

# Scaling up zinc treatment of childhood diarrhoea in Bangladesh: theoretical and practical considerations guiding the SUZY Project

Charles P Larson,<sup>1,2\*</sup> Tracey Perez Koehlmoos,<sup>1</sup> David A Sack<sup>1,3</sup> and the Scaling Up of Zinc for Young Children (SUZY) Project Team<sup>4</sup>

<sup>1</sup>International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDR,B), Dhaka, Bangladesh, <sup>2</sup>Centre for International Child Health, British Columbia Children's Hospital and Department of Pediatrics, University of British Columbia, Vancouver, Canada, <sup>3</sup>Johns Hopkins Bloomberg School of Public Health, Baltimore, MD, USA and <sup>4</sup>SUZY Project team: Nazneen Achar, Lauren S Blum, Jo Grezelinska, Rafiqul Islam, Azhar Islam Khan, Sumona Liza, Hazera Nazrul, Nazretun Nayeem Monalisa, Samina Sultana, Abdul Wazed (ICDDR,B); Md. Altaf Hossain (Control of Diarrhoeal Diseases Programme, Bangladesh Ministry of Health and Family Welfare, Dhaka); Rafique Islam (ACME Laboratories Ltd, Dhaka); and Shomi Kaiser (Dhansiri Media Production House Ltd, Dhaka).

\*Corresponding author. Centre for International Child Health, Rm K4-104, BC Children's Hospital, 4480 Oak Street, Vancouver, British Columbia, Canada, V6H 3V4. Tel: +1-604-875 2345 (5642). E-mail: clarson@cw.bc.ca

**Accepted** 20 December 2010

In 2003, the International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDR,B), in partnership with the Bangladesh Ministry of Health and Family Welfare (MOHFW) and the private sector embarked on a national exercise to scale up zinc treatment of childhood diarrhoea as an adjunct to oral rehydration solution (ORS). Private sector participation included national associations representing licensed and unlicensed health care providers, a local pharmaceutical laboratory, a marketing agency and a technology transfer from the European patent holder of the dispersible zinc tablet formulation promoted in the scale-up campaign. This project was a response to several years of research in the preceding decade demonstrating that zinc supplementation during a diarrhoeal illness episode significantly reduces illness severity and duration as well as prevents subsequent morbidity and mortality. It has been estimated that zinc treatment has the potential to annually save nearly 400 000 under-5 lives, thus significantly impacting on Millennium Development Goal #4. This paper summarizes the primary coverage outcomes of the Scaling Up of Zinc in Early Childhood (SUZY) Project into its third year (December 2006 to October 2009). These results are assessed in relation to the Project's theoretical foundations and the performance framework that was jointly planned and implemented through a public-private partnership. The scale-up campaign encountered numerous constraints, but also benefited from several facilitating factors which are summarized under an assessment framework developed to identify barriers and better promote the scaling up of key health interventions in low- and middle-income countries. The lessons learned are described with the intent that this will contribute to the more effective scale-up of life-saving interventions that will reach those in greatest need.

**Keywords** Zinc treatment, scaling up, diarrhoea, Bangladesh, monitoring, mass media, promotion

## KEY MESSAGES

- Globally, the successful scaling up of zinc treatment for childhood diarrhoea could potentially save 400 000 under-5 deaths per year.
- The eventual adoption of a new health behaviour by a population, such as treating childhood diarrhoea with zinc, is expected to pass through predictable stages, which zinc promotion campaigns will need to align their messages with.
- Critical to the success of a scale-up campaign is the preparation of a project performance framework that clearly identifies the major project components and the activities to be performed under each.
- Scale-up campaigns ideally should be repeatedly monitored for intended and unintended consequences, including rates of zinc coverage, disparities in coverage, continued use of ORS and the continued treatment of other co-morbidities.

## Introduction

Important reductions in under-5 mortality have occurred over the past 40 years, yet nearly 8 million children under the age of 5 years die annually from preventable causes (Rajaratnam *et al.* 2010). This death burden is grossly over-represented among the poor living in less developed countries, with 90% occurring in the world's 42 least developed economies (Black *et al.* 2003). Nearly two-thirds of these 8 million annual deaths could be averted by bringing to scale known treatment or preventive interventions proven to be effective, appropriate and cost-effective (Jones *et al.* 2003; Rajaratnam *et al.* 2010). Among these interventions is zinc treatment of childhood diarrhoea. About 1.4 million children under the age of 5 years die annually from diarrhoea, accounting for 19% of all under-5 mortality (Boschi-Pinto *et al.* 2008). Globally, the successful scaling up of zinc treatment for childhood diarrhoea could potentially save 400 000 of these under-5 deaths per year (Jones *et al.* 2003). Meta-analyses of randomized trials estimate that the overall impact of zinc treatment in children less than 5 years of age would include a 15% reduction in duration of illness, a 16% decreased likelihood of progressing to a severe episode and a 25% reduction in persistent childhood diarrhoea. Additionally, children who have received zinc treatment will experience about 15% fewer repeat episodes of diarrhoea during the next 3 months (Bhutta *et al.* 1999; Aggarwal *et al.* 2007). Given the weight of the evidence in support of the efficacy of zinc treatment, the World Health Organization (WHO) and United Nations' Children Fund (UNICEF) revised their joint guidelines for the clinical management of childhood diarrhoea to include zinc: 20 mg per day, for 10–14 days in children over 6 months and 10 mg per day if under 6 months of age (WHO 2004).

Within least developed countries, the scale up of health interventions encompasses a wide range of activities undertaken to rapidly implement interventions that will reach those in greatest need, in particular poor and marginalized populations. Scale-up programmes need to unfold in several domains (Uvin and Miller 1996). These include addressing important gaps in knowledge, influencing public policy, the integration of programmes into public and private health systems, mobilizing widespread supportive participation, and actions undertaken to ensure the sustainability of a scale-up programme, such as financing, clinical practice guidelines and training. With each of these domains in mind, the International Centre for Diarrhoeal Disease Research, Bangladesh (ICDDR,B) developed a project performance framework in partnership with key stakeholders

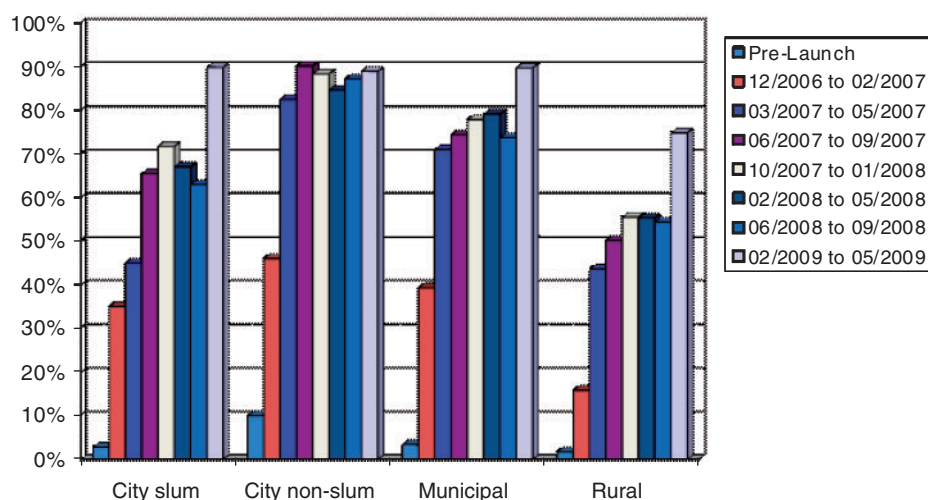
under the title 'Scaling Up Zinc for Young Children (SUZY Project)'. The overriding aims of this project have been to implement zinc treatment promotion and delivery strategies that will set Bangladesh on the path to reaching all children with diarrhoea, regardless of gender, income or where they live.

