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Effectiveness of international aid for diarrheal disease control and potential for future impact

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Effectiveness of international aid for diarrheal disease control and potential for future impact

Richard A. Cash and James R. Potter *

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Abstract: The reduction in deaths from diarrheal diseases is one of the significant public health successes of the twentieth century. That said, the disease still accounts for a significant burden of childhood morbidity and mortality in low- and middle-income countries. Progress made in the past has, to a significant extent, been supported by a variety of both bilateral and multilateral donors aiming to make an impact in reducing this burden. We review the history of international aid in the context of disease control, and the variety of ways in which international aid has driven the international agenda, including a description of the activities of key players during this period, as well as the experiences of national control programmes. We conclude with a discussion of what is known to date about the effectiveness of international aid in supporting national control programmes, as well as some important areas of focus for future efforts. The control of diarrheal diseases remains an unfinished agenda in global health and international aid still stands to make an important impact in the burden.

Keywords: diarrheal disease, aid effectiveness, oral rehydration therapy, child mortality
JEL classification: I18

Glossary: Given at the end of the document.

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1 Introduction

International aid for health has grown exponentially over the past several decades (Ravishankar et al. 2009), so naturally the allocation of these resources has been a topic of much discussion. Global trends in the allocation of aid for health is driven by a variety of factors, including the emergence of new epidemics such as HIV/AIDS, international priorities such as health-related aspects of the Millennium Development Goals, and lobbying efforts by special interest groups. Normative questions about the appropriate distribution of resources within the area of global health are important for governments, multilateral donors, and private donors to consider. In answering such questions, one important issue to consider is the impact of dollars spent on health. During the last several decades, there has been increasing interest not just in the effectiveness of dollars spent in averting morbidity and mortality directly, but also in the potential for their investments to lead to a sustainable impact, and the potential for knowledge transfer to domestic institutions (Bossert 1990; Shediac-Rizkallah and Bone 1998; Gruen et al. 2008). While different health issues may require different solutions, examples of successful aid for health can reveal how this aid can be more effectively targeted and used in the future.

One of the better examples of how international aid has had an impact on health is the story of diarrheal disease and the development of oral rehydration therapy (ORT) (Ruxin 1994). While medical research into the physiology and aetiology of diarrheal diseases dates back to the first half of the twentieth century, the most significant steps in the development of an affordable treatment occurred in East Pakistan (Bangladesh) and West Bengal, India, where international and local researchers collaborated to translate the collective knowledge of *in vitro* experiments into a medical treatment. This led to the development of a systematic treatment of diarrhoea, followed by the development of ORT, a treatment regimen that, to this day, has remained, with only minor alterations, as the standard treatment for diarrheal disease and, when administered correctly, has significantly reduced the mortality rate from diarrhoea. After the development of ORT, the focus shifted on how to distribute the knowledge and spread of this intervention. This has been coupled with investigations on how best to prevent these conditions.

Diarrheal diseases, including cholera, have been a major source of infant and child mortality in the developing world. Estimates for the late 1960s and early 1970s attributed over 4.6 million deaths per year to diarrhoea-related mortality (Snyder and Merson 1982). The trend in mortality has been downward since then, with present estimates of about 700,000 deaths per year, all the more remarkable since the world's population has more than doubled since the earlier estimates (see Table 1). This reduction in mortality has been achieved without a concurrent reduction in diarrhoea incidence, suggesting that the package of interventions to improve both child nutrition and case management of diarrhoea has been effective in significantly reducing mortality rates (Keusch et al. 2006). Despite these successes, diarrheal disease remains, in absolute numbers, in the top two preventable causes of childhood mortality for many low-income countries around the world (Lozano et al. 2012).

The success of public health interventions to date underscores the need to continue current interventions, and to further treat this highly preventable cause of child mortality worldwide. Funding for diarrheal diseases has gone through major changes over the last several decades, the result of a changing global disease burden, and the politics of setting global health priorities. International aid has played an important role in supporting and catalysing some of the great successes that have been seen over the past several decades (Bump et al. 2012).

Due to the historical burden of diarrheal diseases, and the many successes in reducing this burden through public health interventions, much has been written about the history of diarrheal

diseases, and particularly on ORT and related interventions. The scientific and personal history of ORT's development has been described in detail by Ruxin, combining works in the scientific literature with interviews of those involved in ORT's development (Ruxin 1994). Bump et al. (2011, 2012) have described the trends in priority setting for diarrheal disease within the global health agenda through political analysis. More recently, Wilson et al. (2013) have assessed some of the factors associated with oral rehydration scale-up successes and failures in developing countries. These reviews all come from different perspectives, and to varying degrees, all include some discussion on the role of international aid in diarrheal disease research and treatment. However, to the authors' knowledge, there is no similar compilation of experiences and reflections on this progress from the perspective of international aid. This is not a straightforward task. Documentation and accounting records for diarrheal disease funding were not systematically maintained, and still is not done so today (Bump et al. 2011; Wilson et al. 2013). As such, a comprehensive, systematic review of all international aid for diarrheal diseases is beyond the reach of presently available sources. Instead, this study is an attempt to make comprehensive use of resources available to describe the progress and challenges in DD treatment and management during the last half-century, and to consider the outlook for the future.

2 Diarrheal disease: background

Diarrheal disease (DD) is not a single illness nor is it caused by a single pathogen. Rather, it is a diverse array of illnesses that jointly present the symptom of diarrhoea. The causative agents are generally transmitted through the faecal-oral route but can also be indirectly caused by other illnesses such as malaria and measles (Keusch et al. 2006). Diarrheal can also contribute to malnutrition through the mal-absorption of nutrients, the withholding of food, the loss of appetite, or the catabolic effect of the illness (Ochoa et al. 2004). Though case mortality is often low, many deaths are attributed to diarrhoea because of the high incidence of disease, especially in the first two years of life. Until the late 1960s the care available for children with severe diarrhoea and dehydration had been in hospitals, where treatment with IV fluids, when available, was reasonably successful in preventing death (Chowdhury and Cash 1996) The development of ORT in preventing and treating dehydration was a major advance in decreasing mortality from diarrheal diseases, especially as it extended care outside of the hospital. While ORT does not treat the underlying infection, it is highly effective at preventing morbidity and mortality associated with the symptoms of diarrhoea, reducing mortality from DD by 69 per cent (Bhutta et al. 2013).

