbean regions have reported prevalence rates greater than 50 percent, two rounds of treatment were assumed to be necessary in these areas. Yemen is the only country in the Middle East and North Africa where the prevalence is greater than 20 percent; therefore, the estimate for the Middle East and North Africa assumes that one round of treatment is necessary for children in Yemen and no treatment is required in all other countries. No national program is included for Turkey, although deworming might be appropriate in selected regions. Currently, 20 percent of preschool children in the 36 countries are covered. *Additional annual cost = US\$80 million.*
- ***Iron-folic acid supplementation during pregnancy:*** Additional investment allows for US\$2.00 per pregnancy for women to be protected with iron and folic acid. We assume that current coverage is similar to the median cost of coverage with antenatal care (four visits) in 25 of the 26 countries for which these data are available (51 percent: WHO 2008). The unit cost and coverage data are very weak. Follow-on research for these estimates and alternative delivery mechanisms would be valuable. *Additional annual cost = US\$85 million.*
- ***Iron fortification of staples and other foods:*** Additional investment allows for US\$0.20 per person per year to fortify a staple food.

Fortification of wheat or maize flour with iron is only likely to reach about half of the population in the 36 countries, based on present consumption and milling patterns. This estimated cost of US\$0.20 per capita will allow some additional fortification of other vehicles (e.g., soy sauce or adding iron to iodized salt) to reach those not consuming wheat or maize flour. This assumes that current coverage is negligible in the 36 countries considered. Our estimate also allows US\$30 million per year for 10 years for technical assistance, social marketing, and initial premix subsidy to initiate large-scale fortification through the private sector. *Additional annual cost = US\$599 million.*

- ***Universal salt iodization:*** Additional investment allows for US\$0.05 per person per year to iodize salt (this is the additional amount needed: currently 58 percent of households already have access to iodized salt in the 36 countries considered (calculated from UNICEF [2009])). The estimate also allows US\$20 million per year for 10 years for technical assistance, social marketing, and initial premix subsidy to complete salt iodization through the private sector *Additional annual cost = US\$80 million.*

For complementary feeding and targeted therapeutic feeding.....US\$6.2 billion

- ***Provision of complementary food for the prevention and treatment of moderate malnutrition:*** Additional investment is the cost of allocating about US\$0.11 per child per day (including distribution/delivery costs) averaged over the year, for a small amount of micronutrient fortified and/or enhanced complementary food to enrich the nutrient density of complementary food for selected children 6–23 months of age, in countries or regions where global acute malnutrition (i.e. weight-for-height z score < -2) is less than 10 percent. In countries or regions where global acute malnutrition exceeds 10 percent, outside of South Asia, US\$0.22 per child per day is allocated to double the amount of fortified and/or enhanced complementary food. In South Asia, US\$0.14 per child per day is allocated to use Indian ready-to-use food (for further explanation, see appendix D). In countries where this intervention is adopted, it would have to build upon an existing mechanism (such as community-based programs that may or may not use growth monitoring and health promotion) or some other appropriate mechanism for identifying underweight children.

The cost estimations are based on targeted provision of complementary foods. The proportion of the population proposed to be covered is twice the rate of moderate malnutrition (weight-to-age z score < -2). Coverage rates are therefore about 80 percent of the age group in South Asia, 50 percent of the age group in Africa and East Asia and Pacific regions, and about 10 percent of the age group in other regions. Children 6–23 months of age not receiving targeted complementary food are assumed to receive micronutrient powders (see above).

Targeting might be geographic (for all children in selected regions or emergency “hot spots”) or include the provision of coupons to at-risk households to purchase complementary food commercially (a highly conditional cash transfer) or could use other appropriate delivery mechanisms through community-based programs or market-based delivery systems. If targeting is done for individual children (e.g., using growth monitoring), then costs could be significantly higher. Current coverage with micronutrient-fortified and/or -enhanced complementary foods is negligible. *Additional annual cost = US\$3.6 billion.*

- ***Community-based management of severe acute malnutrition:*** This is an expensive intervention, which costs US\$200 per child treated. The prevalence of severe acute malnutrition is 4.8 percent across the 36 countries in the 6–59 months age group (implying an incidence of 9.6 percent, using the incidence: prevalence ratio of 2:1). We assume that if all the other interventions are funded, that prevalence of severe acute malnutrition will fall to 50 percent of present levels (Isanaka et al. 2009, reporting on the effect of an intensive complementary feeding program). Unlike other interventions (where we aim for 100 percent coverage) we aim for 80 percent coverage, since there are no existing programs at scale achieving higher coverage, and we cost the intervention accordingly. Current coverage is approximately one million children (Stephane Doyon, Médecins Sans Frontières, personal communication). *Additional annual cost = US\$2.6 billion.*

For capacity development, M&E and technical assistance ***US\$1.2 billion***

- ***Capacity development for program delivery:*** Country capacities to implement even the basic interventions are weak, and for the more complex interventions, implementation and stewardship capacities

are even weaker (see, for example, the recent United Nations [2009]). While it is not possible to estimate exactly what it will cost to build these capacities, recognizing the magnitude of this task and the centrality of capacity development for the delivery of all the interventions, we allocate US\$1 billion for this effort across all regions. In doing so, we assume that the capacity development for health-related interventions will be closely aligned with the ongoing efforts at health systems strengthening. *Additional annual cost = US\$1.0 billion.*

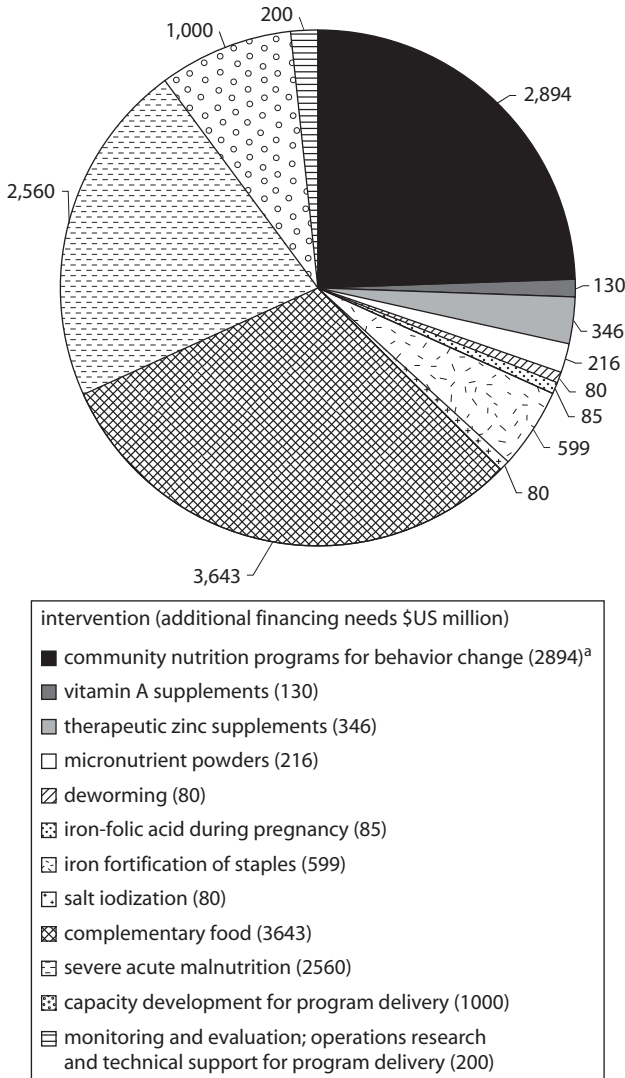
- ***Monitoring and evaluation, and operations research and technical assistance for program delivery:*** We allocate US\$200 million for monitoring and evaluation of large-scale programs (starting with US\$100 million in step 1, and adding another US\$100 million in step 2 as more programs are scaled up). The focus of the research effort costed here will be on evaluation of large-scale programs, and on “delivery science” so we can learn more about how to deliver services more effectively and efficiently. The knowledge and learning from these investments will represent a global public good that will benefit all regions and countries. *Additional annual cost = US\$200 million.*

The total cost of scaling upUS\$11.8 billion

Of the US\$11.8 billion annually, micronutrients (supplementation and fortification) and deworming account for about one-eighth of the total, community nutrition programs for one-quarter, complementary feeding for one-quarter, and treatment of severe acute malnutrition for one-fifth (figure 3.1). Further, US\$1.5 billion of this will be financed from private household resources, leaving an estimated financing gap of US\$10.3 billion from public resources. More analyses are needed to identify how this can be financed from national and international sources.

Given our estimate of the target population of 356 million children under the age of five in the 36 countries, our estimates translate to an annual additional cost of US\$30 per child from public resources. This compares to an annual additional cost of US\$36 per child estimated by REACH (2008), including delivery costs and not including costs of conditional cash transfers. In both cases the estimates do not include the cost of fortification for the population five years of age and older. However, the assumptions here and in REACH regarding the more expensive items (feeding programs) are somewhat different. In particular, we

Figure 3.1 Estimated Additional Costs for Scaling Up Nutrition Interventions to Full Coverage in the 36 Countries with the Highest Burden of Undernutrition (US\$ million)



Source: Authors' calculations, using table 3.1.

a. Community nutrition programs for behavior change include promotion of breastfeeding, appropriate complementary feeding practices, and proper hygiene, specifically handwashing.

assume that as the micronutrient, deworming, behavior change, and complementary feeding programs are phased in, they will have a substantial effect in reducing severe acute malnutrition, whereas that beneficial effect is not allowed for in the REACH estimates. Further, there is ongoing debate on the use of ready-to-use therapeutic foods in India, for example, which needs to be resolved before a large-scale expansion is proposed or financed.

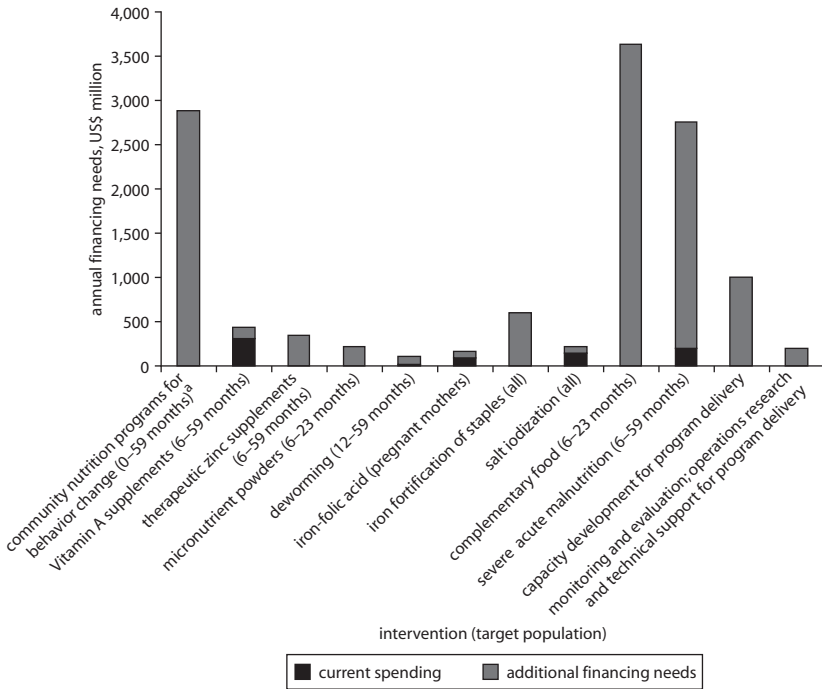
Overall, many aspects of the proposed phasing of the scale-up will need to be adapted to individual country contexts. Countries with higher implementation capacities may proceed at a faster rate, while the scale-up may be slower in other countries where capacities are more limited. Figure 3.2 illustrates how much is currently spent, by intervention, and the additional financing needs envisaged. It is clear that only a small proportion of the need is currently being met and there is a very large financing gap.