This paper describes the theoretical assumptions guiding project design, the SUZY Project performance framework, the activities undertaken to prepare for the national launch of the zinc scale-up campaign, the implemented scale-up strategies, the constraints encountered, the results of project monitoring and lessons learned. The information presented should inform other countries embarking on similar initiatives to scale up zinc treatment of childhood diarrhoea.

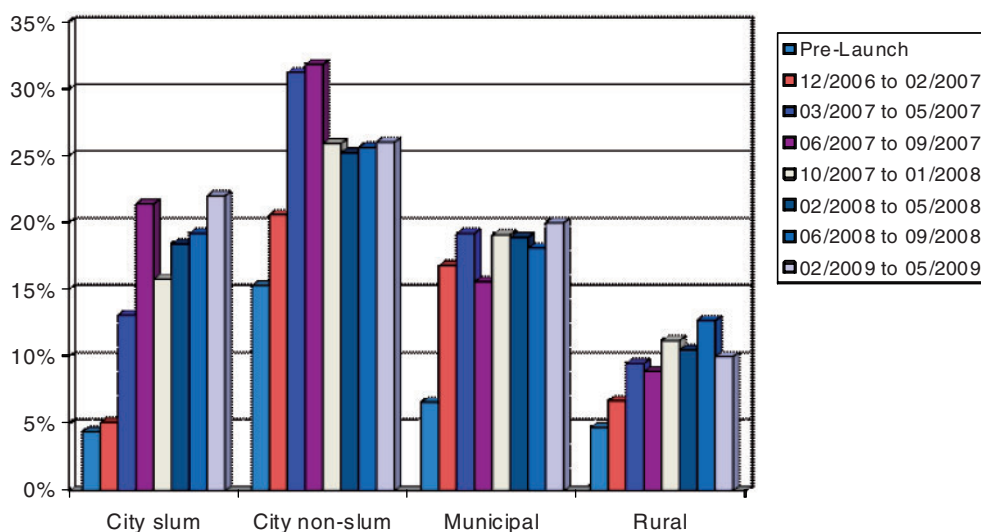
## SUZY Project outcome monitoring

Following the launch of the zinc scale-up campaign in late 2006, repeat impact surveys were carried out in order to monitor for intended and unintended consequences. These were household surveys of families with a child aged between 6–59 months that had reported a diarrhoeal illness of at least 48 hours duration over the past 2 weeks. These surveys were stratified by urban slum ( $n=650$ /survey), urban non-slum ( $n=650$ /survey), municipal/smaller cities ( $n=650$ /survey) and rural districts ( $n=960$ /survey). A detailed description of the survey methods and outcomes covering the first 2 years of the campaign has been published (Larson *et al.* 2009). The results of a survey carried out in the third year of the campaign are added, during which external funding in support of the scale-up campaign came to an end.

Three primary outcomes monitored were: (1) changes over time in caretaker awareness of zinc as a treatment for childhood diarrhoea, (2) the actual use of zinc to treat their child's diarrhoea and (3) the use of oral rehydration solution (ORS). Figure 1 summarizes awareness of zinc treatment. Rapid increases in awareness were observed over the first year. By year 3 of the launch, nearly 90% of urban and over 70% of rural caregivers (almost always interviewed mothers) were aware of zinc treatment. As seen in Figure 2, the actual use of zinc treatment lags far behind awareness. Within the two most vulnerable populations, rural poor and urban slums, coverage rates stagnated by the end of the first year of the campaign. Possible explanations for this are addressed. The coverage rates attained are similar to results reported by zinc scale-up projects in Nepal, Benin and Cambodia (USAID 2010). It was also



**Figure 1** Change in caretaker awareness of zinc treatment for childhood diarrhoea by location of household following the launch of the zinc treatment scale-up campaign



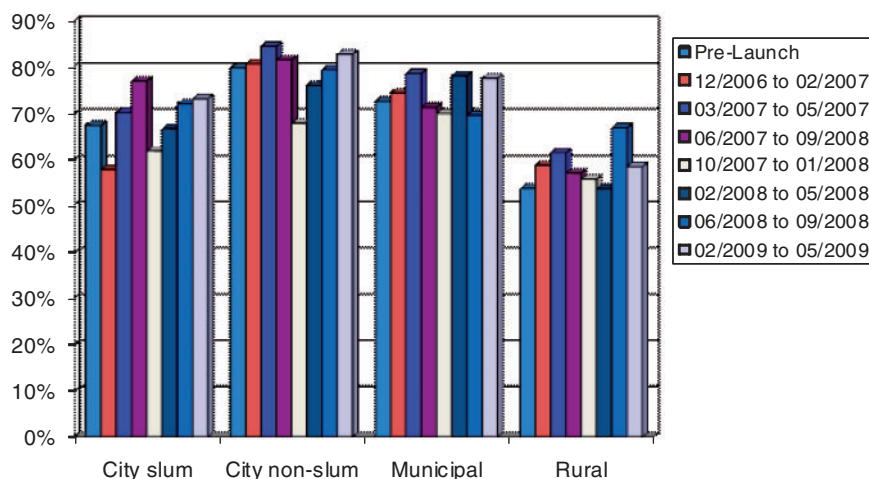
**Figure 2** Change over time in the proportion of children receiving zinc treatment by location of household

observed that large gaps exist in zinc coverage favouring urban, upper-income populations. Over the course of the scale-up campaign, this disparity was reduced by 50%. In Figure 3 the results of monitoring for a potential fall-off of ORS use as zinc was introduced is summarized. By well into the third year of the scale-up campaign there is no indication of a drop in the ORS coverage for childhood diarrhoea among any of the subpopulations surveyed.