2.1 Past and current burden of DD

A list of the major studies estimating mortality due to DD from 1955 onwards is presented in Table 1. Before 1980, it was estimated that there were over 4.6 million annual deaths in children under the age of five in developing countries (Snyder and Merson 1982). This number had decreased to about 3.3 million estimated annual deaths in the same group for the years 1980-89 (Bern et al. 1992). For the decade starting in 1990, different estimates found between 1.6 and 2.5 million annual deaths (methodological differences are likely to account for some of the different estimates) (Kosek et al. 2003; Keusch et al. 2006). In 2011, the estimated number of deaths due to DD was about 700,000 per year (Walker et al. 2013). These numbers are all subject to a high degree of uncertainty, due to the major gaps in surveillance data, but the secular downward trend is compelling. Despite significant progress, DD, together with lower respiratory infections, were responsible in 2010 for the highest mortality burden among children of ages 6 months to 5 years (Lozano et al. 2012).

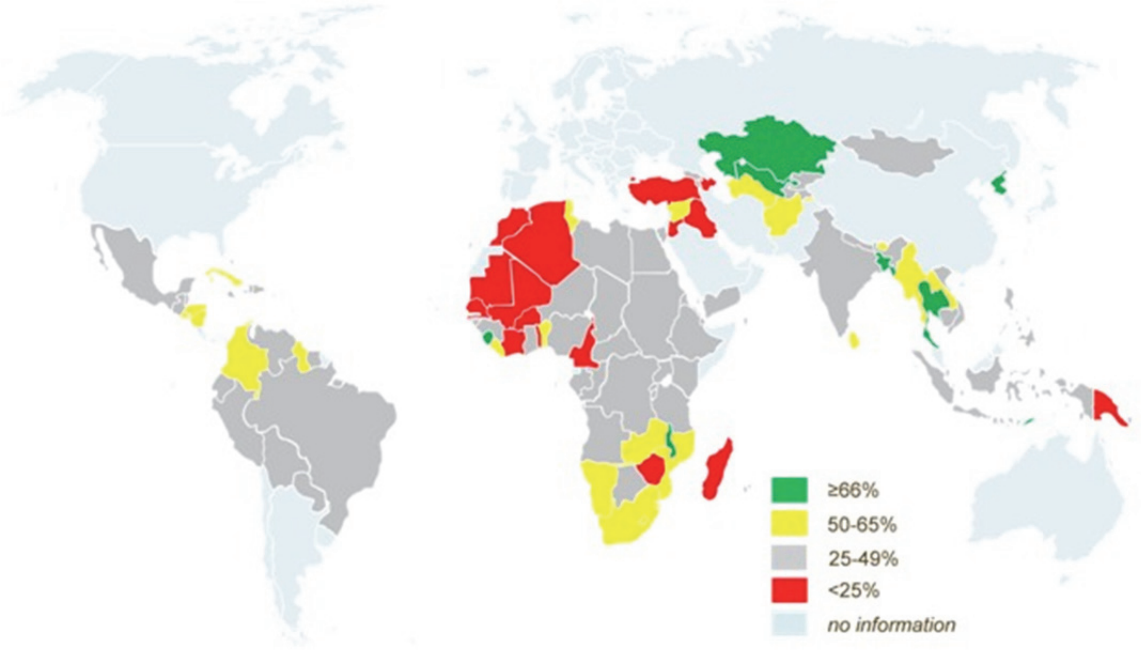
Table 1: Summary of the major estimates of diarrheal disease mortality covering 1955-2008

Authors	Publication date	Date range of underlying survey data	Estimates of annual childhood DD mortality	Data sources
Snyder & Merson	1982	1955-80 (data collection)	4.6 million	Review of 24 published DD studies (18 countries)
Claeson & Merson	1990	1981-86 (data collection)	4 million	276 DD morbidity, mortality and treatment surveys in 60 countries
Bern et al.	1992	1978-87 (data collection)	3.3 million	Review of published DD studies and 40 national surveys conducted by CDD programmes
Kosek et al.	2003	1985-98 (data collection)	2.5 million	Review of 34 published DD studies (21 countries)
Boschi-Pinto et al.	2008	1975-78 (middle years of surveys)	1.87 million	Review of published epidemiological studies, regression model calculation of DD mortality
Black et al.	2010	2008 or closest year in high-coverage vital registration systems; in low-coverage systems qualifying community surveys 1979 to present	1.336 million	Multi-cause proportionate model calculation using regression analysis
Walker et al.	2013	2010 or most recent country-level estimate	0.71 million	Review of 24 systematic reviews of DD and pneumonia burden; global estimates using UN Inter-agency Group for Child Mortality Estimation (IGME) methodology

Source: Table contents reprinted, with updates, from Bump et al. (2012). Reproduction covered under OUP guidelines stipulated in the STM agreement.

Morbidity rates reported in earlier studies are likely to be underestimates compared to later studies, due to changes in surveillance and case finding methods. While mortality has decreased over the past several decades, there have been relatively smaller declines in DD incidence rates since surveillance data has been recorded: 3.5 episodes per child year in 1993, 3.2 episodes in 2003 (Keusch et al. 2006), and 2.7 episodes in 2010 (Walker et al. 2013). Studies have shown improvements in DD case management in several countries, including Brazil, Egypt, Mexico and the Philippines (Victora et al. 2000). These improvements coincide with decreases in mortality, and while there is some evidence that trends in DD mortality were decreasing prior to control of diarrhoeal disease (CDD) programmes and improvements in case management, the trends from the 1990s and early 2000s are most likely due in great part to the successes of national CDD programmes (Victora et al. 2000).