Supportive Policies and Programs: Conditional Cash Transfers

The demand-side costs for conditional cash transfers are not included in our cost estimates, although they can be an effective complement to the supply-side interventions costed here. The costs per household for conditional cash transfers are quite significant, even if the amount of the transfers in South Asia and Africa can be correspondingly lower than in Latin America and the Caribbean. Conditional cash transfers typically need to transfer approximately 20 percent of a household's income to have an impact (Bassett 2008). In Latin America, three of the programs reviewed demonstrated improvements in height-for-age z scores, from 0.13–0.15. In Mexico, an effect of about double this magnitude was achieved in the younger age group (12–36 months of age). However, Mexico also had direct supply-side nutritional inputs (fortified milk for children 4–24 months of age and a food supplement for pregnant and lactating women). Conditional cash transfers imply substantial resource transfers, but not necessarily increased real resource expenditures (other than the program administration and monitoring costs).

These improvements are promising. The *Progres*a Program (now called *Oportunidades*) in Mexico provided a transfer equal to about 20 percent of household expenditure, which resulted in additional consumption of 7.8 percent more calories overall, including 16.7 percent more fruits and vegetables and 30 percent more animal products in beneficiary households (surveyed in Bassett [2008]).

Figure 3.2 Current Spending and Additional Financing Needed to Scale Up Nutrition Interventions to Full Coverage in the 36 Countries with the Highest Burden of Undernutrition



Source: Current coverage data for vitamin A from UNICEF (2009); for deworming from WHO (2008); and for salt iodization from UNICEF (2009); other existing coverage data are authors’ estimates. Cost estimates use unit cost data in table 2.6 and current and target coverage.

Note: Age range of children in months is noted next to the name of the intervention.

a. Community nutrition programs for behavior change include promotion of breastfeeding, appropriate complementary feeding practices, and proper hygiene, specifically handwashing.

Conditional cash transfers have successfully changed behavior in more affluent developing countries at a cost that is feasible in these countries. New pilot programs in some of the 36 countries covered here could show how the approach works in low-income developing countries. If cash transfers were intended for other outcomes, it would be worthwhile to incorporate conditions that could support and enhance demand for nutrition interventions. For example, many countries either have some form of cash transfers already under way or are considering putting such safety nets in place in response to the current crises. In such

situations, making these transfers conditional on use of the nutrition interventions listed here could help to combat undernutrition with minimal additional costs.

In the lower-income countries, one way to incorporate a transfer-type approach would be to provide coupons to poor households in urban areas. Governments could ensure access for the most vulnerable families to micronutrient powders or fortified complementary foods at a nominal cost (or free), while encouraging local provision of such goods on commercial terms through market-based systems to wealthier households.

Links with Health Systems Strengthening

In many countries, efforts are already underway to strengthen health systems, with extensive support from development partners through initiatives such as the International Health Partnership. This includes efforts to strengthen human resources in health, to develop innovative and lower cost service delivery strategies, and to build better health metrics, through initiatives such as the Health Metrics Network. Since many of the nutrition interventions costed here are delivered through the health system, a close link and complementarity with these efforts is critical. This is suggested for pragmatic reasons (wherein the nutrition interventions ride on and complement the strengthened health systems), and in the spirit of the Paris and Accra declarations for aid effectiveness and transaction costs for governments.

Expected Outcomes

What will a US\$10.3 billion of public investment buy each year? The list is long:

- Households with 356 million children under five years of age will be reached by community nutrition programs for behavior change, allowing more mothers to learn the benefits of exclusive breastfeeding and more families to learn about optimal complementary feeding practices and appropriate hygiene practices.
- 103 million additional children 6–59 months of age will receive twice-yearly doses of life-saving vitamin A supplements.
- 40 million additional pregnant women will receive iron-folic acid tablets as part of their antenatal care.

- 319 million children 6–59 months of age will receive zinc supplements as part of diarrhea management.
- 2.8 billion more people will be able to consume staple foods fortified with iron.
- 1.2 billion people who do not currently use iodized salt will be able to obtain it; pregnant women will receive iodized oil capsules until iodized salt becomes available.
- 226 million more children 12–59 months of age will receive deworming medication.
- 34 million children 6–23 months of age will receive vitamins and minerals through multiple micronutrient powders.
- 72 million children 6–23 months of age will receive micronutrient-fortified and/or -enhanced complementary foods that are fortified with vitamins and minerals; 27 percent of these will receive 40g per day, and 73 percent will receive 80g per day.
- 14 million more children 6–59 months of age will be treated for severe acute malnutrition using community-based management practices.

Many researchers have found evidence of substantial benefits from nutrition interventions (table 2.8). Bhutta et al. (2008) provide the most detailed and recent estimates. They estimate that of the 8 million child deaths occurring annually in the 36 countries (80 percent of the child deaths globally), that one-quarter, or 2 million deaths, could be averted by the package they propose. Their package includes elements that could not be costed at the present time (such as neonatal vitamin A in Asia, for which WHO technical guidance is still awaited, and a range of other interventions during pregnancy for which programmatic guidance is unclear) as well as health interventions such as malaria treatment, which is costed in health intervention packages. Their package does not include community-based management of acute malnutrition, although facility-based treatment is included. We have assumed that of the current 276,000 child deaths annually due to severe acute malnutrition, half are prevented by the other interventions, 80 percent of the remaining children with severe acute malnutrition receive community-based treatment, and the relative risk for treated children is 0.45 (Bhutta et al. 2008), reducing deaths by 188,000. Nor does their package include preventive complementary feeding interventions. A comparison between the two is included in appendix B.

Bhutta et al. (2008) estimate about 57.5 million disability-adjusted life-years could be saved by the end of three years of implementation of

their package of interventions, at 90 percent coverage. With the estimated US\$10.3 billion public costs this works out to approximately \$180 per disability-adjusted life-year. Some individual interventions we have included have lower costs per disability-adjusted per life-year (vitamin A, therapeutic zinc, and treatment of severe acute malnutrition, for example). Other interventions that are included have their primary impacts on productivity, often via cognition, and hence boost gross domestic product overall (iron fortification, salt iodization, and micronutrient-fortified and/or -enhanced complementary foods for prevention of moderate malnutrition, with correspondingly higher disability-adjusted life-year costs [see table 3.2]).

Table 3.2 Estimated Benefits from Scaling Up Nutrition Interventions

<i>Intervention</i>	<i>Estimated benefit: cost savings or cost-effectiveness</i>	<i>Source</i>
Behavior change (through community nutrition programs for behavior change)	US\$53–153 per disability-adjusted life-year saved	Ho (1985: Tamil Nadu) Waters et al. (2006: Peru)
Vitamin A supplements	US\$3–16 per disability-adjusted life-year saved	Ching et al. (2000); Fiedler (2000); Horton and Ross (2003)
Therapeutic zinc supplements	US\$73 per disability-adjusted life-year saved	Robberstad et al. (2004)
Micronutrient powders	US\$12.20 per disability-adjusted life-year saved (zinc) 37:1 benefit: cost ratio (iron)	Sharieff et al. (2006)
Deworming	6:1 benefit:cost ratio	Horton et al. (2008)
Iron-folic acid supplements	US\$66–115 per disability-adjusted life-year saved (iron; no estimates known for folic acid)	Baltussen et al. (2004)
Iron fortification of staples	8:1 benefit:cost ratio	Horton and Ross (2003, 2006)
Salt iodization	30:1 benefit:cost ratio	Horton et al. (2008)
Complementary foods	US\$500–1,000 per disability-adjusted life-year saved	Authors' rough estimates ^a
Community-based management of acute malnutrition	US\$41 per disability-adjusted life-year saved	Bachmann (2009)

a. Based on Caulfield et al's (1999) estimate that increased intake of 71–164 kcal per day for children younger than one year of age, as a result of complementary feeding, could decrease deaths due to malnutrition by 2–13 percent, depending on underlying presence of malnutrition in the community.

We do not attempt to make a comprehensive estimate of the benefits of nutrition interventions on IQ, productivity, or gross domestic product. However, salt iodization alone would be estimated to provide US\$2.4 billion in benefits (at a 30:1 benefit:cost ratio), and the iron fortification intervention would provide US\$4.8 billion (at 8:1). Based on the results of a longitudinal study in Guatemala (Hoddinott et al. 2008), we know that children who received fortified complementary food before they were three years of age grew up to have wages that were 46 percent higher than controls (for men). Thus, we expect productivity benefits from the substantial investment proposed for fortified complementary food, particularly if accompanied by community-based programs to reduce relapse rates and prevent further malnutrition. Further work would be needed to estimate the overall gross domestic product impact (allowing for overlaps between interventions). The effects of iron and iodine fortification alone outweigh the cost proposed here to scale up all micronutrient and behavior change interventions (what we describe below as step 1 of a scale-up process).

Bhutta et al. (2008) estimate that after 36 months of implementation the intervention package would reduce stunting by 36 percent, although as much as half of this could be due to preventive zinc supplementation which we have not costed since there is no existing delivery mechanism for this intervention, and since compliance is unknown. Isanaka et al. (2008) found that one intensive complementary feeding program reduced wasting by 36 percent. It seems plausible that the number of underweight children under five years of age might be reduced by between one-fifth and one-third with this package of interventions (this is the authors' estimate and not a scientifically estimated number). Further work on this is planned.

The estimated benefits (a one-fifth to one-third decrease in stunting and a one-fifth decrease in mortality among children under five years of age) would assist substantially in achieving the Millennium Development Goals of halving the number of children underweight (Goal 1) and decreasing child mortality by two-thirds (Goal 4). Further, as in-country capacities are strengthened and detailed programming guidance becomes available for the new interventions, these interventions can be added on. As this happens, and as further synergies are realized with health systems strengthening and complementary investments are made in social safety nets and food security programs, additional benefits will be realized.

Uncertainties and Sensitivity Analyses

Estimation is an exercise of uncertainty. For our parameters, the uncertainty is greatest for the higher-cost interventions and least for the lower-cost ones. For example, there is plenty of information and experience with micronutrient and deworming interventions, which have the least impact on overall estimated costs and financing needs. Community nutrition programs vary in effectiveness (political commitment is important), and this variation has a larger potential impact on overall costs. Although costs for community-based management of severe acute malnutrition are fairly well established in the field under close to ideal program delivery conditions, these costs vary considerably in different contexts. The estimated number of children who would need to be treated is sensitive to assumptions about the number of cases of severe acute malnutrition that can be prevented by other interventions. Finally, the literature on enhanced complementary foods is least developed. The estimated costs per child used here allow only a small margin for distribution and delivery costs. These costs could turn out to be much higher if, for example, the program used growth monitoring and attempted to target food only to selected children (rather than using a rough targeting measure, such as regional targeting, or relying on existing poverty targeting to distribute food coupons) or if there were widespread corruption and diversion of the food (table 3.3).

