

Childhood Pneumonia and Diarrhoea 3



Bottlenecks, barriers, and solutions: results from multicountry consultations focused on reduction of childhood pneumonia and diarrhoea deaths

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Millions of children still die unnecessarily from pneumonia and diarrhoea, mainly in resource-poor settings. A series of collaborative consultations and workshops involving several hundred academic, public health, governmental and private sector stakeholders were convened to identify the key barriers to progress and to issue recommendations. Bottlenecks impairing access to commodities included antiquated supply management systems, insufficient funding for drugs, inadequate knowledge about interventions by clients and providers, health worker shortages, poor support for training or retention of health workers, and a failure to convert national policies into action plans. Key programmatic barriers included an absence of effective programme coordination between and within partner organisations, scarce financial resources, inadequate training and support for health workers, sporadic availability of key commodities, and suboptimal programme management. However, these problems are solvable. Advocacy could help to mobilise needed resources, raise awareness, and prioritise childhood pneumonia and diarrhoea deaths in the coming decade.

Introduction

In 1990, roughly 11.9 million children died, mostly in low-income and middle-income countries. 20 years later, this number had fallen by 40% to about 6.9 million per year.^{1,2} Both then and now, most deaths in the post-neonatal period are due to pneumonia and diarrhoea (see the first paper in this Series).³ Although the reduction in child deaths falls short of the 2015 Millennium Development Goal 4 target for a two-thirds reduction in children younger than 5 years (under-5 mortality),⁴ it is still a major achievement that the global public health community should celebrate.

Targeted investments in public health played a major part, as the case of Bangladesh shows (panel 1). The past decade saw unprecedented amounts of investments in global public health, both from donor nations (in the form of direct contributions or channelled through the Global Fund to Fight AIDS, Tuberculosis and Malaria), and private philanthropic organisations.⁵

However, unfortunate truths remain. Economic development was a key factor in reducing child mortality, and the burden of pneumonia and diarrhoea mortality is increasingly concentrated in resource-poor settings.³ In 1990, childhood mortality rates were highest in sub-Saharan Africa, which is still the case now.² In fact, childhood mortality rates in sub-Saharan Africa have stagnated over the past decade, and have even increased in some countries.⁶ Yet, the basic elements necessary to reduce childhood deaths from pneumonia and diarrhoea are well known. The treatments (antibiotics for pneumonia, oral rehydration solutions, and zinc) are safe and effective; off-patent; inexpensive to manufacture; require no cold chains; only need to be taken episodically and for short periods; and are inexpensive, costing pennies per

treatment course.⁷⁻¹⁰ However, scarcely half of children with severe acute pneumonia receive antibiotics; and of children with acute diarrhoea, only a third receive oral rehydration solution and less than 1% receive zinc (table 1).²

To improve this situation, a series of collaborative exercises with key stakeholders were conducted to identify barriers to reducing childhood pneumonia and

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This is the third in a [Series](#) of four papers about childhood pneumonia and diarrhoea

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Key messages

- Pneumonia and diarrhoea are the leading causes of preventable deaths for children living in the world's poorest countries
- A series of consultations with several hundred public health practitioners working at the front lines of child survival in target countries were held to identify bottlenecks and key barriers to scaling up of evidence-based interventions to reduce pneumonia and diarrhoea mortality, and recommend tangible solutions
- Key barriers included:
 - Absence of national coordination within ministries and other stakeholders to deliver interventions
 - Insufficient financial resources
 - Inadequate training and support for health workers
 - Poor systems for monitoring and assessment of key programmatic indicators
 - Sporadic availability of key commodities
- Key recommendations included:
 - Improve coordination between various groups working on preventive and treatment interventions to control pneumonia and diarrhoea
 - Substantially increase resources for child survival programmes, with an emphasis on pneumonia and diarrhoea control efforts
 - Enhance efforts to attract, train, and retain a competent work force of caregivers
 - Invest in better systems for harmonisation of the collection of essential programmatic indicators, and ensure that this information is shared throughout the system
 - Strengthen supply systems that deliver essential commodities

Panel 1: What happened in Bangladesh?

Between 1980 and 2011, the under-5 mortality rate in Bangladesh fell by an astonishing 75%, from 193 per 1000 to 49 per 1000 (figure 1). This decrease was largely driven by reductions in mortality from pneumonia and diarrhoea but was not accompanied by a corresponding decrease in the incidence of acute diarrhoeal disease in national surveys. In fact, in the past few years, the incidence of diarrhoeal disease has increased in Bangladesh's two most populous districts (Dhaka and Sylhet). Rather, these achievements seem to have been driven by improved case management.

According to the 2006–07 Bangladesh Demographic Health Survey, 81.2% of children presenting with acute diarrhoeal disease receive either oral rehydration solution or a recommended home solution, an increase from roughly 60% in the 1996–97 survey. Even in rural settings, 76% of children receive oral rehydration solution. Simultaneously, antibiotics for acute watery diarrhoea are only prescribed for about 10% of children. Zinc is only used in about 20% of acute diarrhoeal episodes. However, compared with the global average of roughly 1% zinc use, this seems to be a success story, and efforts are underway to minimise stock outs and to market zinc to consumers.

Owing to favourable government policies, Bangladesh now boasts one of the most successful pharmaceutical industries in the world, with more than 18 000 endogenous brands marketed domestically. Notably, 97% of key commodities (oral rehydration solution, zinc, and antibiotics) are produced within Bangladesh including, at last count, 95 branded formulations of zinc. In parallel, Bangladesh has made substantial investments in water and sanitation programmes, and interventions to alleviate severe malnutrition in young infants.