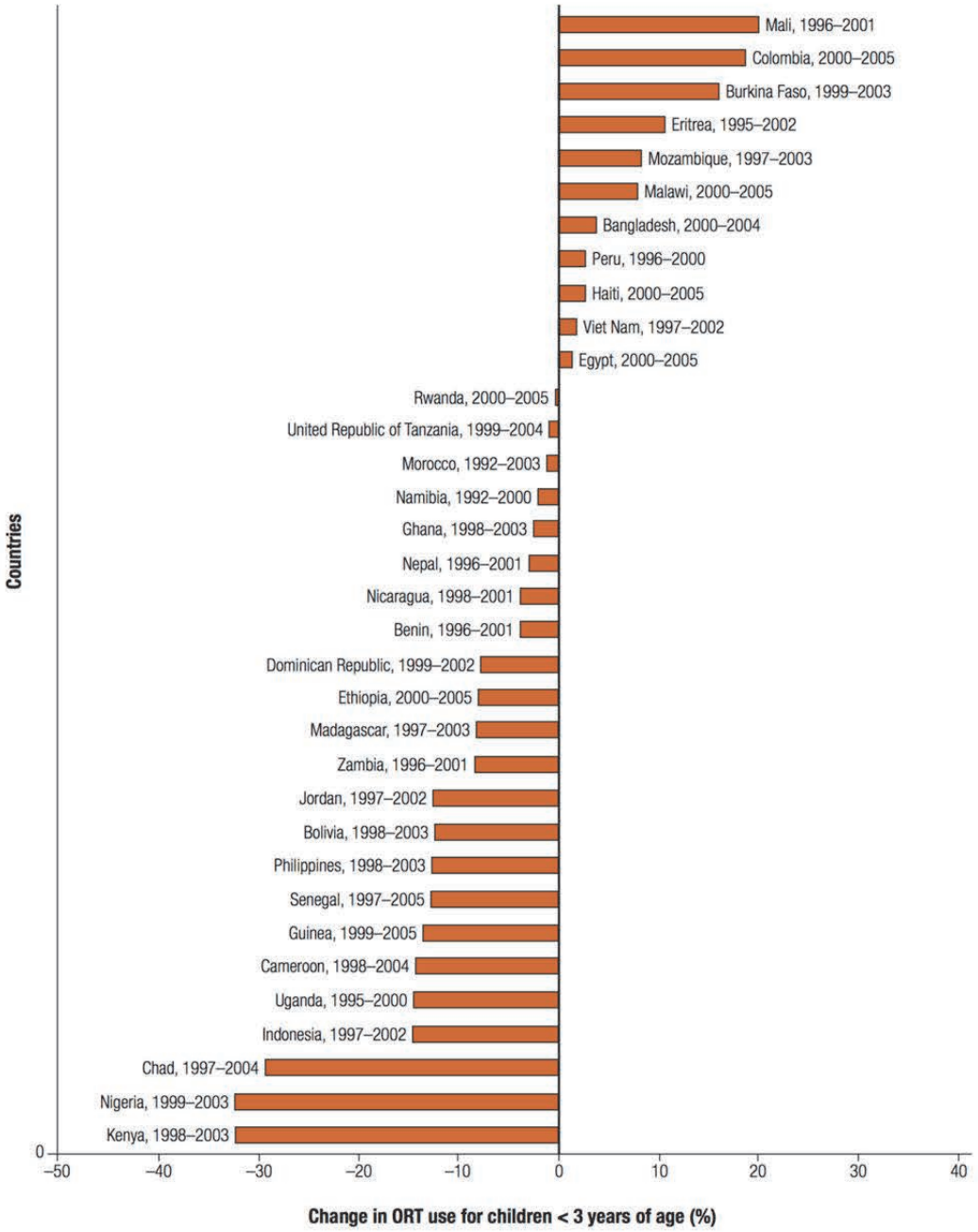
Figure 1: Most recent country-wise data for ORS usage rates



Source: Figure reproduced from Wilson et al. (2013) under the Creative Commons License.

The correct management of DD cases has increased, but the goal of achieving near-universal levels of ORT coverage for the treatment of DD in low- and middle-income countries has not yet been met. According to analyses of available demographic health survey (DHS) data (Forsberg et al. 2007) estimated effective ORT coverage rates ranged from 4-50 per cent, depending on the country, rates that are far below the goal of 80 per cent coverage set by a joint statement of WHO and UNICEF in 1991 (WHO 1994). Estimates are slightly higher when national surveys and Multiple Indicator Clusters surveys are included (see Figure 1), but the coverage is still far below international goals. A survey of selected countries using the most up-to-date DHS data (2005–12) estimates that only one-third of children with acute diarrhoea receive (oral rehydration solution) ORS and less than 1 per cent receive zinc (Gill et al. 2013). These results demonstrate the need for a more concerted effort to increase global coverage. Ram et al. assessed changes between 1992 and 2005, a period during which many vertically oriented DD management programmes supported by the WHO were absorbed by the new integrated management of childhood illness (IMCI) programmes. The analysis reveals a high degree of heterogeneity in coverage among countries, with several countries experiencing decreases in the percentage use of ORT for children <3 years of over 10 per cent (see Figure 2). There are likely to be a number of factors that have played a role in this trend, including the decreased focus in DD under the IMCI framework, as well as a relative decrease in funding for DD implementation as other areas, especially HIV/AIDS, has attracted more funding. A recent study in several high burden countries found that a wide range of barriers remained to reducing DD morbidity and mortality (Gill et al. 2013). In some countries, poor commodity management presented a major barrier, while in others human resources were in low supply. In most countries, the low priority of DD control at both the national and international level was cited as a significant barrier to further progress in DD control.

Figure 2: Change in ORT use for children less than 3 years of age, 1992-2005



Source: Figure reproduced from Bulletin of the World Health Organization (2008).

3 Methodology

The methodology conducted for this study was a narrative review along with semi-structured interviews of experts in the field of DD control. First, exploratory literature searches were conducted on the PubMed and Google Scholar academic literature search engines, and the terms 'diarrh(o)ea', 'diarrh(o)eal disease', 'diarrh(o)eal disease control' were searched in combination with 'international aid', 'foreign aid', 'oral rehydration therapy'. This literature review yielded many articles on diarrheal disease control, but many articles make only passing reference to international aid, and many of these references pointed back to a substantial grey literature from international and bilateral aid organizations documenting individual and collaborative contributions and projects.

Due to the extensive grey literature, as well as the uneven academic documentation of earlier efforts in DD control, it was determined that an inclusive narrative literature review would best suit one of the major goals of this study, to collect and describe the many contributions that international aid have made to DD control. Gary literature searches were therefore conducted on the websites of many of the major organizations involved in international aid for DD control (including UNICEF, CDC, ICDDR-B, USAID, Save the Children, the World Bank, and DFID) using the same search terms described above.

Semi-structured interviews were also conducted with experts who have played important roles in international aid and DD control during the past several decades. These interviews complemented the academic and grey literature review by providing important insights into the internal decision-making processes of aid organizations, as well as the availability and accessibility of information on international aid flows for DD control. An interview guide was developed by the authors covering the history of international aid in DD control, personal experiences in their respective positions, the major stakeholders, as well as the sustainability and scalability of international aid-funded programmes. In total, thirteen experts were contacted, and five agreed to provide an interview. The interviewees represent a wide range of experience in DD control research and implementation, and their past and current affiliations with international aid organizations include USAID, WHO, UNICEF, Save the Children, and the World Bank. Four out of five interviewees are still active in global health, and therefore all direct quotes and paraphrased quotes collected directly from these interviews are cited anonymously in this paper.