Financing Options

Our estimate of the total expenditure required for scaling up the 13 nutrition interventions in the 36 countries of interest is approximately US\$11.8 billion, excluding the cost of conditional cash transfers. Were this amount to be financed out of the health budgets of the target group of countries, the current health budget allocations of about US\$54 billion (World Bank 2008b) would have to increase by nearly 18 percent. If the scale-up efforts were financed out of official development assistance (ODA), our estimated cost of nutrition interventions would call for a substantial addition (17 percent) to the US\$62 billion currently allocated to the 36 countries (World Bank 2008b). To the extent that some countries already finance a portion of costs and may finance some additional costs, less may be required from external sources. We examine the potential for additional funding from the four primary sources of finance for nutrition interventions in most developing countries: government finances, private household resources, private sector corporations, and international financial

Table 3.3 Effects of Changing Five Assumptions about the Costs of Scaling Up Nutrition Interventions

<i>Assumption changed</i>	<i>Effect on costs</i>	<i>Estimated probability^a</i>
Community nutrition costs US\$15 per child instead of US\$7.50 per child	Community nutrition costs US\$5.8 billion, not US\$2.9 billion; overall package cost increases from US\$11.8 billion to US\$14.7 billion	Medium
Iron fortification of staples costs twice as much as expected	Fortification of staples costs US\$1.1 billion, not US\$0.6 billion; overall package cost increases from US\$11.8 billion to US\$12.3 billion	Low
All micronutrient and deworming unit costs are twice as much as expected	Micronutrient plus deworming costs US\$3.2 billion, not US\$1.6 billion; overall package cost increases from US\$11.8 billion to US\$13.4 billion	Low
Cost per child doubles for enhanced complementary food	Complementary feeding costs US\$7.2 billion, not US\$3.6 billion; overall package cost increases from US\$11.8 billion to US\$15.4 billion	Medium-high
Complementary food costs for the wealthiest 50 percent are borne from private resources	Complementary feeding costs decrease from US\$3.6 billion to US\$2.7 billion	Medium-high
Other preventive interventions reduce prevalence of severe acute malnutrition by 25 percent, not 50 percent	Community-based management for severe acute malnutrition costs US\$4.2 billion, not US\$2.8 billion; overall package cost increases from US\$11.8 billion to US\$13.2 billion	Medium

Source: Authors' calculations.

a. Estimated probabilities are the authors' subjective view.

aid. Then we consider some strategies to close the gaps in funding likely to remain.

Government Funds

Government financing for nutrition programs and services is paramount because good nutrition is a fundamental precursor to secure the health and development of our global and local communities. For those living in poverty, governments perform a key regulatory role in ensuring access to and quality of nutrition services and food. Government financing is also crucial because good nutrition is a global public good as well as a private one. For example, handwashing messages help to inhibit the

spread of disease, and deworming reduces the risk of infestation. Governments already invest substantial amounts in nutrition activities. As one example, the central and state governments in India allocated nearly US\$1.3 billion in 2007–08 on nutrition programs and budgeted US\$1.7 billion in 2008–09, primarily via the Integrated Child Development Services Program (Reserve Bank of India 2009). Other countries are making allocations as well, albeit not always for cost-effective and well-targeted programs.

If existing government expenditures could be realigned toward the most cost-effective interventions listed in this report, some of the financing required to scale up nutrition interventions could come from efficiency gains from these reallocations. Even if it is not politically feasible to conduct such a realignment, governments may sometimes make additional finances available if a strong evidence-based argument can be made. For example, many developing-country governments have absorbed the costs of potassium iodate for salt iodization. Many governments already fund the distribution costs of deworming tablets, vitamin A supplements, and iron-folic acid supplements and may be willing to finance the program delivery costs for the proposed scale-up. Other governments have included the costs for these supplies in their Medium-Term Expenditure Frameworks. We must look to governments to seize these opportunities and take the necessary actions to ensure evidence-based investment in good nutrition.

Private Household Resources

Another important source of domestic financing could be private resources—households and corporations—in the target group of countries. Some wealthier households may be able to pay out of pocket for nutrition interventions in the form of user fees for public services or expenses for complementary foods, which account for a large proportion of the US\$11.8 billion estimate. Demographic and Health Survey data for India, Bangladesh, and Ethiopia point to significant proportions of underweight children even among households in the highest income quintiles, which presumably could afford to pay for complementary foods.

If we make the reasonable assumption that the wealthiest 50 percent within each country will pay for their requirements of complementary food for underweight children, US\$0.9 billion (about a quarter) of the estimated US\$3.6 billion cost of complementary foods can be directly raised from household resources. The additional US\$0.6 billion for iron fortification of staple foods and for salt iodization may also be financed by wealthier

households, such that approximately US\$1.5 billion of the proposed US\$11.8 billion can potentially come from private household resources.

Private Corporations

There are examples of private firms absorbing part of the costs of iodization, such as transportation and taxes (UNICEF 2008). If these iodization costs are then passed on to the consumer via higher prices, as is the case in most countries, it is the households that bear the (small) extra burden. We can also envisage that some firms might be willing to absorb part of the cost of behavioral change interventions. For example, a soap manufacturer might include public interest messages regarding handwashing as part of its costs of doing business. However, these cost subsidies from private corporations are not included in these estimates.

Further, as private sector corporations become more innovative in the food sector, and as competition heats up in this sector, they have good reason to invest in better and more nutritious products with greater sales potential. Private foundations such as the Bill and Melinda Gates Foundation and the Children's Investment Fund are also emerging as a very significant source of new financing for nutrition.

International Aid

Information on recent international aid flows related to nutrition is difficult to obtain, although Morris et al. (2008) estimate aid related to "basic" nutrition of about US\$0.3 billion per year in the first half of this decade (also see figures 4.2 and 4.3). Even this relatively low level is subject to the risk of double-counting with government finances, since this aid is sometimes used to support public sector nutrition programs. Aid for nutrition programs is, however, dwarfed by international emergency food aid (including food for humanitarian purposes), which is typically in excess of US\$2 billion annually (figure 4.3). Food aid is often concentrated in areas in need of urgent humanitarian assistance and is likely to be driven by political considerations (Morris et al. 2008). It is unclear whether some of the funds allocated under food aid could be reallocated to support the resource requirements for the nutrition interventions discussed above. An important line of unexplored work is to compare the effectiveness of general food aid in improving nutrition to that of the nutritional interventions emphasized in this report.

Furthermore, as shown in figures 4.4 and 4.5, investments in "basic nutrition" from the five largest aid donors have remained small over the

decades, and, even between 2000 and 2007, except for the World Bank, all other donors' investments in nutrition have declined.

While current aid flows for nutrition are very small (figures 4.4 and 4.5) several bilateral partners (Denmark France, Japan, Spain, the United Kingdom) and others such as the European Commission have either developed new nutrition strategies or positions papers, or seem poised to do so. This represents a much-needed potential resource for nutrition financing in high-burden countries. The recent G8 announcement of an additional US\$20 billion over three years for food security programs offers another opportunity for financing the food-related nutrition interventions and the possibility that Canada will take this agenda further to move forward "from food security to nutrition security" at the next G8 summit 2010, offers yet another opportunity for financing the nutrition scale-up (G8 Summit 2009).

Furthermore, although we can expect some gains from reallocating current government financing and sharing more costs with private households or corporations, it is likely that a large gap will remain between existing and required resources. If we take international assistance as the default source of funds, this gap calls for donors to raise their annual levels of support for nutrition to complement the increasing resources in health and in other social sectors.

Indeed, the latest OECD statistics suggest that international aid amounted to only about 0.28 percent of gross domestic product in donor countries in 2007 (OECD 2008). If those countries raised their contributions to the level considered ideal in a 1970 resolution from the UN General Assembly, 0.7 percent of gross domestic product, total aid resources would more than double (United Nations 1970). Further, private foundations represent a new and emerging source of financing for nutrition, and innovative financing options can be explored. For example, the High Level Taskforce on Innovative International Financing for Health Systems¹ is already exploring new options, and the estimated financing needs include some nutrition interventions (such as maternal calcium supplements). The Taskforce specifically aims to raise additional resources for the health-related MDGs, including MDG 1c (hunger and undernutrition). Its challenge is described as "More and better resources are needed if the health-related Millennium Development Goals are to be reached in 2015. The aim is to *raise additional resources that are provided to countries* in an effective way and linked to results." It also recommends that the allocation of funds in countries be made more efficient by filling gaps in costed and agreed upon national strategies.

All of these sources represent new and potentially viable opportunities for nutrition financing for countries with a high burden of undernutrition. However, more work is needed to explore these financing options further. The challenge is to raise and provide these resources in such a way that they complement rather than compete with investments in health systems strengthening, food security, social safety nets, and HIV/AIDS programs. The challenge is also to make sure these resources are consolidated and programmed such as to fill gaps in carefully developed and articulated country strategies rather than as one-off investments.

Note

1. For more information refer to <http://www.internationalhealthpartnership.net/en/taskforce>.

CHAPTER 4

Phasing the Scale-Up

A Phased Approach for the Scale-Up

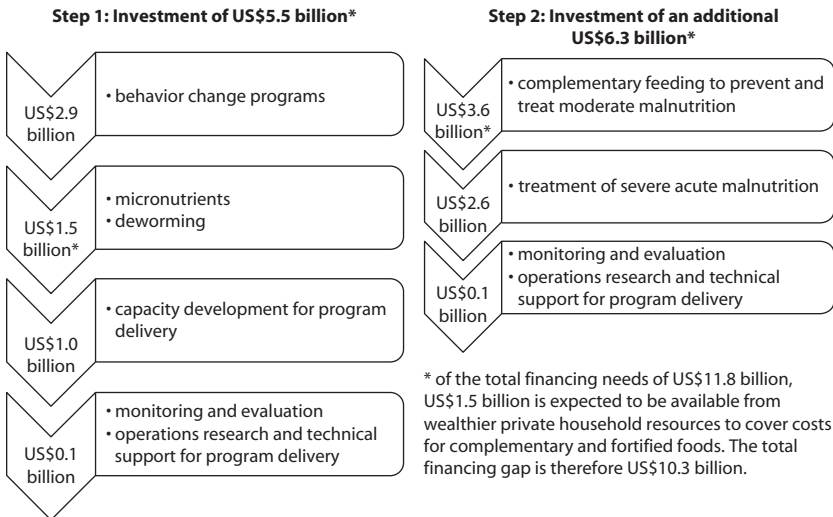
Seeking additional funds to increase nutrition interventions is especially difficult at a time of severe international economic recession. However, the cost of not intervening is much higher. The benefits from iron and iodine interventions alone are estimated at US\$7.2 billion per year. Furthermore, of the total US\$11.8 billion needed per year for a full scale-up, nearly US\$4.4 billion is for micronutrient and deworming interventions and community-level behavior change interventions that can be scaled up fairly rapidly, either with existing capacities or with modest investments in capacity-building for community nutrition programs and child health days.

The other two big-ticket items—complementary feeding interventions and treatment for severe acute malnutrition—would benefit from further research and development before extensive scaling up. For complementary feeding, more country pilots and studies of delivery strategies, capacities, and effectiveness are needed. The proposed new foods in South Asia have not undergone efficacy trials, and questions remain about the daily amounts required in countries with different nutritional profiles, as well as cost-effective ways to deliver the intervention, build capacities, and institute needed effectiveness trials. It is clear that something needs to be

done immediately in nutrition “hotspots.” Despite the high cost, treatment of severe acute malnutrition is efficacious (US\$2.6 billion to treat 14 million children annually). In addition, the health delivery systems needed to provide these services effectively are far from ready, and capacities are fragile, especially where these services are needed most. We therefore advocate a two-step scale-up process (figure 4.1):

- **Step 1**, which will distribute a little less than half of the total annual investment (US\$5.5 billion), comprises US\$1.5 billion for micronutrients and deworming (US\$5 per child), US\$2.9 billion for behavior change interventions (US\$7.50 per child), and an additional US\$1.0 billion to build capacities to start the scale-up of targeted food-based programs for delivering these services, prioritizing areas with especially high rates of undernutrition. US\$0.1 billion is added for rigorous monitoring and evaluation of large-scale programs and operations research and technical assistance for strengthening program delivery.
- **Step 2**, in which the remaining US\$6.3 billion will be spent, will provide complementary and therapeutic feeding programs once capacities

Figure 4.1 A Two-Step Process for Scaling Up Direct Nutrition Interventions
(US\$10.3 billion from public resources)



Source: Authors' calculations.

to deliver these interventions in resource-poor settings are built up in the previous phase. The largest single cost item in this phase is for complementary food to prevent and treat moderate malnutrition among children under two years of age (US\$40–80 per child: US\$3.6 billion per year). The most resource-intensive intervention per child treated (US\$200 per episode per child: US\$2.6 billion per year) is treatment of severe acute malnutrition. Prevention is preferable to treatment; however the human and economic costs involved make addressing current levels of severe acute malnutrition imperative to save lives. As with step 1, an additional US\$0.1 billion will be needed for rigorous monitoring and evaluation of large-scale programs and operations research and technical assistance for strengthening program delivery.