### Theoretical modelling of large-scale behaviour change

Several theoretical models exist that attempt to explain the cognitive changes leading to a decision to carry out and maintain a new health behaviour. These have been broadly

dichotomized into continuous and staged models of behaviour change. Continuous models view behaviour change as being linear, following a single predictive model that predicts behaviour based upon several factors, including one's sense of vulnerability, barriers and self efficacy, that serve to move an individual through decision making, leading from intent to practice (Abraham and Sheeran 2000; Connor and Sparks 2000). These models have been criticized on the grounds that they do not fully explain what is required to move from intention to actual behaviour change, referred to as the 'intention behaviour' gap. Staged models characterize behaviour change as passing through stages, each with its unique set of predictors and therefore intervention strategies (Schwarzer 2002). Factors influencing behaviours that move an individual through one stage to the next will vary. Most importantly, to move from intention to actual practice requires that the



**Figure 3** Oral rehydration solution (ORS) utilization by location of household just prior and into the third year of the zinc scale-up campaign

individual believes in his/her capacity to carry out and maintain a specific behaviour, referred to as perceived self efficacy (Bandura 1977). Staged models are consistent with the promotion strategies implemented by the SUZY Project in support of bringing zinc treatment to scale. The scale-up exercise anticipated three broad stages: (1) creating awareness of zinc as a treatment and the intent to include it in the management of childhood diarrhoea, (2) motivating caretakers to implement the intent by giving zinc treatment a try, and (3) adopting zinc as part of standard household diarrhoea management practice.

With respect to the planned mass media campaign, the Project was guided by social marketing frameworks applied to create a demand for zinc treatment and to change specific health behaviours. The targeted behaviours included treating childhood diarrhoea with zinc, giving zinc for 10 days (beyond the period of observed cure) and continued use of ORS. Social marketing includes components of commercial marketing, in that both would share the goal of persuading parents to purchase zinc for childhood diarrhoea. Social marketing goals go beyond the profit motive with a view to improve health outcomes among less advantaged segments of society (Story *et al.* 2002). An important aim of the SUZY Project was to increase awareness of zinc treatment and educate parents about its benefits and correct use in a manner that did not lead to disparities in practice based upon household wealth or location. This meant reaching urban poor and rural households.

The social marketing of a new health behaviour is much less likely to occur without the support of key organizations and decision makers representing either public or private sectors. In Bangladesh this includes the Ministry of Health and Family Welfare (MOHFW), the Bangladesh Paediatric Association and Village Doctors Association, WHO/UNICEF, health professional training institutions, and national health figures or educators. Interviews were carried out which identified priority benefits that would most likely influence institutional support for zinc treatment of diarrhoea. The identified benefits were: reduced under-5 mortality in support of Millennium Development Goal #4, reduced length and severity of a diarrhoea episode, prevention of future diarrhoea and fewer demands on health

services. It was presumed that recognition of these benefits would lead to national policy changes in support of zinc treatment of childhood diarrhoea, its inclusion in revised training guidelines for diarrhoea management, and provider endorsement. This would then create a foundation upon which to launch a mass media, social marketing campaign.

Social marketing frameworks are grounded upon several basic principles. Applying basic social marketing principles to the scaling up of zinc (Story *et al.* 2002), the mass media campaign addressed the following considerations: (1) the caretaker behaviour of adding zinc to the home management of diarrhoea; (2) emphasizing the benefits of zinc for the child; (3) recognizing and dealing with the fact that zinc will be competing with other treatment practices, even if inappropriate, such as antibiotics and anti-diarrhoeals; (4) under the acronym the '4 Ps' (product, price, place and promotion) a mix of variables to attend to when planning a mass media campaign; and (5) connecting with less advantaged, poorly nourished segments of the population. The product, dispersible zinc tablets, needed to be linked to a set of benefits valued by parents. Formative studies among mothers of young children identified a common cluster of valued benefits. These included cure, protection, strengthening and improved appetite. With respect to price, a national survey of diarrhoea management practices prior to the start of the campaign found that existing expenditures among rural and urban poor households was well within the expected retail price for a 10 day supply of zinc (Larson *et al.* 2006). A subsequent willingness-to-pay study also found a large majority of rural poor would be willing to pay for a 10 tablet blister pack at a cost of US\$0.25 (18 taka) (Akhter and Larson 2009).

Bangladesh is a densely populated but diverse population in terms of the socio-economic conditions in which people live and how they are informed or educated about new treatments. Marketing surveys conducted among selected rural or urban poor populations identified television, followed by radio, as the most likely media to reach these households with zinc messages. In more remote villages, courtyard meetings and cultural events reach caregivers, but are much less efficient. The promotion of a new product, as previously mentioned, needs to

be viewed as legitimate and endorsed by those in whom parents place their trust. Once this is in place, the focus can then turn to consumer demand.

Building consumer demand implies that zinc will eventually become a social norm and be linked to being a good parent. These assumptions are based upon 'diffusion of innovation' theory. This theory addresses the widespread adoption of new behaviours and identifies specific factors that will positively influence consumer demand (Rogers 2003). In the case of zinc treatment, this could include the following:

- (1) Creating awareness of a new treatment, zinc (in our case 'Baby Zinc'), that is available for the treatment of diarrhoea in children under 5 years of age;
- (2) Informing parents of the advantages of zinc over ORS alone (the current standard);
- (3) Providing zinc treatment guidelines that are compatible with existing routines (i.e. giving ORS);
- (4) Providing simple, easily followed zinc instructions about preparation and administration;
- (5) Informing parents that zinc is easily purchased and available over the counter;
- (6) Reassuring parents that zinc is safe and that they can try it out for one episode without long-term commitment or implications.

## Project performance framework

Critical to the success of a scale-up campaign is the preparation of a project performance framework (PPF) that clearly identifies the major project components and the activities to be performed under each. The PPF then links these activities to verifiable outputs. Preparations and the eventual implementation of the national launch of the zinc treatment for childhood diarrhoea campaign in Bangladesh were organized under the PPF summarized in Table 1. The major PPF components included: (1) the zinc formulation to be scaled up, (2) implementation research in support of the scale up of zinc treatment, (3) product/intervention promotion, (4) public and private health care delivery systems, and (5) knowledge transfer and the dissemination of project findings.

### Zinc formulation

An early decision that had to be made was whether to promote a syrup or dispersible zinc tablet formulation. At the time over 20 zinc syrup products were available and promoted for a wide range of ailments. No dispersible tablet formulation was available. The latter was selected on the basis of cost (US\$0.25 vs US\$0.40 for a 10-day treatment regimen), ease of distribution, accuracy of dosing and the opportunity to uniquely position the tablets as solely for diarrhoea treatment in Bangladesh. The patent for the dispersible zinc formulation is held by the French nutrition firm, Nutriset. ICDDR,B purchased the patent rights from Nutriset for the production and distribution of the dispersible zinc tablets in Bangladesh. In turn, ICDDR,B contracted with a Bangladeshi private pharmaceutical laboratory for the zinc tablet production, distribution and provider promotion. This decision was driven by the MOHFW's strongly stated preference that the technical

capacities required to sustain these activities be led by a national enterprise. An open bidding process initially identified five interested private pharmaceutical manufacturers, from which the selection of one company was made. Following the signing of an agreement with ICDDR,B to produce and sell the product at cost to the government sector and at a 'socially responsible' price through private sector outlets, a technology transfer was carried out. For introduction into the government sector, 10 tablet blister packs were produced and distributed at a cost of 9 taka each (US\$0.12). The pharmaceutical laboratory, through its distribution network agreed to distribute the zinc blister packs to public sector facilities at the sub-district level. In turn, these public sector facilities prescribe zinc treatment free of charge.