4 Data sources and evidence

While various data sources have contributed to an understanding of temporal trends in treatment coverage, as well as the corresponding changes in morbidity and mortality, estimating the causal effects of specific interventions on DD outcomes is beyond the reach of current feasible data collection techniques. The risk factors for DD incidence are complex, and sometimes systemic to the infrastructure of different neighbourhoods, regions, and countries. Causal estimates are likely to be elusive for the foreseeable future. Even estimating changes in treatment coverage of ORT is difficult. The WHO guidelines for ORT, which were revised several times during the 1980s and 1990s, created a moving target for enumerating ORT coverage rates. In 1981, ORT was defined as simply oral rehydration salts. In 1988, the definition was expanded to include recommended home fluids, but by 1993 ORT had been redefined as increased fluid intake with ORS and continued feeding (Victora et al. 2000). This shifting definition precluded a rigorous temporal analysis of the effects of national CDD programmes, because the treatments across time vary substantively.

The comprehensive nature of an effective CDD programme is difficult to fully capture in a quantitative analysis. The recommendations for a CDD programme include improvements in sanitation infrastructure, breast feeding, proper preparation of weaning foods, continued feeding during diarrhoea, education, and access to clean drinking water, among others (Chopra et al. 2013). Increased vaccination rates leading to routine direct protection (rotavirus) and protection during epidemics (cholera) should also be considered. Surveys that attempt to measure the impact of these programmes might rely on the few quantitative measures available, most prominently diarrhoea rates (Victora et al. 2000). These estimates are likely to overestimate the effect of ORT in the absence of a method to control for the comprehensive package of interventions provided by the CDD programme. In addition, a variety of external factors, including but not limited to selection effects, spillover effects, and non-random policy distribution are often unobserved variables affecting outcomes, and in many cases adequately controlling for these factors is not feasible. With DD being so deeply embedded in many of

these intangible aspects of development, estimates of ORT rates and their effectiveness might fail to fully capture the other important factors that contribute to the success of effective CDD programmes.

5 The development of ORT and shifting global priorities

While DD had always been a global health problem, by the middle of the twentieth century, high-income countries had seen significant improvements in sanitation, drinking water supply, infrastructure, and nutrition (Aykroyd 1971). All of these factors had an impact on DD incidence rates, and as a consequence, the DD burden became disproportionately concentrated, especially in low-income countries, where the provision of these public goods had not kept pace with those in high-income countries. The higher burden of DD in the developing world was compounded by the challenges of access to treatment. Before oral rehydration therapy (ORT), access to treatment for children suffering from DD was limited because of poor facility access, treatment expense, and household-level knowledge about treatment options. Many healthcare providers were also not well trained in the care of the dehydrated diarrhoea patient. A typical intravenous treatment in Bangladesh for a case of severe adult cholera might cost almost three months of a person's income (Chowdhury and Cash 1996).

These intravenous treatments continued to be the standard treatment for DD through the first half of the twentieth century and through the 1960s, as researchers struggled to discover the aetiology of DD and to design an effective treatment solution (Ruxin 1994). Outside of the lab, the spread of cholera outbreaks served as the catalyst for much of the research that led to modern DD treatment. In the years after the Second World War, cholera was reported across a wide geographic area, from Egypt to Japan and across most of South and South-East Asia. The United States Naval Medical Research Unit performed research during the 1947 cholera outbreak in Egypt, and again during a later outbreak in the Philippines in 1961 (Savarino 2002). The 1950s saw a return to relative calm, with cholera reports limited mostly to India and East Pakistan (now Bangladesh), where cholera is endemic. In 1958, a sudden outbreak of cholera in West Pakistan (now Pakistan) and Thailand led to the decision from SEATO as well as the United States National Institute of Health (NIH) to establish a centre for long-term study of cholera. The outbreak in Thailand declined before the visit of the NIH Cholera Advisory Committee in 1959, and it was decided that East Pakistan, where cholera was endemic, would be the most suitable location for long-term cholera study (CRL 1962).

This decision laid the foundation for an agreement establishing the Pakistan-SEATO Cholera Research Laboratory known throughout the country as the Cholera Research Laboratory (CRL, but now the International Centre for Diarrheal Diseases Research, Bangladesh, or ICDDR-B), based in Dacca, East Pakistan (now Dhaka, Bangladesh) was founded in December, 1960 as a research institution to reduce the burden of diarrheal diseases in the developing world (SEATO proceedings of the conference on cholera, December 1960, Dacca, East Pakistan, 1962). The major US funders included the National Institutes of Health (NIH), the Center for Disease Control (CDC), and USAID, with additional support from other SEATO nations, including Great Britain and Australia (Mosley et al. 1969). Researchers supported by the NIH played an important role in some of the early trials leading to the development of ORT. At the same time, the Johns Hopkins Center for Medical Research and Training in Calcutta, India (now Kolkata), also supported by the NIH, was working on some of the same questions in West Bengal. The group based in Dacca first established the clinical efficacy of ORS and Calcutta followed soon afterwards (Ruxin 1994). Further work by researchers at CRL demonstrated the efficacy of ORS in field trials, paving the way for the use of ORS outside of hospital settings. This made ORS

programmes implementable in low resource settings, establishing the groundwork for ORS to be one of the major initiatives in global health priorities.

The 1970s saw a shift in the global health agenda away from vertical programming towards primary healthcare (PHC), exemplified by the 1978 Alma Ata declaration of 'Health for All by the Year 2000' (WHO 1978). The Declaration of Alma-Ata, a product of the international conference on PHC in 1978 jointly sponsored by WHO and UNICEF, was a turning point for international health. The declaration framed health as a human right, and emphasized the role of PHC as the centrepiece of health systems that would provide access to healthcare for all (Lawn et al. 2008). This was a change in direction from the prior emphasis on vertical implementation of health interventions, including WHO's successful eradication of smallpox. While the declaration was praised for its aspirational, comprehensive view of healthcare, it was criticized for being vague and overambitious. Even those concerned about the impracticality of 'health for all by the year 2000' could not deny, however, that great progress could be made with the proper focus on achievable goals (Passmore 1979).

The prescriptions of the Alma-Ata Declaration led to much discussion about how to implement and achieve these goals. Yet another model termed 'selective primary healthcare' (SPHC) was also proposed (Walsh and Warren 1979). While acknowledging the importance of PHC in providing the highest level of care, the authors argued that as an interim measure, governments and international organizations should be prioritizing diseases and interventions for conditions with a high level of morbidity and mortality that had developed a cost-effective approach. ORS was a natural candidate for an SPHC model of primary care, addressing a substantial portion of morbidity and mortality at low cost in developing countries. Among the organizers and attendees at a 1979 Rockefeller Foundation sponsored conference on health and population development, where the paper was presented, were a number of important figures in the international health arena, most notably Robert McNamara and James Grant (Cueto 2004). McNamara, the then president of the World Bank, wanted to respond to criticisms that his organization was too focused on economic growth and paid too little attention to poverty reduction. James Grant, the director of UNICEF from 1980 to 1995 was also influenced by the SPHC proposal. During his tenure, he pushed UNICEF to support concrete, measurable interventions.