This two-stage process is neither meant to be a straightjacket nor suggestive of a linear “one-size-fits-all” approach to scaling-up. Country situations are diverse and they need to follow diverse paths. Those with stronger implementation capacities are likely to proceed to the second step faster than those where capacities and political will lag behind. However, in countries where program delivery capacities are constrained, an explicit investment in capacity development must be a prerequisite to the proposed scale-up. This reiterates one of the key recommendations from the High Level Taskforce on Innovative International Financing for Health Systems to “strengthen the capacity of governments to secure better performance and investment from private, faith-based, community, NGO and other non-state actors in the health sector.” It also reiterates the critical role of governance arrangements for maximizing the impact of health spending and ensuring poor, vulnerable, and marginalized groups benefit most from increased resources. Strengthened leadership backed by stronger stewardship and management systems including financial and human resources management is vital in public organizations, and it takes time to build up. All of these issues will need to be addressed as part of the capacity development for scaling up nutrition investments to maximize their development effectiveness.

South Asia accounts for more than half of the annual financing needs (US\$5.90 billion), followed by Sub-Saharan Africa (US\$2.78 billion), with the balance for East Asia and the Pacific (US\$1.07 billion), Middle East and North Africa (US\$0.56 billion), Latin America and the Caribbean (US\$0.15 billion), and Europe and Central Asia (US\$0.13 billion). In addition, US\$50 million is required for technical assistance for iron fortification of staple foods and salt iodization, US\$1.0 billion for

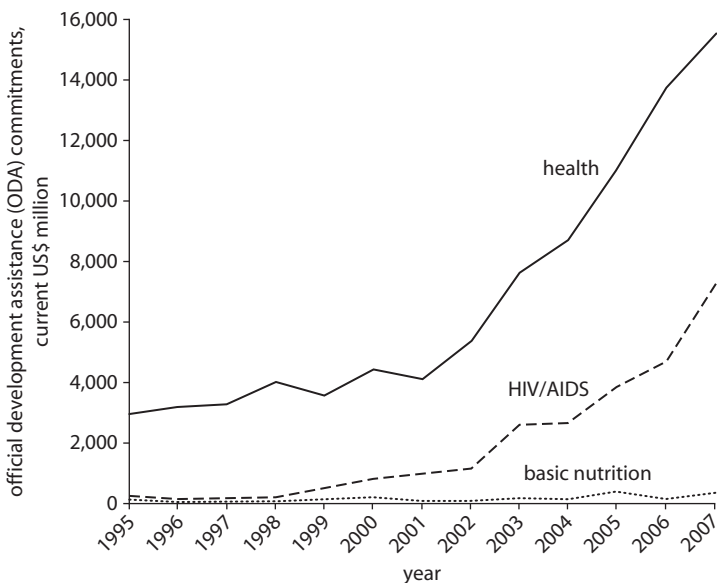
regional and country-level capacity development for program delivery, US\$0.2 billion for monitoring and evaluation and operations research for program delivery across all regions, and technical assistance. Thus, the total estimated financing needs are of the order of US\$11.8 billion, of which approximately US\$1.5 billion can be raised from private resources (see figure 4.1), and the financing gap of US\$10.3 billion would be needed from public resources.

These interventions, if funded at scale (ideally at close to 100 percent coverage) are estimated to prevent approximately 1.1 million deaths and 30 million cases of stunting among children under five years of age, in addition to averting 30 million disability-adjusted life-years lost every year and substantial economic benefits. The costs of not acting are indeed very high.

The data in figure 4.2 suggest that, despite the potential for huge benefits, nutrition is grossly underfunded through ODA. Increasing nutrition financing, however, must be complementary to increasing financing for health systems.

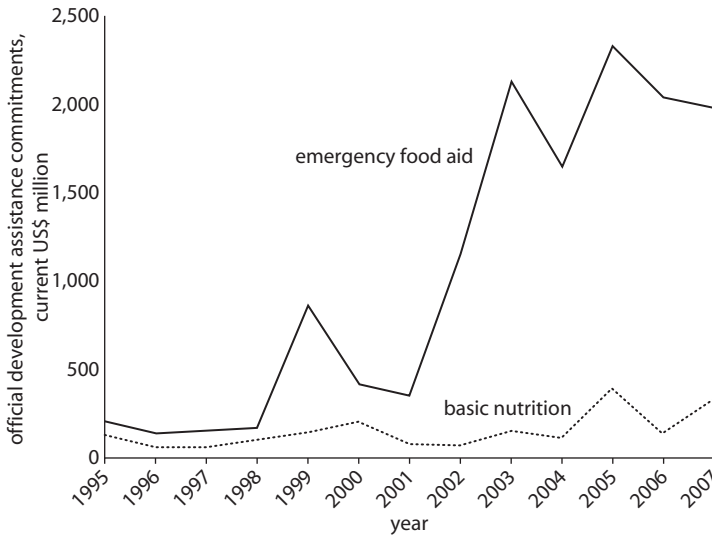
While ODA for emergency food aid has increased dramatically (figure 4.3), nutrition has remained chronically underfunded.

Figure 4.2 Official Development Assistance Commitments for Health, HIV/AIDS, and Nutrition, 1995–2007



Source: OECD DAC at <http://www.oecd.org/dac/stats/idsonline>.

Figure 4.3 Official Development Assistance Commitments for Nutrition and Emergency Food Aid, 1995–2007



Source: OECD DAC at <http://www.oecd.org/dac/stats/idsonline>.

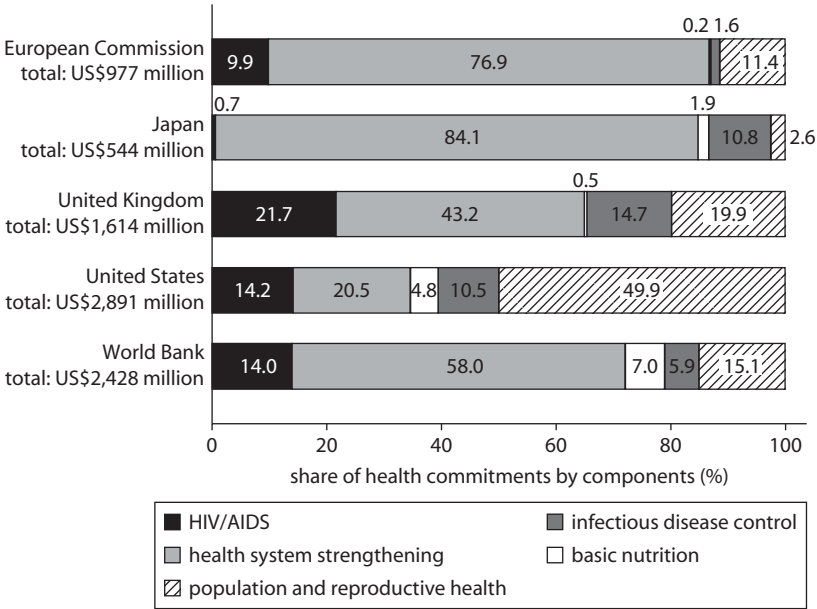
Conclusions and Next Steps: Starting the Scale-Up

Despite overwhelming evidence that nutrition interventions have the potential to impact several Millennium Development Goals in health and education and on preserving human capital in crises-stricken countries for generations to come, official development assistance for nutrition remains minimal (figures 4.2–4.5). We need to kick-start this scale-up immediately with three necessary tasks: financing priority investments based on evidence, financing research into a variety of program delivery and implementation issues, and concurrently building country capacities to continue to strengthen delivery mechanisms.

Financing the Scale-Up of Evidence-Based Interventions

While we recognize that more work will be needed to identify financing sources, we are proposing the generation of an additional US\$10.3 billion from domestic and donor resources for the proposed scale-up. Further, because the full scale-up will take time, we propose a two-step process to allow countries to continue to build capacities as more resources become available. The sequencing also corresponds roughly to the order

Figure 4.4 Share of Total Official Development Assistance for Health Commitments, by Selected Donors, 1998–2000

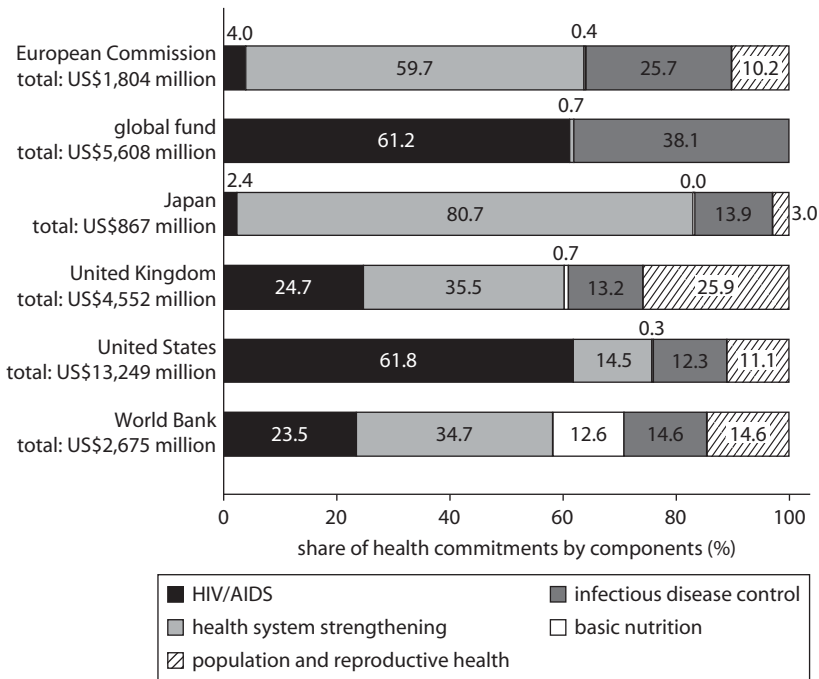


Source: OECD DAC at <http://www.oecd.org/dac/stats/idsonline>.

of cost-effectiveness and the recommended timing of interventions, and is based on existing approximations of country capacities for implementation. The investments in micronutrient supplementation and fortification are the lowest in unit cost (a cost per child per year of about US\$5), have high cost-effectiveness (US\$10 per disability-adjusted life-year for vitamin A supplementation, and US\$73 per disability-adjusted life year for therapeutic zinc supplementation) and high benefit: cost ratios (8:1 for iron fortification of staples; 30:1 for salt iodization, as shown in table 3.2). These micronutrient interventions are also known to work well, even when capacities are constrained. However, these must be implemented in such a manner that they continue to build country capacities and facilitate the next phase of the scale-up.

The investments in community-level behavior change interventions (around US\$7.50 per child) also have high cost-effectiveness (US\$53–US\$153 per disability-adjusted life-year), but these interventions need stronger in-country capacities to be successfully implemented.