Coinciding with the technology transfer, the 20 mg dispersible zinc tablet formulation was approved by the Bangladesh Drug Administration. This was followed by approval for branding the product as 'Baby Zinc'. Next, an over-the-counter sales waiver was obtained and permission was granted to proceed with the mass media promotion of Baby Zinc, pending Drug Administration approval of content. Each of these approvals was considered essential to a successful scale-up campaign and required over 1 year to complete.

A business plan was prepared with technical assistance from Futures Group International. The key determination to be made was the potential demand for Baby Zinc. Factors influencing demand included the following (estimates in parentheses): the number of under-5 children at risk for diarrhoea (20 million), the incidence of diarrhoea in this age group (four episodes per year), the estimated maximum likelihood that any form of zinc treatment would be purchased (50%), the proportion of providers or caretakers that will choose a zinc dispersible tablet over syrup formulation (50%) and the anticipated reductions in the occurrence of diarrhoea as zinc use increases (15%). This resulted in an estimated potential demand of approximately 19 million blister packs per year. Assuming a 10% increase in coverage per year, this would result in a demand for 1.9, 3.8 and 5.7 million blister packs over years 1 through 3 of the scale-up campaign. In line with WHO revised diarrhoea management guidelines, health providers and caregivers were advised to treat a child 6 months to 5 years of age with one 20 mg of zinc tablet daily for 10 days (WHO 2004).

### Research in support of zinc scale up

#### Zinc safety

From the outset local health professionals expressed their concerns about the safety of zinc, in particular among malnourished children. Randomized trials among malnourished children, including one carried out in Bangladesh, have demonstrated zinc treatment to be effective and not associated with adverse events (Roy *et al.* 1997). Nevertheless, given the degree of concern among key decision makers, over a period of 1 year we monitored for serious adverse events that could be linked to zinc treatment among children admitted to the ICDDR,B-Dhaka hospital, a diarrhoeal disease specialty hospital in which zinc treatment is routinely given to all under-5 children. In nearly 24 000 observations, no serious events were detected that could be attributed to the zinc treatment (Khan *et al.* 2007). A randomized trial to assess the risk for vomiting

**Table 1** SUZY Project performance framework

Component	Performance activities
<b>1. Zinc formulation</b>	
a. Choice of zinc formulation	<ul style="list-style-type: none"> <li>• Syrup vs dispersible tablet formulations: confirmation of acceptability and willingness to pay</li> </ul>
b. Regulatory steps	<ul style="list-style-type: none"> <li>• Registration of formulation with Bangladesh Drug Administration</li> <li>• Product pricing approval</li> <li>• Product branding, logo and packaging approval</li> <li>• Application for over-the-counter waiver</li> <li>• Approval for mass media (TV and radio) promotion</li> </ul>
c. Technology transfer	<ul style="list-style-type: none"> <li>• Open bidding and eventual selection of a local pharmaceutical laboratory</li> <li>• Patent and technology transfer agreements</li> <li>• Conduct of technology transfer and follow up quality control monitoring</li> </ul>
d. Production	<ul style="list-style-type: none"> <li>• Preparation of a business plan</li> <li>• Import of raw products</li> <li>• Production, tablet compression and packaging</li> <li>• Quality control reviews</li> </ul>
e. Distribution	<ul style="list-style-type: none"> <li>• Private sector drug vendors</li> <li>• Public sector health facilities</li> <li>• Private sector retail outlets</li> </ul>
<b>2. Research in support of zinc scale up</b>	
a. Pre-launch	<ul style="list-style-type: none"> <li>• Safety and side effects studies</li> <li>• Provider and caretaker diarrhoea management practices survey</li> <li>• Formative studies of provider behaviours and interaction with drug salesmen</li> <li>• Zinc formulation acceptability and caretaker adherence</li> <li>• Product branding exercise</li> <li>• Frequently asked questions compendium</li> <li>• Diarrhoeal illness expenditures and willingness-to-pay for zinc treatment</li> <li>• Pre-test of zinc provision through NGO community health workers</li> </ul>
b. Post-launch	<ul style="list-style-type: none"> <li>• Monitoring for intended and unintended consequences</li> <li>• Drug vendor barriers to prescribing zinc</li> <li>• NGO village doctor (unregulated private sector) promotion of zinc treatment</li> </ul>
<b>3. Product promotion</b>	
a. Providers	<ul style="list-style-type: none"> <li>• Training of drug representatives (salesmen)</li> <li>• Education/promotion materials</li> <li>• Conduct and monitoring of provider promotion activities</li> </ul>
b. Caregivers (mass media)	<ul style="list-style-type: none"> <li>• Identify key messages</li> <li>• Identify target audience(s)</li> <li>• Contract agreements with TV and radio outlets</li> <li>• Preparation and implementation of marketing tools <ul style="list-style-type: none"> <li>• TV and radio commercials</li> <li>• Billboards and posters</li> <li>• Special events</li> <li>• Courtyard meetings</li> </ul> </li> </ul>
<b>4. Health care delivery systems</b>	
a. Key players and partnerships	<ul style="list-style-type: none"> <li>• Bangladesh Paediatrics Association</li> <li>• WHO/UNICEF</li> <li>• Project advisory committee</li> </ul>
b. Health policy	<ul style="list-style-type: none"> <li>• MOHFW Project oversight committee</li> <li>• MOHFW Project implementation committee</li> <li>• MOHFW Diarrhoeal Diseases Control Programme</li> <li>• District health managers</li> </ul>
c. Manpower	<ul style="list-style-type: none"> <li>• Training in private and public sectors</li> <li>• Medical schools and other training institutions</li> </ul>
d. Financing	<ul style="list-style-type: none"> <li>• Essential drugs list</li> <li>• Public sector subsidies</li> </ul>
<b>5. Knowledge transfer/dissemination</b>	
a. Website	<ul style="list-style-type: none"> <li>• Create a project website with links to other sites addressing zinc or diarrhoea management more generally</li> </ul>
b. Newsletter	<ul style="list-style-type: none"> <li>• Published in Bangla and English semi-annually</li> <li>• Distributed to 20 000 health workers in Bangladesh</li> </ul>
c. International conference	<ul style="list-style-type: none"> <li>• Held annually</li> <li>• International presentations and participation</li> </ul>
d. Publications	<ul style="list-style-type: none"> <li>• Local and international publication of key findings and progress reports</li> </ul>

was embedded in this safety study. An increased absolute risk of about 10% for transient vomiting following an initial zinc dose was found among hospitalized children (Larson *et al.* 2005). This increased risk for vomiting has been incorporated into health provider information kits. These studies required about 18 months to complete and then disseminate.

#### *Provider and caretaker practices*

Prior to planning the scale-up strategies, we needed to know more about current caretaker and provider diarrhoea management practices. Surveys were carried out in four distinct populations; those living in mega-city urban slums, mega-city non-slums, smaller municipal cities and rural households. It was found that regardless of household location or socio-economic status, over 90% of all health care provider visits for childhood diarrhoea were in the private sector. Among the rural poor or urban slum households (those likely to benefit the most from zinc treatment), 80% of provider visits were to unlicensed 'village doctors' or drug vendors (Larson *et al.* 2006). Given this knowledge, the decision was made to focus our efforts initially on private sector providers using drug company sales representatives and on caretakers through mass media advertising targeting lower income households. This study required approximately 6 months.