The specific packages of interventions that would emerge from this push towards SPHC came to be known as GOBI, growth monitoring, oral rehydration, breastfeeding and immunization. These interventions were chosen because they were easy to monitor, measurable, and had clear targets. As a result, they became popular with aid agencies looking for results that could be easily reported. In practice, UNICEF, USAID, and the World Bank began to pay particular attention to oral rehydration and immunization, the so-called 'twin engines' of child survival, not in small part because these interventions were concrete and measurable (Cueto 2004). While proponents of PHC argued that SPHC was a band-aid that did little to address the root causes of child mortality, major international donors drove the momentum towards funding elements of SPHC (Lawn et al. 2008).

The momentum behind SPHC and an emphasis on cost-effective, scalable interventions led to large investments in DD control programming during the 1980s. Many organizations, including USAID, WHO, UNICEF, UK DFID and Swedish SIDA, took part in funding these efforts. Aid flows continued through the first half of the 1990s, but this decade also saw a shift in the priorities of some of these organizations. The WHO initiated its programme for the integrated management of childhood illness (IMCI), collapsing all child health sector programmes into this new initiative. This programme re-emphasized horizontal health interventions at the individual level, emphasizing a set of comprehensive guidelines for child health management. However, the

aid flows did not match the ambition of the programme, and many countries struggled to keep up. After several years of implementation, some countries were forced to cut corners in quality to reach their targets for comprehensive care provision (Victora et al. 2004). IMCI programmes often led to decentralization of healthcare away from national-level control, which led to more locally responsive care, but also limited the potential positive effects of central planning, data collection and monitoring.

Along with the WHO's shift towards IMCI, aid flows began to shift away from vertical child health interventions such as CDD. International aid flows directed towards vertical programmes began to focus on HIV/AIDS adding malaria and tuberculosis at a later stage. While USAID continued to invest in child health programmes, the budgets for these programmes began to decrease compared to other infectious disease programmes. At the same time, just as the WHO shifted its priority away from vertical programmes towards a comprehensive approach to child health, some donors, including the World Bank and DFID, were taking a more sector-wide approach to aid allocations for health, of which only an unspecified fraction might be allocated for child health (DFID et al. 2004). One decade earlier, the WHO estimated that only about 2 cents of every US$10 spent on healthcare research was allocated to pneumonia or diarrhoea (WHO 2002), and this has not likely change substantially in the next decade. While DD control programmes globally receive approximately US$10 per DALY (disability-adjusted life year), this pales in comparison to US$102.07 per DALY for diabetes and US$64.45 per DALY for cardiovascular disease allocated each year (Landriault and Matlin 2009).

6 Control of diarrheal diseases programmes

As discussed above, diarrheal diseases is a symptom complex with an array of underlying causes, ranging from proximal factors (exposure to contaminated water, infant feeding practices etc.), to distal factors (the quality of regional and local sanitation infrastructure etc.). Implementation of WHO standards for ORT remains a critical foundation for the treatment of DD, but other interventions also form an important component of CDD programmes, as many programmes that work directly on distal determinants of DD may in fact improve DD control rates even if the effect was not directly intended (Bhutta et al. 2013). Prevention can play an important role in the control of DD by both reducing exposure and reducing the risk after exposure. Behavioural interventions, especially the promotion of hand washing and breastfeeding, are effective ways to reduce exposure to DD agents (Luby et al. 2004). Improving the nutritional status of children also reduces the risk of DD incidence and severity after exposure to DD-causing pathogens (Keusch 2003).

Additionally, vaccines for rotavirus (Santosham 2010; Madhi et al. 2010) have been effective in preventing DD incidence in many countries. The risk of intussusception associated with previous rotavirus vaccines has been significantly reduced in the new vaccines (Patel et al. 2011). WHO now recommends that rotavirus vaccines be implemented as part of comprehensive CDD programmes worldwide, due to its effect on reducing the severity of disease rather than incidence (WHO 2009). New oral cholera vaccines, though not routinely used to prevent disease in endemic environments, have the potential to reduce transmission in epidemic situations (Sur et al. 2009).

Poverty is associated with a number of risk factors for DD, including poor access to clean drinking water and adequate household sanitation, cohabitation with domestic animals, crowding, and lack of refrigeration for stored food. Interventions related to poverty reduction and infrastructural improvements might therefore be associated with reductions in DD incidence and mortality. While a detailed review of the various interventions is beyond the scope of this

article, recent review articles provide a more in-depth analysis of both the efficacy and cost-effectiveness of many of these interventions (Zwane and Kremer 2007; Seguin and Niño-Zarazúa 2013).

7 Key players and national programmes

The shift in the global health agenda following Alma Ata led to a flurry of new funding sources for DD, including bilateral aid agencies, supranational organizations like the WHO, local NGOs, as well research organizations. The breadth and variety of activity exemplifies the energy and resources that drove the push to address the heavy burden of DD. Attempts to systematically track aid flows for DD during the first half of the twentieth century, however, have faced numerous barriers (Bump et al. 2011). By far the most comprehensive sources of this class of data is the creditor reporting system (CRS) of the Organisation for Economic Co-operation and Development (OECD), which collects geographically and sectorally disaggregated aid flows for almost two hundred recipient countries (OECD 2007). CRS data is organized into categories that often encompass multiple disease groups, including 'infectious disease control' and 'basic healthcare', precluding a simple analysis of whether all or part of funds were targeted towards DD control. Apportioning methods can be used to disaggregate these broad categories into disease-specific measures, but these methods have several limitations and only give very broad estimates (Powell-Jackson and Mills 2007). Several interviewees echoed these issues in systematically tracking aid flows, especially for the early periods of DD funding activity, noting that individual donors had different practices for developing line-items in budgets, and in many cases a line-item for DD control may have been collapsed into larger thematic programme groups, or might simply have never existed in the first place.[1] In the absence of detailed trends in aid flows during this period after Alma-Ata, a summary of some of the major players during this period, as well as the ways in which they contributed to DD control are summarized below.