Figure 4.5 Share of Total Official Development Assistance for Health Commitments, by Selected Donors, 2005–07



Source: OECD DAC at <http://www.oecd.org/dac/stats/idsonline>.

Complementary feeding for children 6–23 months of age is more expensive, between US\$40 and US\$80 per child per year. Complementary feeding programs have had only a modest effect on deaths. Caulfield et al. (1999) estimate 2–13 percent of child undernutrition deaths can be averted by programs that increase intake of complementary foods among children 6–12 months of age by 71–164 kcal per day. We estimate that this would give costs per disability-adjusted life-year saved of US\$500–US\$1,000. However, complementary feeding has the potential to have a strong impact on gross domestic product, which is not quantified here.

Furthermore, prevalence data from many countries show that undernutrition rates are high even among wealthier households. In such circumstances, some of the costs may be borne by families (especially among the economically better-off populations), thereby reducing the

burden on public resources. Therefore, the total financing needs from governments and donors may be somewhat less than the US\$10.3 billion reflected here.

Finally, the most costly intervention per child is treatment of severe acute malnutrition, at US\$200 per child treated, which has a cost per death averted of US\$1,351, corresponding to around US\$41 per disability-adjusted life-year saved (Bachmann 2009). The reason this intervention is the last priority relates to weak national capacities and delivery systems, as well as the high cost and implementation difficulties of scaling it up. However, when the scale-up becomes tractable with enhanced capacities, this is a high-priority intervention to save lives.

Conditional cash transfers can provide additional demand-side support to nutrition interventions, although we have little experience with the nutritional effects of such transfers outside Latin America. Conditional cash transfers are not an alternative to nutrition interventions; rather they can be complementary. Transfers set up to be social safety nets for the poor, for example, can require the use of critical nutrition services, thereby increasing demand for them.

Directions for Further Operational Research

We know the most about what interventions to scale up, but we know less about how to deliver these interventions at scale, how to build capacities in countries, and how to minimize costs through alternative delivery mechanisms. Continuing to building this evidence base is critical since delivery costs are often much higher than the costs of the interventions. Further, we know a lot more about the costs and impacts of the least expensive interventions while our uncertainty is greatest for the most costly interventions involving food and necessary capacities to deliver these services effectively. We need stronger data on the unit costs and coverage of iron-folic acid supplementation for pregnant women, on the costs of delivery of multiple micronutrient powders for children below two years of age, and on the costs of delivery of deworming medication for the same target population of children. We need both costs and programmatic guidance protocols for some interventions that the *Lancet* study (Bhutta et al. 2008) suggests are effective, including maternal calcium and food supplements, and zinc supplementation for children. We know a lot about the costs and potential benefits from food fortification programs, but have less data from real-life programs that link investments with measured health outcomes. Although we believe we have used reasonable, conservative estimates for these interventions, additional

research from programs would be very useful. Experts suggest allocating two percent of program costs to research and evaluation. This suggests about US\$100 million per year for research and evaluation in step 1 and an additional US\$100 million per year in step 2, with a strong focus on research and evaluation on strategies to deliver known interventions, rather than on basic research.

Furthermore, research into new nutrient-dense complementary foods is ongoing and may offer a breakthrough in improving nutrition in South Asia and Sub-Saharan Africa, since the approach used in Latin America (frequently milk-based) will not be feasible. Continued operational work, particularly in developing appropriate foods for South Asia, is urgently needed. Research on community-based management of acute malnutrition, particularly the development of appropriate therapeutic foods (or home-based food options) for South Asia using locally available foods, is also a priority, both from a political point of view and due to cost considerations.

There are areas we have not covered, where evidence or experience is lacking. For example, food supplements for pregnant women are highly debated, and there are no clear programming guidelines that could guide a scale-up; and yet, there are clearly countries where the prevalence of low birth weight and undernutrition in very young children indicates that maternal supplementation during pregnancy coupled with other nonfood interventions may be important. Other interventions include bed nets to prevent malaria during pregnancy, treatment of pregnant women with antibiotics for sexually transmitted diseases, and treatment of pregnant women with antimicrobials or treatments for parasites. Similarly, we do not cost other potentially critical interventions, such as empowering women to make the right health-related decisions for their children or nutrition interventions for HIV-endemic communities. Nor do we include food security interventions through the agriculture sector, which may be critical in some regions, especially South Asia and Africa. There are also potential entry points for nutrition through the education sector: for example, deworming and iron-folic acid supplementation for adolescents through schools. These issues, the potential delivery synergies with other sectors, and their costs need to be addressed in future work.

Capacity Development

Finally, and perhaps most importantly, the scaling up of nutrition financing must be accompanied (or even preceded by) a scale-up of in-country

capacities and systems to design, deliver, manage, and evaluate large-scale programs. Building these capacities, in consonance with efforts to strengthen health systems and health and nutrition metrics, will ensure that countries are ready to take proven interventions to full scale effectively and efficiently as new resources become available. The time to act is now.

APPENDIX A

Meeting Participants

Peer Review of the Concept Note, September 2008

Alan Berg (Brookings Institute, Wolfensohn Center)

Peter Berman (World Bank)

Laura Birx (USAID)

Jana Krystene Brooks (World Bank)

Ian Darnton-Hill (Renewed Efforts Against Childhood Hunger, or REACH)

Frances Davidson (USAID)

Darren Dorkin (World Bank)

Sundararajan Gopalan (World Bank)

Pablo Gottret (World Bank)

Sara Hommel (Brookings Institute)

Ajay Mahal (Harvard School of Public Health/World Bank consultant)

Nkosinathi Mbuya (World Bank)

Christine McDonald (Harvard School of Public Health/World Bank consultant)

Meera Shekar (World Bank)

Emily Wainwright (U.S. Agency for International Development)

Mary Young (World Bank)

Meeting at the UNICEF Innocenti Research Center Regarding List of Interventions, September 2008

Ian Darnton-Hill (Renewed Efforts Against Childhood Hunger, or REACH)

Juan Pablo Pena Rosas (WHO)

Ellen Piwoz (Bill and Melinda Gates Foundation)

Meera Shekar (World Bank)

Emily Wainwright (USAID)

Peer Review of the Final Draft, May 2009

Alemayehu Ambel (Independent Evaluation Group, World Bank)

Maryanne Anderson (USAID Basics III)

Jere Behrman (University of Pennsylvania)

Alan Berg (Brookings Institute, Wolfensohn Center)

Peter Berman (World Bank),

Keith Bezanson (Global Alliance for Improved Nutrition consultant)

Martin Bloem (World Health Organization)

Francisco Branca (World Health Organization)

Richard Bumgarner (World Bank consultant)

Yoonyoung Cho (World Bank)

Sadia Afroz Chowdhury (World Bank)

Denise Coitinho (World Food Programme)

Patricia Daniels (USAID, Africa Bureau, Office of Sustainable Development)

Stéphane Doyon (Médecins Sans Frontières)

Catherine Feeney (World Food Programme)

Laurent Gadot (Médecins Sans Frontières)

Marcia Griffiths (Manoff Group)

Vaibhav Gupta (World Bank)

Paul Isenman (World Bank consultant)

Kathleen Kurz (Academy for Educational Development)

Asma Lateef (Bread for the World)

Ruth Levine (Center for Global Development)

Chessa Lutter (Pan-American Health Organization/World Health Organization)

Elodie Montetagnaud (World Bank)

Eric Munoz (Bread for the World)

David Pelletier and students (Cornell University)

Juan Pablo Pena-Rosas (World Health Organization)

Zahra Popatia (Global Alliance for Improved Nutrition consultant)
Ellen Piwoz (Bill and Melinda Gates Foundation)
Marie Ruel (International Food Policy Research Institute)
Kavita Sethuraman (FANTA-2, Academy for Educational Development)
A. Elizabeth Sommerfelt (Academy for Educational Development)

Costing Team Members

Jana Krystene Brooks (World Bank)
Sue Horton (Wilfrid Laurier University)
Ajay Mahal (Harvard School of Public Health/World Bank consultant)
Christine McDonald (Harvard School of Public Health/World Bank
consultant)
Meera Shekar (World Bank)

APPENDIX B

Rationale for Selected Nutrition Interventions and Comparisons with the 2008 *Lancet* Undernutrition Series

The interventions costed in this paper represent a modified package of the interventions listed in the 2008 *Lancet* undernutrition series. Some new interventions have been added based on emerging evidence since the series was published, and others deferred for now, either because there are no clear WHO protocols for the interventions or because data on compliance and delivery mechanisms are unclear. In some cases it is not possible to cost these interventions without exceeding the evidence, so no scaling-up costs can be estimated for now. In other cases, there are little or no capacities for scaling up these interventions. As these are added on, additional benefits can be expected.

Table B.1 Interventions Included/Excluded in This Costing Exercise

<i>Interventions included in the current paper</i>	<i>Interventions listed in the Lancet nutrition series as “sufficient evidence for implementation in all countries”</i>	<i>Rationale for deviation from Lancet list (if any)</i>
<i>Behavior change interventions</i>		
Breastfeeding promotion	Breastfeeding promotion	No deviation
Promotion of appropriate and timely complementary feeding (does not include provision of complementary foods)	Behavior change communication for improved complementary feeding	No deviation
Promotion of handwashing	Promotion of handwashing/hygiene interventions	No deviation
<i>Micronutrients and deworming interventions</i>		
Vitamin A supplements	Vitamin A supplementation or fortification	Only vitamin A supplementation
Therapeutic zinc supplements for management of diarrhea	Therapeutic zinc in management of diarrhea	No deviation
Provision of micronutrient powders (sachets or crushable tablets) to children under two years of age	Not included	Micronutrient powders added as an evidence-based strategy to reduce anemia; international expert meeting occurred after <i>Lancet</i> publication
Deworming	Deworming included only under specific situational contexts	No deviation
Iron-folic acid supplements for pregnant women	Maternal iron-folate supplements; and maternal multiple micronutrient (MMS) supplements	Only iron-folate supplements are costed here for two reasons. First, mothers will receive only one of the two interventions, not both; second, there are no available costs for MMS and delivery platforms for the two are identical.

Iron fortification of staple foods	Iron fortification recommended only in specific situational contexts	Given the high prevalence of iron deficiency anemia and low costs of iron fortification, a wider application is justified.
Salt iodization Iodized oil capsules	Universal salt iodization Maternal iodine supplements	No deviation No deviation
<i>Complementary and therapeutic feeding interventions</i>		
Prevention or treatment for moderately malnourished children 6–23 months of age using complementary foods	Not included	Added here based on recent research and humanitarian imperative.
Treatment of severe acute malnutrition using a community-based approach	Treatment of SAM	Community management of treatment added on the basis of new evidence from MSF.

⌘ The following interventions proposed by Bhutta et al. have not been costed in this paper for the following reasons:

Table B.2 Proposed Interventions and Rationale for Inclusion/Exclusion

<i>Intervention</i>	<i>Rationale for exclusion from these cost estimates for scaling-up</i>
Preventive zinc supplements	No programmatic guidelines available; there are no cost data, nor are there data on compliance and delivery mechanisms, thus no scaling-up costs can be estimated for now.
Maternal supplements of balanced energy and protein ^a	No programmatic guidelines available; no clear indication of targeting, quantity, nature of supplements; hence no cost estimates feasible for now. Will follow in later iterations
Intermittent preventive treatment for malaria ^a	Costs included in malaria programs
Insecticide treated bed nets ^b	Costs included in malaria programs
Neonatal vitamin A supplements ^a	WHO reviewing programmatic guidance; discussions at 2009 Micronutrient Forum suggest that a decision on implementation of this intervention be deferred
Delayed cord-clamping ^b	Costs to be included in maternal health programs linked to safe delivery
Conditional cash transfers ^a	Cost of the supply side of conditional cash transfers is included here; cost of the cash transfers per se is not included since the income effect of the transfer is minimal and since this is often covered from other sources
Maternal calcium supplements	No programmatic guidelines available; no WHO guidelines, no clear delivery mechanisms/platforms, compliance or cost information.
Interventions to reduce tobacco consumption or indoor air pollution	Costs included in tobacco and climate change programs

a. These interventions were recommended for implementation in “specific situational contexts” only. However, details to describe these contexts have not yet been defined.

b. These interventions were recommended for implementation in “specific, situational contexts” only.