#### *Formative studies*

These studies had three broad aims: first, to better understand caregiver and provider perceptions of childhood diarrhoea and management decisions; second, to integrate these findings into the project's communication strategies; and third, to then develop specific messages for mass media and interpersonal communications. These messages needed to be culturally appropriate and consistent with local beliefs about the origins and management of diarrhoea. Among providers the messages were designed to influence their likelihood of prescribing zinc and reinforce the need for a full 10 days of treatment. This required an improved understanding of which rationales for treating diarrhoea with zinc would most likely influence decision making by licensed or unlicensed providers to promote (or prescribe) zinc. The most convincing rationale was found to be zinc's preventive effects. Among caretakers, the most important features of a treatment were reported to be its curative powers and ability to strengthen their child so they were less susceptible to future infections. Based upon the qualitative interviews of providers and caregivers, a common set of frequently asked questions was identified. Standardized answers to these questions were then prepared and distributed to providers during zinc orientation or training sessions (available online at <http://centre.icddr.org/activity/index.jsp?activityObjectID=448>). These studies were carried out over a period of 18 months prior to the campaign launch.

#### *Acceptability and caregiver adherence to treatment instructions*

These are important features of an intervention that need to be documented prior to investing in a particular product. To be effective, caregivers must know how to dissolve a dispersible tablet formulation in water (or breast milk) and give it only once per day. In community-based urban and rural household trials, we found 98% of mothers properly adhered to

preparation instructions, which are aided by a cartoon on the back of each zinc blister pack. The dissolved syrup has a vanilla taste which is unusual in South Asia. While young children are unable to report taste, over 90% of mothers reported their child had accepted the syrup as well as or better than other syrup medications they had tried. Only 56% of caregivers adhered to a 10-day course of treatment (Nasrin *et al.* 2005). These observations were completed within 3 months.

#### *Household expenditures*

The retail cost of a 10-tablet blister pack is approximately US\$0.25. Pre-launch surveys of caregivers found that total household expenditures on a diarrhoeal illness did vary by the socio-economic status of the household; however, even the poorest quartile households spent, on average, US\$0.50, per childhood diarrhoea illness. A subsequent willingness-to-pay survey found that among rural poor households, following an explanation of zinc treatment benefits, parents of children under the age of 5 would be willing to pay a mean of US\$0.45 for a 10-day course of zinc treatment. The willingness-to-pay study was completed in approximately 2 months.

#### **Provider and mass media product promotion**

The goals of the zinc promotion activities were, first, to create awareness of zinc as a treatment of childhood diarrhoea and its protective effects against future episodes; second, to include zinc in diarrhoea management practices; and third, to reach providers and caretakers in all regions of Bangladesh and all socio-economic strata. A secondary but equally important goal was to avoid any adverse effect on the use of ORS through its displacement in favour of zinc. Formative studies among providers and caretakers guided the development of specific messages. These messages were shared and received the support of key stakeholders, including the Bangladesh Paediatric Association, MOHFW and the project's Technical Interest Group. Nearly one-third of the project's overall budget (US\$2 million) was set aside to support the promotion of Baby Zinc. All promotion activities maintained a sharp focus on Baby Zinc treatment as an adjunct to ORS in the management of childhood diarrhoea, with both mentioned in all messages.

#### *Provider promotion*

Private pharmaceutical companies in Bangladesh maintain close ties with licensed and unlicensed providers throughout the country and are their primary source of information on drug products and new treatments. The pharmaceutical laboratory prepared information pamphlets and trained its drug representatives (salesmen) in promoting Baby Zinc among licensed and unlicensed providers. The content of these encounters was guided by our observational and formative studies of health provider-drug salesman interaction and the delivery of product information. Approximately 2000 representatives, working in all geographic regions of Bangladesh, received training and then initiated their promotion activities. This activity required approximately 6 months.

#### *Mass media promotion*

Caretaker-targeted promotion adopted a diversified approach to generate demand among urban, semi-urban and rural

populations, in particular the poorest and illiterate. The campaign was rolled out in phases over several months to ensure visibility and sustained interest. After the initial phase of design development between the research team and the advertising agency, a culturally appropriate and technically catchy sound and picture logo were developed. The product catch phrase, 'Cring Cring Baby Zinc', has become synonymous with the use of zinc for childhood diarrhoea. The mass media messages developed included TV and radio commercials, plus advertising through newspapers, billboards and posters. Entertainment education strategies were also employed, including a TV drama series, talk shows and health education programmes, the sponsoring of cultural events, village (courtyard) entertainment programmes and a Baby Zinc theme song. The TV commercials began with a 30-second teaser, followed by commercials with more emotional content. All promotional materials included a reference to the continued use of ORS. Furthermore, the decision was made to target children 6 months to 5 years of age, with a dose of one 20 mg tablet per day for 10 days. The preparation of the commercials, which was a combined effort including marketing experts and social scientists, required approximately 9 months to complete.

### Public and private health care delivery systems

The scale up of zinc in Bangladesh has been largely private sector driven, but in close partnership with the MOHFW. Within the MOHFW, two committees were created: the first, a National Advisory Committee (NAC) chaired by the Health Secretary; the second, a Project Implementation Committee chaired by the Joint Secretary for Public Health. The latter was mandated by the NAC to recommend policy and programme decisions in support of the national zinc scale-up effort. Through this arrangement a policy in support of zinc treatment of childhood diarrhoea was recommended and approved in 2006. This was followed by the decision to include zinc treatment in the national Integrated Management of Childhood Illness (IMCI) programme.

The decision to place an emphasis on private sector promotion was based upon the recently acquired knowledge of caretaker health-seeking practices for young children with a diarrhoeal illness (Larson *et al.* 2006). Qualitative caretaker interviews indicated that they were unlikely to initially include zinc in their home management of diarrhoea unless this was supported by their provider. In turn, unlicensed providers consistently stated that they would not recommend zinc unless this was seen to be the practice of paediatricians and other MBSS physicians. With this cascade effect in mind, workshops were held with members of the Bangladesh Paediatric Association, medical school faculties and government staff working in the diarrhoeal disease control or IMCI programmes of the MOHFW. A Project Technical Interest Group was created and met quarterly. This included representation from the MOHFW, UNICEF, WHO, Bangladesh Paediatric Association and the private sector. In addition to the orientation of government sector providers in all Bangladesh upazilas (sub-districts), training was delivered to more than 6000 informal providers (village doctors and drug vendors). Following the launch of the mass media campaign, particular emphasis was given to training and the scale up of zinc treatment within the

non-state sector and among non-governmental organization (NGO) providers in Bangladesh. The training included a review of revised WHO management guidelines for childhood diarrhoea, a summary of acquired knowledge regarding the impact of zinc treatment, possible explanations for why zinc works and a presentation of responses to frequently asked questions. The trainers came from the MOHFW and ICDDR,B.