7.1 USAID and the international conferences on oral rehydration therapy

From the beginning, USAID played an important role in supporting DD research, dissemination, and implementation programmes. According to one interviewee, in terms of the major rise of DD control as a global health movement, 'most of the money came from the US and multilaterals here [in the US]'. From the beginning, USAID was involved in DD control efforts, which began with their role as the primary funder of the CRL supporting research that led to the development and testing of ORS (Sacks et al. 1970; Cash et al. 1970). After the development of ORT, they assisted in the funding of additional field trials of ORT in many different locations, including in Bangladesh, the White Mountain Apache Nation in Arizona USA, and the Philippines (Hirschorn et al. 1973; International Study Group 1977; Sack et al. 1978). This provided further proof-of-concept of how ORT could be used in multiple situations.

USAID was also the principal funder and organizer of the three international conferences on Oral Rehydration Therapy (ICORT I-III), along with ICDDR-B, UNICEF, and WHO. These meetings, held from 1983 to 1988, served a critical role in bringing researchers and multiple donor organizations together to share best practices and pool resources for DD programmes (USAID 1988). ICORT I-III were the centrepieces of a larger concerted effort from USAID to bring a greater focus of international aid priorities on DD control. The importance of these meetings and USAID's support should not be underestimated – the meetings were attended by

[1] One study also noted the heavy burden that detailed requests for historical records would place on donor organizations, and suggested that ethical considerations should be taken into account before forwarding burdensome requests to organizations that are involved in development work (Powell-Jackson and Mills 2007).

some of the most influential members of multilateral donors, technically inclined health organizations, as well as national health ministry representatives. These meetings, and USAID's substantial resources, were a true example of 'right time, right place': aid organizations were looking for cost-effective interventions to address health issues with high disease burdens, and ORT had recently proven its worth.

Besides funding basic research and organizing meetings, USAID was also responsible for funding major national CDD programmes. By 1981, USAID was supporting over 67 projects in 30 countries related to ORT and DD control, mostly focused on education and training for integrated health delivery services, as well as operations research (Drasbek 1981). At the ICORT III conference in 1988, USAID announced that ORT had been used in over 32 per cent of diarrhoea cases, and was responsible for averting one million childhood deaths (USAID 1988). Many countries received large-scale support from USAID in establishing country programmes such as the following: improving case management of DD; assuring adequate product of ORS packets; mass media campaigns to promote ORT; health worker training programmes; and the establishment of oral rehydration centres within the existing healthcare infrastructure. Egypt's highly successful national control of diarrheal diseases project (NCDDP), described and evaluated in detail (Miller and Hirschhorn 1995), made use of many of these interventions.

7.2 World Health Organization

One of the earliest supporters of the ORT research based at an international organization was Dhiman Barua of WHO, who urged the WHO to play a more active role in the use of ORT and reducing the mortality associated with diarrheal diseases. His early work, including contributing to ORS research and advocacy during the late 1960s and 1970s, helped to lay the groundwork for the WHO's diarrhoeal disease control programme (CDD programme) in 1980. This programme provided an important role in supporting research and translating the results into best practices and guidelines for implementation. During the early years of the CDD programme, the WHO supported research activities focused on the aetiology and epidemiology of DD, and supported numerous research projects related to the composition of the ORS formula, confirming the proposed formula's efficacy in control trials, and supporting further research to leading to a recommended standard ORS formula. The research leading to the standard ORS formula was conducted jointly with WHO and ICDDR-B in the early 1980s (WHO 1999). Over the 1980s, the focus of research activities gradually shifted towards more applied topics, including work on vaccines, as well as case management, operational issues and implementation. The CDD programme supported various skills training courses for community health workers, medical staff, and medical students to promote best practices in DD case management, and also developed a set of tools for monitoring and evaluation that could be utilized by national CDD programmes.

By the end of the 1980s, there was renewed momentum away from vertical programmes, which culminated in the announcement by the WHO of a new initiative, the integrated management of childhood illnesses (IMCI), which combined the WHO's CDD programme with its acute respiratory infections (ARI) programme, among others (World Health Organization 1999). While the goals of this initiative included a framework for comprehensive improvements to health systems, one interviewee familiar with WHO's work commented that in practice it became a set of clinical guidelines, as the initiative's prescriptions for health systems improvement required large increases in funding beyond the amounts previously committed to CDD programmes. Implementation and data collection, previously some of the primary goals of WHO's DD control activity, lost priority and began to disappear, for a variety of reasons, including leadership transitions, the loss of key staff members as well as changes in the international health funding

space (Bump et al. 2012). Under the IMCI framework, CDD was part of a larger package of programmes meant to strengthen the health system, but the complications and expense of implementing IMCI, without a corresponding increase in funding sources, led to the effective closure of many previously successful national CDD programmes (Bump et al. 2012.).

7.3 UNICEF

After the Alma-Ata Declaration in 1978, UNICEF became one of the major supporters of Selective Primary Healthcare (SPHC), and UNICEF was largely responsible for the promotion of GOBI, a package of four inexpensive and effective health interventions. The 'O' in GOBI stood for ORT, and by the mid-1980s UNICEF was promoting ORS use through mass media campaigns, and had already become a major distributor of ORS packets, producing 20 million packets annually and distributing to 87 countries worldwide (Acra et al. 1984). UNICEF continues to be substantially involved in procurement of ORS packets, increasing from 28 million packets in 2000 to 86 million packets in 2011 (UNICE 2012). In several countries, most notably Bangladesh, UNICEF successfully transitioned ORS packet procurement to local organizations and manufacturers (Mosites et al. 2012), but in other cases the dependency on UNICEF procurement proved hard to break, such as in Senegal (Wilson et al. 2012b) and Madagascar (Gilbert et al. 2012). In a technical capacity, UNICEF collaborated with WHO to make recommendations on revised and improved versions the ORS formula (WHO/UNICEF 2004).

7.4 National programmes

Starting in the 1980s and continuing into the 1990s, many countries benefitted from the efforts of large-scale national programmes to implement and spread both resources and education in DD prevention. However, during this period, relatively few of these programmes were comprehensively and systematically documented. One well-documented programme was Egypt's national control of diarrheal diseases project (NCDDP), funded by USAID between 1981 and 1991 (Miller and Hirschhorn 1995). The programme included efforts to increase the production and distribution of ORS packets, nation-wide education and mass media programmes, as well as the integration of rehydration into the existing public and private healthcare networks. Other NCDDP programmes that had been documented include the Philippines (Baltazar et al. 2002), Brazil (Victora et al.1996), and Mexico (Gutiérrez et al. 1996).