APPENDIX C

Estimation of the Target Populations in the 36 Countries with the Highest Burden of Undernutrition

The target groups are

1. Pregnant women
2. Mothers of infants under six months old
3. Mothers of children under two years old
4. Mothers of children under five years old
5. Pregnant women in areas with a severe shortage of iodized salt
6. Children 7–60 months old
7. Children 0–24 months old with weight-for-age z score < -3
8. Children 0–24 months old with weight-for-age z score < -2
9. Children 0–24 months old with weight-for-height z score < -3
10. Children 0–24 months old with weight-for-height z score < -2
11. Children 25–60 months old with weight-for-age z score < -3
12. Children 25–60 months old with weight-for-age z score < -2
13. Children 25–60 months old with weight-for-height z score < -3
14. Children 25–60 months old with weight-for-height z score < -2
15. Entire population

The methods used for estimating the size of each of these populations and the associated data sources are discussed below.

Pregnant Women

We considered two main categories within this population: (a) pregnant women with live births and (b) women who end up with miscarriages or stillbirths.

Since we are interested in interventions that promote infant and child health, we excluded cases of induced abortion even though these can be a significant category in countries such as Ukraine for contraception or such as India for gender selection. For this same reason, we omitted spontaneous abortions since most occur early in pregnancy.

The “size” of the target population can potentially take at least three different meanings:

- a. The total number of *new pregnant* women in any given year (incidence)
- b. The *number* of pregnant women observed *at any given point* during the year (point prevalence)
- c. The total number of *pregnant women months* (whether new or old) observed during a given year (another measure of prevalence)

For simplification, we used the assumption of stable populations and steady states to estimate the target population, although that assumption is not necessarily realistic. If the errors are not particularly large (suggested by some of our calculations), the methodology under the stable population assumption is very simple.

Suppose b births (including stillbirths) take place on average during each month. In a *steady state*, it must be that exactly as many births are taking place (exits) as new pregnancies are occurring (entrants). Thus, during *any given year* there must be $12b$ new pregnancies. This is the incidence measure.

If we assume that each pregnancy (still or live) lasts *exactly* nine months, there must be $9b$ pregnant women observed during each month. Any pregnant woman with a time period of greater than nine months since first becoming pregnant would already have given birth. Now that b women are getting pregnant every month, the total number of women with nine months or less since the date of first becoming pregnant must be 9 times b . This is the point prevalence estimate.

Finally, how many pregnant women (new or pregnant from a previous year) would be observed during a given year? This includes $12b$ new

pregnancies from *this year* plus any pregnancies carried over from the preceding year as on December 31 (say). The latter number must be **9b**. Thus, we observe a total of **21b** pregnant women during any given year. Because the time for which we observe these women varies, it is useful to get a measure of the person-months of pregnancy that we observe. Calculating this is straightforward in steady state. Given that during each month we observe exactly **9b** pregnant women, there are a total of **108b** person months of pregnant women.

Data from the United Nations Population Statistics Division indicates the number of live births separately for rural and urban areas; and the WHO estimates of the number of stillborn children (United Nations 2008; WHO 2006a). We assume that the ratio of stillborn children to live births is the same in both rural and urban areas (we could modify this assumption, but the results do not change by much). Adding stillborn and live births and dividing this total by 12 yields an estimate of **b**, separately for rural and urban populations.

Mothers of Young Children

We can break up our indicators of the target population into an incidence measure, a point prevalence measure, and a person-month measure. We assume that each mother with a child age two years or younger has *exactly* one child in that age category and no more. For simplicity, we did not calculate the case of mothers with more than one child age two years or younger.

Starting from the number of live births (which we assumed to be in steady state), we assessed the number of a given birth cohort that is alive month by month during the first year. We constructed our child “monthly” life table using information on the neonatal mortality rate (NMR) and the infant mortality rate (IMR) (WHO 2006a; World Bank 2008b). The NMR determines the likelihood of surviving beyond the first month. The “monthly” mortality risk is assumed to be constant from the second month to the 12th month, at a rate determined by a residual mortality parameter, itself obtained by comparing information from the IMR and the NMR. In steady state, the total number of children alive in any given month can be directly calculated by adding up the number of children of each age (from newborn to six months old) alive during any given month.

Using directly available UN data on the size of the populations aged 0–24 months, we estimated the number of children in the 0–6 month age group, as well those in the 7–24 month age group. Finally, UN data on the rural-urban breakup of the population under two years old was used to

estimate separately the number of children in each category for rural and urban areas.

The exercise outlined above yields the point prevalence estimate of the number of children age 0–6 months (X) and 7–24 months (Y) alive in any given month during a year. Multiplying either X or $(X + Y)$ by 12 equals the total number of person-months of mothers of children age 0–6 months and 7–24 months in any given year.

It is important to note that the number derived in the preceding paragraph is different from the total (cumulative) number of mothers who had a child that was alive and in the age group 0–6 or 7–24 months at *some* point during the year. For instance, the number of mothers of children age 0–6 months who were alive at some point during the year is the number of children age 0–6 months on the first day of the year (X), plus new births during the year: that is, $X + 12b$. Notice that the incidence measure is simply the number of new children during the year (or $12b$).

For mothers of children age 7–24 months, the corresponding measure is $(X + Y) + 6b$. This is obtained by adding Y (the number of children age 7–24 months at the beginning of the year) to $6b$ (the number of newborn children growing up to be at least seven months old in the year – that is, those born within the first six months) and children born in the last six months of the preceding year and who are alive at the beginning of the year. This gives $X + Y + 6b$.

Finally, the number of new children (our incidence measure) in the 7–24 month age group during the year is $X + 6b$ (the number of children born during the first six months of the year, and who, therefore, attain an age of six months or more by the end of the year, plus the number of children born during the last six months of the preceding year and therefore fall into the 7–24 month age group during the year).

The number of children age less than five years old at any point in time (point prevalence) is published UN data. Call this W . The number of new children added to this group is $12b$ in any given year (the incidence measure). The cumulative or total number of mothers observed in this category during the period of a year is $W + 12b$. Finally, it can be easily checked that the number of person-months of mothers of children age 0–60 months in any given year is $12W$.

Pregnant Women in Areas with a Severe Shortage of Iodized Salt

The World Development Indicators database provides estimates of the proportion of households that do not consume iodized salt by country.

However, this does not highlight shortages in iodized salt use in severely affected areas.

If we make the (not entirely unrealistic) assumption that pregnant women are uniformly distributed over all households, this is also the proportion of women without access to iodized salt. Without further information on “areas with severe shortage of iodized salt” this proportion, when multiplied by the total number of pregnant women, can be taken to our estimate of this target population.

An alternative approach would be to designate a cutoff value of the proportion of households, so as to designate specific countries as having a severe shortage (or not). We do not pursue this option.

Children 7–60 Months of Age

As before, we can break up our indicators of the target population into an incidence measure, a point prevalence measure and a person-month measure. The *point prevalence* measure is simply the number of children in the 7–60 month group alive in any month. This is estimated from UN data (that gives the number of children aged 0–60 months) after subtracting from it our estimates of the children in the 0–6 month age group, separately for rural and urban areas (this was derived in section III). Let us call this number Z .

To estimate the (*cumulative*) number of children aged 7–60 months alive at any stage during the year, we have to add $X + 6b$ to Z . This is the number of children born in the six months preceding the year and alive at the beginning of this year, plus the number born in the first six months of the year. Thus, we have in total $Z + X + 6b$ as our cumulative prevalence measure. The number of children-person-months in the 7–60 month age group during the year is $12Z$.

Note that the number of children newly added to this group, the *incidence* measure is $X + 6b$.

Malnourished Children 0–60 Months of Age

We calculate the number of children in two age groups (0–24 months and 25–60 months) who have any of these markers of undernutrition: (a) weight-for-age z score < -3 , (b) weight-for-age z score < -2 , (c) weight-for-height z score < -3 , and (d) weight-for-height z score < -2 .

In general, these populations are not difficult to calculate. However, Demographic and Health Survey (DHS) data (accessed at

<http://www.measuredhs.com>) can be used to construct numbers for children only in the 0–6 months, 7–12 months, 13–24 months, and 0–60 months age groups (for about 19 countries based on DHS surveys in the past five years; and an additional five countries if we include DHS surveys up to 1999–2000). In its *State of the World's Children* (UNICEF 2009) the United Nations Children's Fund provides numbers for age categories 0–60 months for all of the missing countries for the children with weight-for-age z scores < -2). It also provides weight-for-height nutritional status of children in the 0–60 month age group for weight-for-height z scores < -2 . Although UNICEF does not provide the data sources used for this purpose on its Web site, we assume the numbers for at least the 24 countries (with relatively recent DHS data) are from DHS surveys. This assumption is confirmed for the 24 countries, where the UNICEF estimates for stunting and wasting in the 0–60 month age group match one-for-one with DHS data.

For the age breakdown on child nutritional status as shown above, estimates of children in the age groups 0–6, 7–12, and 13–24 months, which were derived using the procedure of previous sections, were used to weight DHS estimates of nutritional status for children with z scores < -3 , and < -2 , respectively, both for weight-for-height and weight-for-age. With these data, age-weighted nutritional status indexes for the 0–24 month age group were constructed separately for weight-for-height and weight-for-age. This exercise was undertaken for the 24 countries for which we had “acceptable” (relatively recent) DHS data.

DHS data on weight-for-height and weight-for-age for the 24 countries in question for the 0–60 month age group, along with information on the nutritional status of the 0–24 month age group and the respective sizes of population in the 0–24 month age group and the 25–60 month age group, were used to calculate the nutritional status of children in the 25–60 month age group. As an illustration, let W be the nutritional statistic of interest. Let p_{060} be the size of the population in the 0–60 month age group, p_{024} be the size of the population in the 0–24 month age group, and p_{2560} be the size of the population in the 25–60 month age group. Let w_{060} be the nutritional indicator (as the percentage of the population falling below a certain threshold) for the 0–60 month age group, and w_{024} be the indicator for the 0–24 month age group. Then, our procedure (for the 24 countries for which DHS data were readily available) was

$$W_{2560} = \frac{W_{060}p_{060} - W_{024}p_{024}}{p_{2560}}$$

Here W_{2560} is the corresponding nutritional indicator for the 25–60 month age group.

Our next step was to generate estimates for the full set of 36 countries, including those for which recent DHS data were not available. For the 24 countries for which we had DHS data on both moderate and severe malnutrition, we estimated logistic relationships between children rated as severely malnourished by weight-for-height (weight-for-age) criterion in the 0–24 month age group and children rated as moderately malnourished by the weight-for-height (weight-for-age) criterion in the 0–60 month age group, using additional dummy variables for Sub-Saharan Africa and South Asia. We also estimated logistic relationships between children rated as severely malnourished by weight-for-height (weight-for-age) criterion in the 25–60 month age group and children rated as moderately malnourished by the weight-for-height (weight-for-age) criterion in the 0–60 month age group, using additional dummy variables for Sub-Saharan Africa and South Asia. We did so as well for moderately malnourished children in the 0–24 month and 25–60 month age groups. The fit was excellent in all cases, with the coefficient of determination ranging from 0.78 to 0.95.