### Knowledge translation and dissemination

Knowledge translation occurred from the inception of the programme through the involvement of a wide range of stakeholders. In order to gain the support of MOHFW officials and paediatric academic leaders within Bangladesh, information sharing sessions were held and presentations made at special events or workshops held in Dhaka and in each of the country's six administrative divisions. Within the MOHFW, this information and the efficacy of zinc was reinforced by WHO and UNICEF representatives. A half-day course reviewing the revised WHO/UNICEF recommendations for the clinical management of diarrhoea was developed and modified to meet the specific needs of licensed physicians, village doctors and community health workers. For the latter two groups, a 15-minute training video was produced and is available upon request. In order to reach decision makers outside Bangladesh, an annual international zinc conference, jointly sponsored by the MOHFW and ICDDR,B, was organized. The proceedings are available on the Project website at <http://www.icddr.org/activity/SUZY>. A biannual newsletter was published and distributed to approximately 20 000 recipients, primarily Bangladeshi health providers, but internationally as well.

### Project conduct: constraints and facilitators

Given the general failure of health sectors in developing countries or emerging economies to bring well-identified, life saving interventions to scale, conceptual frameworks and guidelines have been developed. These identify specific issues to anticipate and potential constraints to scaling up health interventions in resource-constrained environments (Hanson *et al.* 2003; Gericke *et al.* 2004; ExpandNet 2009). Gericke and colleagues have developed a framework for reporting these constraints. This can be applied to a wide range of interventions, thus standardizing the identification of important constraints and facilitating comparisons. In line with this framework, but with the addition of a category to address private sector capacity, Table 2 summarizes the constraints, or in certain instances facilitators, that we found influenced the scale up of zinc treatment for childhood diarrhoea in Bangladesh.

### Intervention characteristics

Relative to other interventions, zinc treatment of diarrhoea is inexpensive, safe and feasible to implement at all levels of the health system or in households. The low cost of zinc results in a very limited profit margin for producers and retail outlets, thus creating a disincentive to produce or stock it in place of other more expensive drugs, such as antibiotics. Alternative incentives addressing best practices, client demand and social



**Table 2** Summary review of the constraints and facilitators influencing the scale up of zinc treatment of childhood diarrhoea in Bangladesh

Category	Criteria	Intervention: Dispersible zinc tablet treatment of childhood diarrhoea	Potential for simplification*
<b>1. Intervention characteristics</b>			
1.1 Product design	Stability	Stable under conditions of high humidity and temperatures for up to 3 years in aluminum-PVC blister packs	Low
	Standardize	Difficult to control in Bangladesh with 6 approved zinc tablet brands and over 30 zinc syrup brands in the market	
	Safety profile	No reported serious adverse events with a well-established safety profile Inconsistent reports of an increased risk for transient vomiting	
	Ease of storage	No special requirements	
	Ease of transport	The blister packs are lightweight and easily distributed in 3 or 10 pack cartons	
	1.2 Supplies	Supply needs	
1.3 Equipment	Technology equipment	No high technology equipment or infrastructure needed	Low
		Households will require a spoon or small container	
<b>2. Delivery characteristics</b>			
2.1 Facilities	Retail sector	Feasible, given an existing distribution system is in place	Low
	Levels	Feasible at all facility levels of care and in homes	
2.2 Human resources	Knowledge	Requires provider orientation and training, aided by a frequently asked questions repository with standardized responses	Moderate
	Supervision	None required	
	Professional services	Requires periodic quality control evaluation of product production facility Requires individuals skilled in monitoring and in maintaining product supplies	
2.3 Communication and transport	Infrastructure	Requires a product promotion and distribution infrastructure that reaches retail outlets and supplies health facilities	Moderate
<b>3. Government capacity</b>			
3.1 Regulation/legislation	Regulation	Several regulatory considerations: <ul style="list-style-type: none"> <li>• registration of the zinc tablet formulation</li> <li>• registration/approval of product branding and packaging</li> <li>• over-the-counter sales approval or waiver</li> <li>• approval for mass media advertising</li> </ul>	Low
3.2 Management systems	Monitoring	Capacity required to effectively monitor the quality of the zinc products available over the counter Private-public partnerships are essential	Moderate
3.3 Collaborative action	Inter-sectoral	Must be able to maintain equitable, socially responsive pricing that reaches the poor	Moderate
	External funding	If a high demand for zinc occurs in the government sector the purchase of zinc will require external funding (unless passed on to the consumer)	
<b>4. Private sector capacity</b>			
4.1 Manufacturing	Production	Requires a pharmaceutical laboratory that can maintain good manufacturing practices (GMP) certification, preferably in-country	Moderate
	Distribution	Distribution systems that reach drug and general retail outlets required	
4.2 Marketing	Communication networks	Widespread access to mass media networks (TV, radio), especially among poor and rural households, is needed	Moderate
	Expertise	Requires professional skills in preparing and delivering marketing messages that target households at greatest risk (urban slums and rural poor)	

(continued)

Table 2 Continued

Category	Criteria	Intervention: Dispersible zinc tablet treatment of childhood diarrhoea	Potential for simplification*
4.3 Health care providers	Regulation/ continuing education	The vast majority of health providers in Bangladesh are not licensed and are poorly regulated, but are represented by special interest groups that can organize continuing education  Primary source of information is through private sector medical representatives (drug salesmen)	Moderate
	Access	Easy access and widespread availability of unregulated providers at little cost	Low
	Cost	Licensed private providers limited to urban settings	
4.4 Households	Health seeking	Caregivers overwhelmingly seek help in the private sector	Moderate
	Demands	Consumers demand and expect a curative treatment	
	Expenditures	If burden to pay for zinc is passed onto households, then likely not to reach many of the poorest households	
<b>5. Usage characteristics</b>			
5.1 Ease of usage	Information	Zinc as a treatment for childhood diarrhoea will be universally unknown to caretakers and the majority of providers, thus requiring comprehensive education of providers and caretaker orientation  Caretaker adherence with instructions regarding preparation is high (98%), but to duration given is low (<50%)	High
5.2 Pre-existing demand	Need for promotion	This is a largely unknown intervention, therefore requiring large-scale provider and mass media promotion	Moderate
5.3 Black market risks	Resale/ counterfeiting	If product is provided free of charge in public sector facilities then risk of resale exists (MOHFW supplied blister packs are labelled 'not for sale')  The dispersible tablet formulation can be counterfeited, with lower quality products jeopardizing the reputation of the intervention	Low

responsibility may be able to counter this. An additional constraint at the outset of a zinc scale-up campaign is the uncertainty about consumer demand for the product. A significant increase in the supply of zinc blister packs will require a 3 to 6 month period for adjustment.