A recent study has made some progress in building knowledge of why some ORS scale-up efforts have succeeded while others have failed. Nine country-wide case studies were commissioned as part of the project, and several key factors were identified that contributed to scale-up success, including the promotion of collaboration among key players, the consideration of both supply and demand factors, and the inclusion of both the public and private sectors (Wilson et al. 2013). Promoting both supply and demand was found to be an important factor in scale-up success. A case study of Sierra Leone found that by generating demand through strong and varied advertising campaigns, combined with generating supply through strong supply chain management, the country was able to promote and sustain high ORS usage rates through its free healthcare initiative (FHCI) in the 2000s (Wilson et al. 2012c). Many international donors were involved in funding primary healthcare projects in Sierra Leone through the 2000s, but DFID and UN agencies provided the majority of funding for the FHCI, through which ORS was procured through UNICEF and later through other international sources. Collaboration among key stakeholders was also found to be an important indicator of success. A case study of Madagascar found that a short scale-up project from 2008-10 funded in large part by USAID and UNICEF failed to adequately increase ORS coverage and was out of sync with the country's demand for ORS, and ultimately poor buy in from the government left the project without a

clear direction after the funding period ended (Gilbert et al. 2012). One of the other major factors that was found to contribute to scale-up success is engagement with both the public and private sectors. In India, for example, various scale-up approaches promoted by the national government, UNICEF and USAID, only found mixed success in increasing access and demand for ORS, due to the robust and popular private health sector and the influence of large domestic pharmaceutical companies that promote antibiotics and other non-recommended remedies (Wilson et al. 2012b).

7.5 BRAC and other NGOs

While some countries find sources of large-scale funding from bilaterals, other countries have found help in the form of international or domestic NGOs, of which the most notable success story can be found in Bangladesh. In the wake of Pakistan's civil war, which led to the founding of Bangladesh, the NGO Bangladesh Rehabilitation Assistance Committee (BRAC) was formed in order to work towards the country's development. While BRAC now works in many sectors, one of its most prominent achievements has been its successful national scale-up of ORT, named the oral therapy education programme (OTEP). BRAC succeeded in scaling up the ORT programme. so that over a 10-year period they trained over 13 million care givers nationwide and made some of the most impressive advances in national treatment rates (Chowdhury and Cash 1996). The process of scaling up the ORT intervention began with the question of how to disseminate the intervention. The supply of nurses and doctors was far too low for the intervention to be implemented solely through these healthcare workers. In order to reach the largest possible population in Bangladesh, it was proposed that the intervention be implemented either through a network of community health workers (CHWs) or through a mass education campaign to teach the technique of preparing ORS. There was some concern that that an improperly mixed solution could lead to adverse outcomes, but field experiments demonstrated all women and men, regardless of their level of education, could formulate a safe, effective solution after being taught the proper technique (Chowdhury and Cash 1996). BRAC then set out to educate the entire population of Bangladesh, demonstrating how to make a homemade ORS solution using locally available ingredients.

In addition to BRAC, there have been many other NGOs that have worked in DD control in the past several decades. Due to the cross-disciplinary nature of DD prevention and treatment, NGOs from a variety of sectors have been heavily involved in DD programmes, including Partners in Health, CARE, Save the Children, Child Health Foundation, CARE,, PATH, John Snow Inc., and Management Sciences for Health, to name just a sample of the major players. Some of these organizations focus on their respective areas of expertise, ranging from child health and nutrition to improving supply chain management, while some become involved in comprehensive interventions. Many of these organizations also work closely with host governments in order to improve existing health systems and integrate known solutions into the existing health systems. While it may be difficult to fully estimate the collective impact of NGOs, their contributions to DD control have been substantial. In recent years, NGOs have also been a source of much-needed advocacy in bringing more global attention to the unmet need for DD control in developing countries (Kniaz 2009).

8 Recent history and ways forward

The 2000s saw the continuation of the decline in support for DD programming among international aid funders. The focus on health systems strengthening and vertical programmes to tackle HIV/AIDS, malaria and tuberculosis continued, and DD control programming received substantially less support. Bump et al. were able to obtain estimates of DD control budgets from

some of the major international funders. Their findings show that WHO's budget for DD control dropped from about US$46–71 million in the mid-1980s to around US$2 million in 2008, and similar estimates were found for reductions in funding at USAID (Bump et al. 2012). During the same time period, staff dedicated to DD control programmes were approximately 5-10 per cent of the staff that were working on DD control in the 1980s, an indicator of a significant decline in support. After James Grant's death in 1995, UNICEF's support for DD control programmes was reduced considerably, along with immunization, Grant's other 'twin engine' (Bump et al. 2012).

This trend of reduced resources available for DD control lines up with estimates of ORT usage in DD case management from DHS surveys, whose best estimates show an uneven trend across countries. Some countries saw reductions in ORT usage rates of more than 30 per cent between their latest two DHS surveys (mostly late 1990s—early 2000s), while other countries saw increases of up to 10 per cent or 20 per cent (Ram et al. 2008). The global drop in funding, as well as material and technical support in DD control, during the latter half in the 1990s likely contributed to the drop in ORT rates in some countries. But what explains the other half of countries, where ORT rates actually increased, despite the decrease in funding and support?

The transition from more vertically oriented CDD and ARI programmes at WHO towards the IMCI strategy serves as a useful place to begin to examine the shift in emphasis away from vertical programmes. When the CDD and ARI programmes were folded into the new IMCI strategy, the motivation from WHO was to move back towards a comprehensive primary care model. However, with the introduction of IMCI, funding support for national and regional CDD programmes ended, and the funding sources necessary to fully establish IMCI programmes never fully materialized. This left countries cutting corners in quality in order to meet the needs of these comprehensive programmes, and existing CDD programmes ended. In effect, during this transition point, national and regional institutions needed to pick up where WHO's CDD programmes had left off. Some institutions succeeded while others failed.

This point can be generalized to the dilemma of many aid organizations and national recipients: can international aid lead to sustainable progress in the control of DD? Certainly, history shows that early basic research in Dacca, East Pakistan and Calcutta, India towards the development of ORS and the subsequent field trials of ORT, international aid played a crucial role in reducing the burden of DD in the decades to come (Ruxin 1994). The aid sponsored international conferences did much to disseminate the results of ORT and other DD initiatives, and without the support of international aid, early progress in the design and implementation of national CDD programmes would not have been possible. However, it should be no surprise that the sustained increases in ORT usage rates are not automatic. Among our interviewees, Egypt was cited several times as a success story, turning their USAID-supported national programme into a sustained, government-maintained initiative. While a case study on this transition might reveal more details on Egypt's success, anecdotal evidence suggests that the transition in Egypt was successful in integrating CDD programmes into the national health system, absorbing any components that had been administered separately under the CDD banner into existing healthcare facilities. Crucially, funding existed to maintain adequate staff that had received training in DD case management, and from the beginning, the programme had included substantial investment in DD centres that were attached to primary healthcare centres and hospitals. In short, there was adequate health funding at the national level to continue to administer these successful programmes through existing institutions, and the programmes had been administered in a manner that was easily absorbed into the health system.