Because UNICEF provides numbers on moderately malnourished children in the 0–60 month age group for the full set of 36 countries, we used the estimated coefficients from the logistic regression and UNICEF numbers on moderate malnourishment in the 0–60 month age group to “predict” severe and moderate malnourishment in the missing group of 12 countries. This yielded the extent of severe and moderate malnourishment (whether weight-for-age or weight-for-height) in the 0–24 month and 25–60 month age group for all 36 countries.

Entire Population

This information is directly available from the UN Population Statistics Division.

APPENDIX D

Program Costs for Complementary and Therapeutic Feeding Interventions

The approach to treatment of severe acute malnutrition has changed in the past five years, and there is ongoing research regarding moderate malnutrition. Since no authoritative survey of the costing literature was available, the following is a short survey undertaken for the purpose of this costing exercise, including treatment of severe acute malnutrition and treatment or prevention of moderate malnutrition. Finally we outline the costing strategy utilized for this exercise.

Treatment of Severe Acute Malnutrition

The 2007 World Health Organization guidelines greatly increased the success rates for treatment of severe acute malnutrition. A metaanalysis by Ahmed et al. (2007) compared nine studies and found when treatment followed WHO guidelines the relative risk was 0.52 as opposed to conventional treatment. Only two of the nine studies found no improvement.

For children with severe acute malnutrition who have additional medical complications, treatment in hospital facilities is required, typically for up to two weeks. Death rates can be relatively high since these children

have reached the most severe levels of the condition. Increased risk of infection due to overcrowded hospital conditions puts these children at further risk. Bachmann (2009) cites mortality rates of 37 percent for hospitals in Lusaka, Zambia, although the rates are likely to vary according to context.

The key innovation in treatment has been the development of community-based management of acute malnutrition. This has been made possible by the development of ready-to-use therapeutic foods. The best-known variant is Plumpy'Nut, developed by Nutriset (France), which has been widely used throughout Africa. This is a nutrient-dense, micronutrient-fortified food that can be stored in sachets for up to two years (depending on packaging) and, unlike milk-based F100 (which was the previous "gold standard"), is resistant to contamination and therefore can be used in the home. BP-100 compressed biscuits are an alternative, but the technology makes compressed biscuits more difficult than the ready-to-use therapeutic foods to produce and package in developing countries.

Families prefer to treat children at home under supervision from the health care system (typically from primary health care), since alternatives (daycare feeding centers and residential centers) impose considerable costs on the family because they require a caregiver to accompany the recovering child to the center. Because dropout rates from community-based treatment programs are lower, higher coverage rates can be achieved. The number of children who can be treated increases since the capacity constraints in the community are much less binding than in the treatment centers. Ahmed et al. (2007) point out that the majority of existing studies have been for Africa, often in an emergency or chronic food deficit situation; the application in South Asian contexts require further research.

Bachmann (2009) estimates that the cost-effectiveness of community-based management of acute malnutrition in Zambia is US\$1,351 per life saved (US\$41 per disability-adjusted life-year), as compared with the alternative of no treatment.

Calculating the costs of community-based management of acute malnutrition poses several difficulties. First, successful cases have received external assistance (Ashworth (2006) provides a very useful review). Thus, experience to date includes costs of supervision from headquarters which might not be necessary in future operations. Second, the costs of cases with external assistance are skewed because the imported foods are often much more expensive than what locally produced equivalents would be. Ashworth (2006) finds, for example, that imported ready-to-use

therapeutic food for a project in Malawi cost US\$55 per child treated, as compared with US\$22 for food produced domestically (Nutraset has licensed production in about four African countries). Finally, costs vary between the initiation phase of a new program (where training is required) and that of a more mature program. Some estimates include the cost for the initial two-week stabilization phase in hospital for children with complicated cases, and some may not.

A more serious problem is that ideally to develop cost estimates we need both prevalence and incidence data for severe acute malnutrition, whereas published data (for example in UNICEF's *State of the World's Children*) are for prevalence only. Conceptually, the total costs should include costs for treating all children with severe acute malnutrition at the outset of the intervention (costs are for approximately two months of treatment), plus costs for retreating recurrent cases and new cases. The relationship between prevalence and incidence is likely to vary according to whether the situation is a newly developing emergency, a chronic condition, or an emergency that is stabilizing. The relationship is also likely to change if there are complementary and effective programs for treating moderately malnourished children (or for complementary feeding for young children).

The rule of thumb currently used in the field in Africa is to double the prevalence numbers when ordering supplies on an annual basis (Tanya Khara, UNICEF; Stéphane Doyon, Médecins Sans Frontières, personal communications). A study of two African countries (Garenne et al., forthcoming) found that prevalence data had to be increased by 60 percent to estimate incidence, noting variations depending upon whether weight-for-height or mid-upper arm circumference was used and which anthropometric standard was chosen (Hamill et al. 1997; WHO 2006b; Kuczmarski et al. 2000).

The UNICEF (2009) data on the prevalence of undernutrition does not include cases with edema, which will increase resource needs. We also need to consider likely coverage. No existing program has exceeded 80 percent coverage, and many fall substantially below this level.

Further research is needed, particularly in adapting the community-based model to South Asia. Ensuring large-scale availability of an acceptable ready-to-use therapeutic food requires further work. In Bangladesh, preparations utilizing pulses, such as *khichri* and *halwa*, have been used in trials. These cost less than half of what it would cost to use F100 (Ahmed, International Centre for Diarrhoeal Disease Research, Bangladesh, personal communication). However, these preparations are not ready to use. In existing programs, households are taught to prepare

foods with their own resources rather than receiving donated food. A similar approach is used in India. See Ashworth (2006) for a survey of the efficacy and effectiveness of different approaches.

In one district in Sri Lanka in 2007, a large pilot was initially targeted at populations affected by conflict. The pilot used BP-100 (compressed biscuits) to feed the severe acute malnourished in the community, supervised by the routine primary health care system and implemented by community outreach workers and volunteers (Emergency Nutrition Network 2008). Sri Lanka used weight-for-height as the nutrition indicator, rather than mid-upper arm circumference as in Africa, which may result in differences in the proportion of the target population treated.

In India, although work is being done on ready-to-use food for prevention and treatment of moderate malnutrition, it is not intended to be used for treatment of severe acute malnutrition.

Treatment and Prevention of Moderate Malnutrition

There is more consensus on the treatment of severe acute malnutrition than moderate malnutrition. To quote the report from a recent WHO/UNICEF/WFP/UNHCR consultation (Shoham and Duffield 2008):

“In contrast to severe malnutrition, programmes for the management of MM [moderate malnutrition] in children have remained virtually unchanged for the past 30 years—although it seems likely that this form of malnutrition is associated with a larger proportion of nutrition-related deaths than severe malnutrition.”

Moderate malnutrition is particularly high for children age 6–23 months, when growth is very rapid. This is the key window for intervention: after stunted children are two or three years old, there is minimal opportunity for catch-up growth, and the functional losses are very difficult to reverse. Therefore, much of the current research focuses on specialized complementary foods designed to be added to the diet in relatively small quantities to improve its nutrient composition. Options for complementary foods range from micronutrients only to supplements with significant amounts of energy (de Pee and Bloem (2008) provide helpful categorization and nutrient content information).

Prevention and treatment of moderate malnutrition typically requires counseling to change behavior, with or without the provision of additional food, micronutrients, or both. The consensus has been that well-designed education and behavior modification programs, costing around US\$10 per participant, can be successful (Mason et al. 1999). Recent

studies of effective educational programs in Africa include Alderman et al. (2009), Alderman (2007), and Galasso and Umapathi (2007). Programs involving food are more expensive, however. In environments where food supply is a serious constraint, programs involving only counseling and behavior change will be less effective. In the context of emergencies in Africa and Sub-Saharan countries with chronic food deficits, it seems likely that provision of food is necessary and needs to be included in program costs. Likewise in South Asia either food or resources may need to be provided to the poorest households.

Dewey and Adu-Afarwuah (2008) conclude from a lengthy review of the literature on complementary feeding that providing complementary food has positive effects on growth in some countries (Ghana and Malawi), but not others (Brazil, Indonesia, and South Africa, all of which are higher-income countries than Ghana and Malawi). They reviewed two studies (Bangladesh and India) where the intervention included an education group, an education plus food group, and a control. In both studies, growth outcomes were best for the group receiving food plus education and intermediate for the group receiving only education.

There are studies comparing the provision of fortified lipid-based spreads and the provision of micronutrients; micronutrients alone are less costly than fortified spreads (Dewey et al. (forthcoming) provide a comprehensive review). Micronutrients have significant effects on micronutrient status, morbidity and mortality, but no significant effect on growth (in the absence of other supplements). In two studies in Africa (Adu-Afarwuah et al. 2007; Kuusipalo et al. 2006) micronutrients alone had no significant effect on growth, whereas micronutrients plus a small amount of fortified spread had a significant effect on growth. By comparison, in Mexico, where energy intake is less of a constraint, there was no difference in the effect on growth by adding food (a milk-based food), and micronutrients alone had a similar effect on micronutrient status (Neufeld, Micronutrient Initiative, personal communication).

Given these advances in scientific knowledge, there is ongoing research to identify appropriate complementary foods that are locally acceptable and cost-effective. Advances in nutritional research have shown that the traditional aid-provided foods (variants of corn-soy blend) are not optimally designed. Various agencies are reviewing their composition, typically for older children and adults (see recommendations in Shoham and Duffield 2008; de Pee and Bloem 2008). Lipid-based complementary foods (often containing either milk or soy) show much promise.

Médecins Sans Frontières (MSF) has, for example, used therapeutic foods in Niger (Plumpy'Nut, originally developed for treatment of severe acute malnutrition) for moderately malnourished children 6–60 months of age as a preventive intervention. That application obtained high cure rates and wiped out seasonal emergence of severe malnutrition (Defourny et al. 2007; Isanaka et al. 2009). In the study by Isanaka et al., half of the dose appropriate for a child with severe acute malnutrition was used as a preventive measure to supplement the participating child's normal diet.

Since ready-to-use therapeutic food was not intended for preventive use, Nutriset has subsequently developed an alternative supplement intended for prevention, namely Plumpy'doz. Plumpy'doz is intended to be an adjunct to the diet; the daily ration provides about a quarter of the amount of energy of Plumpy'Nut, but with the full daily requirement of micronutrients. Field trials suggest that this intervention can be effective (UNICEF is currently using this product in Somalia), but efficacy and cost-effectiveness studies need to be completed. MSF's estimates, based on field experience, are that the annualized cost per child is US\$50–70 including distribution. For programs focused in the "hungry season" in Sub-Saharan Africa, which provide 250 kcal per child per day, the food cost was about US\$0.17 per day (Laurent Gadot, MSF, personal communication).

Other lipid-based nutrient supplements are being investigated (for example, a large trial by University of California–Davis, led by Kay Dewey, in Burkina Faso, Ghana, and Malawi), which have the possibility of providing the appropriate energy density of the overall diet for young children, as well as improving micronutrient content. The issue is how to balance using locally available foods (to make programs as sustainable as possible) with adding in enough micronutrients and energy-rich foods (milk powder, peanuts, soy, or legumes, for example) to achieve an appropriately energy and micronutrient-rich diet for children age 6–23 months of age. The daily cost of the lipid-based nutrient supplement, such as Nutributter (15–20g, supplying around 100 kcal per day), was US\$0.07, excluding transport and distribution (Dewey et al. forthcoming), and given declines in the U.S. dollar is now closer to US\$0.10 per day (Dewey, personal communication).