### Delivery characteristics

No special facilities are required to deliver the zinc intervention. A major constraint to delivering zinc through the private sector is the need to create awareness of zinc as a treatment for childhood diarrhoea among a wide range of health providers and to educate these providers in caretaker instructions for its use. Additionally, informal provider and caretaker insistence on following the practices of the formal sector prevented the intervention from reaching out directly to the end-line user and created the need to develop a cascade of orientation and training activities. This began with leading paediatricians and academics, then other licensed physicians and ultimately reached unregulated, informal sector providers. All levels of health providers found it helpful to have a prepared list of frequently asked caretaker questions (often reflecting their own) and standard responses.

### Public sector capacity

The regulatory steps required to approve and market a new treatment are complex and can create important constraints. In

Bangladesh, zinc was classified as a drug because it was being prescribed at a dose four times above the recommended daily dietary allowance. Therefore the zinc tablet formulation required a series of approvals from the Bangladesh Drug Administration. This required proof of safety from phase III trials carried out in a developed country. No such trials have ever been carried out in a developed country, nor is it likely they ever will be. Lack of understanding and preparation for country-specific regulations can lead to significant delays in product introduction. The capacity of the public sector to cover the cost of zinc treatment is another potentially important constraint. The SUZY Project subsidized the purchase of zinc for distribution in government health facilities. At US\$0.25 a treatment, this could be taken on by the MOHFW, but sustained only if health-seeking practices for childhood diarrhoea in government facilities remain low. In countries with scarce resources and high demand on government health facilities, external funding is likely to be required.

The introduction of a new treatment intervention cannot succeed without strong government support and ownership in the programme. At the outset of the SUZY Project decision makers within the MOHFW and the private sector expressed numerous and severe concerns about zinc, in particular its safety. They also wanted greater participation in the decision making and local control over the scale-up process. This represented a significant early constraint that resulted in delays in registration of the formulation, initial resistance

within the diarrhoeal diseases control programme and from district health managers. The creation of a project advisory committee with meaningful input by representatives from these and other affected health professionals largely resolved these early concerns.

### Private sector capacity

Public–private partnerships have tremendous potential to favourably influence the scale up of new treatments, such as zinc. This project was able to build upon a positive, successful past history of public–private partnership in the scaling up of ORS in Bangladesh. Few other developing countries have experienced such success. A constraint to private-sector scale up for several countries will be the lack of capacity of local laboratories to produce a high quality product that meets good manufacturing practices certification. Bangladesh has a well-established, highly competitive pharmaceutical industry with the capacity to meet international standards. In addition, these laboratories support well-developed health provider promotion and drug outlet distribution networks. These networks reach most drug vendors and village doctors, but not general retail outlets. This limitation has significantly curtailed the over-the-counter introduction of the zinc blister packs.

The marketing of zinc will need to be tailored to separately reach health care providers, retail outlets and caregivers. Zinc as a treatment for childhood diarrhoea will largely be unknown where it is being introduced for the first time, hence the need for an extensive, well-planned promotional campaign led by professionals with expertise in the development of messages and behaviour change communication. Prior to launching a mass media campaign, local providers need to be oriented and prepared to respond to commonly asked client inquiries about zinc treatment. This represents an important constraint to the timing of a mass media launch, as it should not occur in the absence of awareness and support among leading health professionals and a broad segment of health care providers. Formative interviews with providers and caregivers should inform the sequential adoption of new child health interventions, starting with leading national figures in health, then cascading down to paediatricians, general physicians and eventually informal, unregulated providers. Caregivers reported they would not purchase zinc unless it had first been approved by their local provider. The predominantly private sector focus to the scale up of zinc in Bangladesh has placed the cost burden on households. This will create added challenges to reaching the poorest through messages they are able to relate to.

### Usage characteristics

The intervention is simple, easily learned and acceptable to caregivers. The most compelling rationale for scaling up zinc is its preventive attributes, including reduced morbidity and mortality. To achieve these benefits, a child probably needs to receive 8 to 10 days of treatment. Lack of adherence with this number of days remains one of the greatest constraints to zinc scale-up campaigns, in particular in societies where drugs are prescribed in small quantities on an as needed basis. This is provider and consumer driven, with both focusing on cure and not well informed about prevention. Effective, evidence-based prevention messages currently represent a key gap in

knowledge. As previously mentioned, the near-complete lack of any pre-existing demand for zinc treatment is also a constraint.

## Conclusions and lessons learned

The project performance framework developed for the scale up of zinc in Bangladesh is applicable to a wide range of health interventions being introduced in resource-restricted settings. This framework began with the identification of important gaps in knowledge that not only guided strategic decisions, but served to reassure stakeholders that the scale up could be conducted safely and would not adversely affect other beneficial practices. A primary concern expressed by opinion leaders in Bangladesh, and supported by research in sub-Saharan Africa, has been the impact scaling up zinc treatment might have on the use of ORS and the treatment of other life-threatening illnesses such as malaria (Ellis *et al.* 2007; Winch *et al.* 2008). With this in mind, a survey monitoring system was initiated and maintained in representative rural, small and large urban populations over the first 3 years of the scale-up campaign. What these repeat surveys are indicating is that awareness can be rapidly attained, but does not reflect actual practices. Future scale-up campaigns need to anticipate a relatively rapid shift from messages aiming to inform the public to messages that directly influence practices. The latter likely requires greater emphasis on more direct, personal communication strategies than were offered through the SUZY's less personal, mass media messages.

The performance framework facilitated the tracking of planned project activities that could be matched with a timeline and expected outputs. For example, early on in the project it was evident we were falling behind with the multiple regulatory steps to be completed and in gaining the support of leading paediatricians in Bangladesh. In both instances this could be directly attributed to lack of ownership and control over the scale-up process. Placing responsibility and building capacity for the production of the dispersible zinc tablet formulation within a local, Bangladeshi laboratory was pivotal to moving the regulatory process forward. Likewise, gaining the support of the Bangladesh Paediatric Association and arranging for them to take the lead on advocacy for zinc treatment facilitated policy decisions and reassured stakeholders that a stewardship was in place.

The preparation, planning and conduct of promotion activities in support of scaling up zinc required the co-operative efforts of formative researchers, producers, advertisers and government regulators. The Government of Bangladesh took an important step by recognizing the role of informal, unregulated providers and showing a willingness to work with them in the promotion of zinc treatment. Expanding awareness and changing practices at a national level requires realistic funding, multiple strategies and clear and consistent messages. It is complex and it is expensive. In our experience, awareness of zinc treatment for childhood diarrhoea was rapidly obtained; however, as anticipated, behaviour change lagged behind and has been much more difficult to achieve. New innovations will take time for caregivers to process and eventually integrate into their diarrhoea management decision-making, thus the need for a longer-term promotion strategy (Rogers 2003). Our decision to

distribute and sell zinc exclusively through drug shops (regulated pharmacies and unregulated drug vendors) did not take full advantage of the over-the-counter waiver Baby Zinc received and may have inhibited favourable home management practices by over-medicalizing the zinc treatment option. As of autumn 2008, Baby Zinc had been integrated into a bottled water distribution system and thus reaches general retail shops where ORS is available.