After funding significantly decreased for DD control programmes and child health in general, the transition towards self-sustaining programmes did not go so smoothly for a number of countries. In many cases, the funding simply was not available to sustain even the amount of health workers necessary for DD case management. In some countries, the national DD control programmes were also designed as vertical programmes that could not be easily adapted to the existing health system, especially in the absence of a new funding mechanism.

More difficult to measure, but likely to be just as important, are the factors of political will and governance in individual countries. An example of a failure to maintain DD control efforts might be the recent cholera outbreak in Haiti, where there have been over 8,000 deaths. During the 2010 outbreak, thousands of community health workers were rapidly trained in case management, and rapid distribution of ORS sachets and other products was implemented in order to prevent more case fatalities (Tappero and Tauxe 2011). While emergency measures were eventually able to establish effective case management, emergency responders could have focused on other priorities if there were an established system for DD control and case management in Haiti. DD control programmes established during the 1980s and early 1990s were not adequately maintained, a story that is all too common among high priority countries. A 2008–09 cholera outbreak in Zimbabwe resulting in over 4,000 deaths serves as another example of how poor case management can lead to public health disasters when the public sanitation systems break down (BBC News 2009). A challenge for international aid agencies in countries like Haiti and Zimbabwe will be to convert emergency DD control systems into a sustainable programme beyond the length of stay for emergency responders.

While cost-effective DD control interventions have existed for decades, there are still significant gaps in coverage worldwide. By one estimate, 54 per cent of DD mortality could be averted by 2025 by simply maintaining present levels of investment in DD and childhood pneumonia interventions, which currently stand at about US$3.8 billion globally (Bhutta et al. 2013). The same authors estimate that an 'ambitious scale-up', by achieving 80 per cent coverage of all interventions and 90 per cent coverage of all vaccines, would cost an extra $2.9 billion and would avert 95 per cent of DD deaths. While investment in new vaccine research is an important component of new treatment and prevention methods, a large majority of the impact would come simply from implementing programmes and strategies that are already tried and tested (Chopra et al. 2013), ending of preventable deaths from pneumonia and diarrhoea: an achievable goal.

9 Conclusion

Many of the most important advances that have been made in DD research, treatment, prevention, and programme implementation, can be attributed to the sustained funding efforts of some of the large international donors. USAID took a central role in funding a large proportion of early research, as well as funding the rollout of the early national DD control programmes. WHO and UNICEF played important roles in establishing standards and coordinating with country offices to provide technical and logistic support, including the support of local ORS packet manufacturing. BRAC's OTEP initiative, in part funded by Swiss Aid, was able to demonstrate an early, effective, and sustainable DD control programme based on home use of ORS. A multitude of bilateral and multilateral donors played key roles in supporting national ORS scale-up efforts in middle-income and developing countries. While it may be difficult to causally attribute the impact of specific aid dollars on lives saved, there is overwhelming evidence that these collective efforts have significantly reduced the level of DD-related mortality.

The shifts in global priorities over the past several decades also played a crucial role in research and implementation related to DD control. USAID greatly assisted in driving global priorities towards DD control as part of the SPHC movement and the focus on child health, particularly through the three ICORT conferences it organized during the 1980s. However, priorities in the late 1990s shifted away from DD control and child health towards sector-wide funding approaches, as well as vertical infectious disease programmes. National monitoring, particularly through DHS surveys, showed that ORS usage appeared to decrease in the late 1990s along with these shifting priorities.

A number of case studies have shown that the scale-up of DD control programmes can lead to sustained changes, and most of these programmes received critical international aid during scale-up phase of implementation (Chowdhury and Cash 1996; Miller and Hirschhorn 1995; W ilson et al. 2013). However, just as many scale-up efforts have failed to have a sustained impact, and learning from these successes and failures will be critical to any organization looking to address DD in the future. The recent cholera outbreak in Haiti is a vivid reminder that failure to sustain ORT rates and other DD control programmes can have devastating consequences. As several of our interviewees and case studies have suggested, political will and strong institutions play a crucial role in having a sustainable impact, and understanding the complex market dynamics of a health system is equally critical. Just as USAID, WHO, and UNICEF became major drivers of support for DD control programmes, in a similar fashion, health systems need the support of the health community, politicians and other leaders in order to maintain DD control programming beyond international aid. It is imperative that international aid organizations plan the transition from international to local programme support from the very beginning.

Though a large proportion of international aid dollars has shifted towards other priority diseases, especially HIV/AIDS, malaria, and tuberculosis, DD remains the second major cause of under-five mortality in low and middle-income countries (Lozano et al. 2012). When funding was strong for DD, international aid contributed to one of the great public health successes of the twentieth century, averting millions of infant and child deaths. After the money stopped flowing as freely, progress has been uneven. It should be the priority of the next several decades to continue research into treatment and prevention, especially the development of new vaccines, and to design, develop and implement DD control programmes that are both successful and sustainable.

Glossary

AIDS	acquired immunodeficiency syndrome
ARI	acute respiratory infections
BRAC	(formerly) Bangladesh Rehabilitation Assistance Committee
CARE	Cooperative for Assistance and Relief Everywhere
CDD	control of diarrhoeal disease
CDC	Centre for Disease Control
CRL	Cholera Research Laboratory
CRS	creditor reporting system
DALY	disability-adjusted life year
DD	diarrhoeal disease
DFID	Department for International Development (UK Government)
DHS	demographic and health survey
FHCI	free healthcare initiative
GOBI	growth monitoring, oral rehydration, breastfeeding and immunization

HIV	human immunodeficiency virus
ICDDR-B	International Centre for Diarrhoeal Disease Research, Bangladesh
ICORT	International Conference on Oral Rehydration Therapy
IMCI	integrated management of childhood illness
NCDDP	national control of diarrheal diseases project
NGO	non-governmental organization
NIH	National Institute of Health
OECD	Organisation for Economic Co-operation and Development
ORS	oral rehydration solution
ORT	oral rehydration therapy
OTEP	oral therapy extension programme
PHC	primary healthcare
SEATO	Southeast Asia Treaty Organization
SIDA	Swedish International Development Cooperation Agency
SPHC	selective primary healthcare
TB	tuberculosis
UN	United Nations
UNICEF	United Nations Children's Fund
USAID	United States Agency for International Development
WHO	World Health Organization

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