In China, sachets have been developed to sprinkle onto the child's porridge, which contain both micronutrients and foods designed to increase the energy density of the diet. One variant of "Ying Yang Bao" contains 10g soy powder and provides 40 kcal of energy; another variant contains 200 Kcal, and in addition to micronutrients and soy powder also

contains yellow bean powder. The former variant was tested in randomized controlled trials in Gansu province for children less than two years of age, and the latter was used (not in such trials) to benefit earthquake-affected children in Sichuan province. The Gansu project showed significant improvements in anemia, length-for-age, weight-for-age, and development/IQ scores, compared with children receiving energy but no micronutrients and those children receiving no intervention at all (Chen, International Life Sciences Institute, personal communication). The sachets currently cost about US\$0.14, and it is hoped that the cost can be reduced to about US\$0.10 (Chen, International Life Sciences Institute, personal communication).

In India, the World Food Programme is helping develop a nutrient-dense complementary food that contains chickpeas, milk powder, soybean oil, soy flour, rice flour, sugar, vitamins, and minerals, known as India ready-to-use-food. It would be provided at 50g per day (260 kcal) and fortified with micronutrients similar to Plumpy'doz. It has not yet completed field trials. The cost is expected to be around US\$0.13 per day per child.

Another alternative is the provision of micronutrients in the form of sachets or crushable tablets to improve the diet of young children. This is a lower-cost option than providing both food and micronutrients. Options include Sprinkles or MixMe (sachets) and Foodlets and Nutritabs (crushable tablets). Yearly doses of 60 sachets of Sprinkles are recommended for children under two years of age (typically consumed over a two-to four-month period), and field trials show that this treatment can improve children's micronutrient status, particularly iron and zinc, as evidenced by reduced diarrhea (Zlotkin et al. 2005). Few program data include distribution costs: recent cost estimates of the powders alone are US\$0.03 per package, or US\$1.80 per year, but typically the full program costs would be at least double the cost of the sachets.

Costing Strategy

To calculate costs of treatment for severe acute malnutrition we take the median unit cost figure from seven African programs (US\$201 per case) and assume this covers locally produced ready-to-use therapeutic food and the cost of hospitalization for the small proportion of cases that require it (table D.1). The cost per country per year is therefore US\$201 times the prevalence of severe malnutrition times two. This formula assumes that prevalence is twice incidence (this may be generous and hence also allows for cases of kwashiorkor). We assume that this is the last

Table D.1 Cost per Case of Severe Acute Malnutrition Treated

<i>Context</i>	<i>Cost/beneficiary</i>	<i>Source</i>	<i>Comments</i>
Zambia	US\$201.47	Bachmann (2009)	<ul style="list-style-type: none"> • Delivered in primary health centers • Used cost of locally produced ready-to-use food • Cost split: food, US\$72; support from international nongovernmental organization, US\$69; hospitalization cost if required averaged over all cases, US\$34
Niger	US\$100–115	Gaboulaud (2004), cited in Ashworth (2006)	Upper end of range includes children treated in facility for two weeks
Bangladesh	(a) US\$156 (b) US\$59 (c) US\$29	Khanum et al. (1994, 1997, 1998), cited in Ashworth (2006)	(a) In-patient delivery (b) Daycare delivery (c) Community (i.e. home-based) delivery No food was provided
Bangladesh	(a) US\$76 (b) US\$21 (c) US\$22	Ahmed et al. (2002), cited in Ashworth (2006)	(a) In-patient delivery (b) Home care with home visits (c) Home care with clinic visits No food was given, but multimicronutrients were given
South Sudan (Anweil West)	US\$281	Emergency Nutrition Network (2004)	Likely does not include a hospitalization component; explains that costs are unusually high as new operation, and supplies flown in from Kenya (1 euro = US\$1.10)

Malawi (Dowa)	US\$283	Emergency Nutrition Network (2004)	Likely does not include a hospitalization component; explains costs high as the administering international nongovernmental organization was new to country (1 euro = US\$1.10)
Ethiopia	US\$331	Emergency Nutrition Network (2004)	Likely excludes hospitalization component: well established program (1 euro = US\$1.10)
Niger	US\$110	Gadot, Médecins Sans Frontières, personal communication	Includes hospitalization for 15 percent of children; also allows 12 percent for coordination, support, and investment (1 euro = US\$1.36)
Malawi (Nsanje)	US\$228 (< US\$200 if locally produced food were used)	Concern (2007)	Food not locally produced (food cost was US\$92 per child); includes stabilization center plus community-based management of acute malnutrition

Source: Survey by authors.

intervention to be implemented and that the rate of severe acute malnutrition falls to 50 percent of current levels as a result of the other interventions. There are still some questions about the feasibility of this strategy in South Asia: no locally available ready-to-use therapeutic food has yet been used at scale (treatment of severe acute malnutrition in the community uses home-prepared foods) and further operational research is required.

We assume that community-based management of acute malnutrition is implemented only in regions of countries where global acute malnutrition rates exceed 5 percent (using World Health Organization, 2000, where global acute malnutrition rates of 10 percent, or 5 percent with “aggravating factors” are considered an impetus for action). In other environments, the prevalence is likely too low to maintain effective supervision. This implies that Egypt, Guatemala, Peru, South Africa, and Turkey would only implement community-based management of acute malnutrition in selected regions, if at all. In those environments, we assume that treatment is facility based. We assume that although the cost per child is higher in facilities, this is offset by lower coverage rates, and hence lower impacts.

Costing out a strategy for preventing and treating moderate malnutrition is even more difficult. Efficacy and effectiveness trials are very promising, but there have been no pilot programs costed out with the recent developments in enhanced complementary foods (for example., lipid-based nutrient supplements). Unfortunately, prevention and treatment of moderate malnutrition is likely to be one of the bigger-ticket items in scaling up nutrition, so the overall cost is sensitive to the assumptions made. Further work on moderate malnutrition is urgently required to guide programming. Issues include

- How far can interventions targeted to children with moderate malnutrition reduce the probability that they progress to severe acute malnutrition (this can both help to save lives and also be cost-effective)?
- What are the estimated outcomes of enhanced complementary feeding, in terms of child growth, in programs as compared with more limited efficacy and effectiveness trials?
- What is the most appropriate enhanced complementary food for different regions, and what is its cost and cost-effectiveness? In which environments is provision of micronutrients and behavior change sufficient, and in which environments is a food-based approach required?

- What is the appropriate daily amount of energy required in complementary food to affect weight-for-age and height-for-age status, and how does this differ in different resource settings?
- What is the required duration of intervention (how many months?)
- Within countries, how can we determine how many households require government assistance (subsidy, coupon, targeted donation) to obtain the fortified complementary food, and which households have the resources to purchase this nutritionally superior product if it is widely available?

We do not have complete answers to these questions. Nevertheless, we believe that an emerging consensus suggests some priorities for costing purposes, to mobilize appropriate resources for this intervention. Ongoing research will provide answers to questions regarding program design as resources become available. Those priorities follow:

- For now, we assume that 13 countries from the 36, where global acute malnutrition exceeds 10 percent, are priorities for the higher level of daily complementary food intervention (40–50 g per day, amounting to approximately 250 kcal: data on global acute malnutrition for children under five from UNICEF, 2009). These include Bangladesh, Burkina Faso, the Democratic Republic of Congo, Ethiopia, India, Malawi, Mali, Nepal, Niger, Pakistan, Somalia, Sudan, and the Republic of Yemen. Within these countries, further subnational targeting would be necessary to identify the most vulnerable regions. WHO and UNICEF guidelines indicate that rates of global acute malnutrition in excess of 10 percent put nutrition-related emergencies into the “serious” category, the criterion for implementation of selective feeding programs (WHO, 2000). In the other countries, the lower level of energy would be appropriate.
- We assume that micronutrient-fortified and/or-enhanced complementary foods will be available in all countries commercially, such that all households can benefit. However, we assume that selected households receive the enhanced complementary foods at much reduced cost (or no cost) through a system of coupons or the like. Another possibility would be blanket distribution in selected regions. At this point our focus is the costing rather than the distribution and delivery mechanism (which is an area for further research).

Table D.2 Cost per Child 6–18 Months of Age Receiving Preventive Feeding for Moderate Malnutrition

<i>Context</i>	<i>Cost and energy provided</i>	<i>Source</i>	<i>Comments</i>
Ying Yang Bao, variant 1	US\$0.13 per child per day (40 kcal)	Chen Chunming, International Life Sciences Institute, China, personal communication	Excludes distribution cost
Ying Yang Bao, variant 2	n/a (200 kcal)	Chen Chunming, International Life Sciences Institute, China, personal communication	Excludes distribution cost
Lipid-based nutrient spread (e.g., Nutributter)	US\$0.10 per day (100–125 kcal)	Dewey, University of California–Davis, personal communication	Excludes distribution cost
Plumpy'doz	US\$0.17 per day for food alone; US\$52 for seven months, including distribution (240 kcal)	Gadot, Médecins Sans Frontières, personal communication	Based on costs from Niger, refined with program experience; includes both supplement and distribution costs
India ready-to-use food	US\$0.13 per child per day (250 kcal)	De Pee (World Food Programme), personal communication	Excludes distribution cost

- We assume within each country that the proportion of households receiving coupons or free complementary food is twice the proportion of children under five years of age who are moderately malnourished. For the 20 African countries included, this ranges from 24 percent of households (South Africa) to 88 percent (Niger), with the average across the region being 50 percent; 50 percent of children in the five countries in East Asia receive the free complementary food, as do 80 percent of children in the five countries in South Asia (but only 10 percent in the six countries in the other three regions). Targeting might be by region (blanket distribution in some regions), or by means testing, or by other strategies as appropriate.
- We use the costing of enhanced complementary food from African projects, except for South Asia, where we use costing based on India's ready-to-use food (World Food Programme, 2008). Although India ready-to-use food has a higher level of antinutrients than lipid-based nutrient spreads, and hence a smaller nutritional benefit, it is based on locally produced and locally acceptable foods and is expected to be feasible to use at scale. Costs of food are projected to be US\$0.11 per child per day where global acute malnutrition is less than 10 percent, US\$0.22 per child per day where global acute malnutrition exceeds 10 percent, except in South Asia, and US\$0.13 per child per day in South Asia (table D.2).
- We assume that children between 6 months and 23 months of age receive the supplement daily.

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Action against malnutrition is needed more than ever. An additional US\$10.3 billion a year is required from national and international public resources to successfully attack undernutrition worldwide. This would benefit more than 360 million children in the 36 countries with the highest burden of undernutrition—home to 90 percent of the stunted children globally. Since early childhood offers a special window of opportunity to improve nutrition, the bulk of the investment needs to be targeted between pre-pregnancy until two years of age.

Scaling Up Nutrition: What Will It Cost? notes that investment will yield high returns through thriving children, healthier families, and more productive workers. This investment is essential to make progress on the nutrition and child mortality Millennium Development Goals and to protect critical human capital in developing economies. The human and financial costs of further neglect will be high.

This call for greater investment in nutrition comes at a time when global efforts to strengthen health systems provide a unique opportunity to scale up integrated packages of health and nutrition interventions with common delivery platforms, thereby reducing costs.

Scaling Up Nutrition: What Will It Cost? has benefited from the expertise of many international agencies, nongovernmental organizations, and research institutions. This book will be of interest to policy makers, public health officials, nutritionists, government officials, and all those interested in improving child nutrition and health outcomes.



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