The application of a constraints framework is particularly important in the dissemination of scale-up process activities because outcomes alone do not measure the transferability of large, complex programmes aiming to bring interventions to scale in resource-deprived settings. It also captures contextual factors that play a significant role in the scale-up process which will vary from setting to setting and impact the generalizability of a single experience. The addition in the framework of a section addressing private sector constraints reflects the emphasis given to working with private sector providers as partners in the scale up effort. The Bangladesh MOHFW assumed an important stewardship role in working with the Bangladesh Village Doctors' Association and overseeing their training and that of drug vendors. The benefits of working with formal and informal provider systems, as well as the identified decision-making cascade starting with leading paediatricians, were important lessons taken from the scale-up experience.

The goal of the SUZY Project was to set Bangladesh on the path to universal coverage of childhood diarrhoea with zinc treatment. This has been achieved, but with important lessons learned and constraints identified that others engaged in the scaling up of life-saving interventions can benefit from. The Project serves as an example of partnerships between researchers, public sector decision makers, providers and a diverse array of stakeholders in the non-state, private sector.

## Acknowledgements

ICDDR,B acknowledges with gratitude the commitment of the Bill & Melinda Gates Foundation to the Centre's research efforts.

## Funding

The SUZY Project was funded through a grant from the Bill & Melinda Gates Foundation: grant # 00231.

## References

- Abraham C, Sheeran P. 2000. Understanding and changing health behavior: from health beliefs to self regulation. In: Norman P, Abraham C, Connor M (eds). *Understanding and Changing Health Behavior*. Amsterdam: Harwood.
- Aggarwal R, Sentz J, Miller MA. 2007. Role of zinc administration in prevention of childhood diarrhoea and respiratory illness: a meta analysis. *Pediatrics* **119**: 1120–30.
- Akhter S, Larson CP. 2009. Willingness-to-pay for zinc treatment of childhood diarrhoea in a rural population of Bangladesh. *Health Policy and Planning* **8**: 379–84.
- Bandura A. 1997. *Self-Efficacy: The Exercise of Control*. New York: Freeman.
- Baqui AH, Black RE, El Arifeen S *et al.* 2002. Effect of zinc supplementation started during diarrhoea on morbidity and mortality in Bangladeshi children: community randomised trial. *British Medical Journal* **325**: 1059.
- Black RE, Morris SS, Bryce J. 2002. Where and why are 10 million children dying every year? *The Lancet* **361**: 2226–34.
- Bhutta ZA, Black RE, Brown KH *et al.* 1999. Prevention of diarrhea and pneumonia by zinc supplementation in children in developing countries: pooled analysis of randomized controlled trials. Zinc Investigators Collaborative Group. *Journal of Pediatrics* **135**: 689–97.
- Boschi-Pinto C, Velebit L, Shibuya K. 2008. Estimating child mortality due to diarrhea in developing countries. *Bulletin of the World Health Organization* **86**: 710–7.
- Connor M, Sparks P. 2005. Theory of planned behavior and health behavior. In: Connor M, Norman P (eds). *Predicting Health Behavior: Research and Practice with Social Cognition Models*. Buckingham: Open University Press, pp. 170–222.
- Ellis AA, Winch PJ, Daou Z, Gilroy KE, Swedberg E. 2007. Home management of childhood diarrhoea in southern Mali – implications for the introduction of zinc treatment. *Social Science & Medicine* **64**: 701–12.
- ExpandNet. 2009. Nine steps for developing a scaling up strategy. Online at: <http://www.expandnet.net>.
- Gericke CA, Kurowski C, Ranson MK, Mills A. 2004. The role of intervention complexity for the feasibility of scaling-up health interventions in developing countries. Global Forum for Health Research, Forum 8, Mexico City, 16–20 November 2004.
- Jones G, Steketee RW, Black RE *et al.* 2003. How many child deaths can we prevent this year? *The Lancet* **362**: 65–71.
- Hanson K, Ranson K, Oliveira-Cruz V, Mills A. 2003. Expanding access to priority health interventions: a framework for understanding the constraints to scaling-up. *Journal of International Development* **15**: 1–14.
- Khan MA, Larson CP, Faruque ASG *et al.* 2007. Introduction of routine zinc therapy for children with diarrhoea: evaluation of safety. *Journal of Health, Population and Nutrition* **25**: 127–33.
- Larson CP, Hoque M, Larson CP, Khan AM. 2005. Initiation of zinc treatment for acute childhood diarrhea and the risk for vomiting or regurgitation: a randomized, double-blind, placebo-controlled trial. *Journal of Health, Population and Nutrition* **23**: 311–8.
- Larson CP, Saha UR, Islam R, Roy N. 2006. Childhood diarrhoea management practices in Bangladesh: private sector dominance and continued inequities in care. *International Journal of Epidemiology* **35**: 1430–9.
- Larson CP, Saha UR, Nazrul H. 2009. Impact monitoring of the national scale up of zinc treatment for childhood diarrhoea in Bangladesh. *PLoS Medicine* **6**: e1000175.
- Nasrin D, Larson CP, Sultana S, Khan TU. 2005. Acceptability and adherence to zinc dispersible tablet treatment of acute childhood diarrhoea. *Journal of Health, Population and Nutrition* **23**: 215–21.
- Rajaratnam JK, Markus JR, Flaxman AD *et al.* 2010. Neonatal, postneonatal, childhood and under-five mortality for 187 countries, 1970–2010: a systematic analysis of progress towards Millennium Development Goal 4. *The Lancet* **375**: 1988–2008.
- Rogers EM. 2003. *Diffusion of Innovations*. 5th edn. New York: Free Press.
- Roy SK, Tomkins AM, Akramuzzaman SM *et al.* 1997. Randomised controlled trial of zinc supplementation in malnourished Bangladeshi children with acute diarrhoea. *Archives of Disease in Childhood* **77**: 196–200.
- Story DJ, Saffitz GB, Rimon JG. 2008. Social marketing. In: Glanz K, Rimer BK, Viswanath K (eds). *Health Behaviour and Health*

- Education: Theory, Research and Practice*. 4th edn. San Francisco, CA: Jossey-Bass, pp. 435–64.
- Schwarzer R. 2002. Self efficacy in the adoption and maintenance of health behaviors: theoretical approaches and a new model. In: Schwarzer R (ed). *Self Efficacy: Thought Control of Action*. Washington, DC: Hemisphere, pp. 217–43.
- Schwarzer R. 2008. Modeling health behaviour change: how to predict and modify the adoption and maintenance of health behaviors. *Applied Psychology* **57**: 1–29.
- USAID. 2010. Introducing pediatric zinc with ORS/ORT in the private sector. Washington, DC, 29–30 June 2010. Workshop proceedings.
- Uvin P, Miller D. 1996. Paths to scaling up: alternative strategies for local non-governmental organizations. *Human Organization* **55**: 344–54.
- WHO. 2004. WHO/UNICEF Joint Statement. Clinical management of acute diarrhoea. Geneva: World Health Organization.
- Winch PJ, Gilroy KE, Fischer-Walker CL. 2008. The effect of HIV/AIDS and malaria on the context for introduction of zinc treatment and low-osmolarity ORS for childhood diarrhoea. *Journal of Health, Population and Nutrition* **26**: 1–11.