One notable aspect of Bangladesh's approach to reducing childhood mortality has been the large number of stakeholders who have assumed ownership of this problem. Such stakeholders include the Bangladesh Ministry of Health and Family Welfare and its Divisions; the Ministry of Local Government's Public Health Engineering Department; multilateral agencies such as WHO and UNICEF, The World Bank, and the Global Alliance for Improved Nutrition; non-governmental organisations, such as Save the Children and Water Aid; and the International Center for Diarrhoeal Diseases Research, Bangladesh.

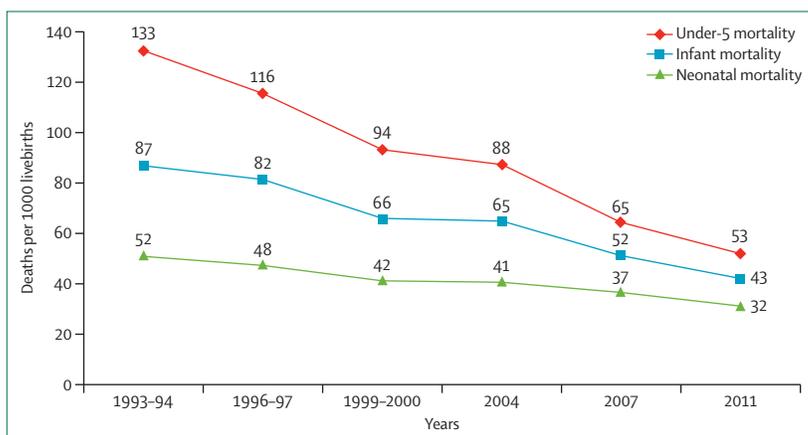


Figure 1: Decreasing child mortality in Bangladesh, 1993–2011, according to data from the Bangladesh Demographic and Health Survey each year

diarrhoea deaths and recommend solutions¹¹ (panel 2). We present the main lessons learned and address the most important bottlenecks to the use of key commodities for the prevention or management of pneumonia and diarrhoea; the key programmatic, policy, and resource

barriers impeding progress; and suggest how we can move forward.

Bottlenecks impeding access to and use of commodities

Figure 2 summarises the key bottlenecks for each commodity. For both zinc and oral rehydration solution, the main bottlenecks are concentrated in downstream areas related to provision of these commodities in the community (eg, through private sector outlets, or the public sector through the Integrated Management of Childhood Illnesses [IMCI] strategy at health facilities, or as community case management by community health workers). An additional barrier for zinc was the absence of national policies supporting its use for routine case management of diarrhoea in four of the seven countries that took part in the Diarrhoea Global Action Plan (DGAP) consultation, and scarce or no availability in all the countries surveyed.

By contrast, the key bottlenecks to vaccines were upstream, concentrated in the areas of guideline formulation and sufficient funding to support vaccination programmes. However, many of the DGAP countries had not yet incorporated either the rotavirus or pneumococcal conjugate vaccines into their national programmes, or were at an early stage of doing so. Participants drew attention to the successful implementation of other vaccine programmes as indicators that downstream barriers could be surmounted. Bottlenecks impeding access or use of antibiotics for pneumonia were identified at all points of the process chain, with substantial variation between countries.

Barriers and solutions

Qualitative data for barriers and solutions were classified into five thematic areas (table 2).

Theme 1: coordination

Poor coordination for planning and implementation was perceived as one of the most notable barriers to progress by the workshop participants, and included poor coordination between and within government ministries, international agencies (eg, WHO and UNICEF), non-governmental organisations, funders, and the private sector. Another contributing factor was that ministries felt beholden to the priorities of multilateral funders, resulting in external interests being favoured over national priorities.

Public–private partnerships were perceived to have extraordinary potential, especially because most children with acute diarrhoea and pneumonia receive treatment through the private sector. However, these partnerships were often underused or poorly coordinated, and their goals vaguely defined. For example, even when countries had policies promoting zinc, these were rarely linked to efforts to support local manufacturers or the commercialisation of zinc, or to attempts to coordinate the activities of private drug vendors with the prescribing needs of

community or facility-based health workers. Similarly, efforts to promote the use of key interventions, such as zinc and oral rehydration solution, were not coordinated through the public sector, resulting in inadequate availability of these commodities, and little advocacy from the private sector to promote their use.

Most participants indicated that the problem was not the absence of policies for diarrhoea and pneumonia control; rather, policies were not linked to up-to-date practice guidelines or implementation plans. Participants proposed that ministries should regularly review and update (or discard) policies, and should combine these with implementation plans, timelines, budgets, and performance standards. To efficiently leverage public-private partnerships, key stakeholders in the private sector should contribute to policy development and dissemination activities, and policies that include incentives to motivate the private sector to provide and promote key interventions.

Theme 2: resources

Resource barriers included challenges to financial and human resources. Three types of financial barrier were

identified. First, funding was often earmarked for special projects, and not allocated commensurate with burden of disease (eg, money allocated to HIV was not transferable). Second, too many barriers blocked access to existing resources, typically because of over-centralised control of health allocations and burdensome bureaucratic processes. Third, corruption was endemic and drained valuable resources. Solutions included matching of funding to burden of disease; creation of fast-track mechanisms to quickly route resources to areas of greatest need; decentralisation of control over funding; and intensification of financial oversight to ensure transparency to minimise corruption.

For human resources, the numbers of facility-based and community-based health-care workers were insufficient, which posed a major challenge to the effectiveness of care through IMCI or community case management.^{15,16} The root causes were poor incentives to attract or retain workers and inadequate training, resulting in poor quality of services. Related to this factor was the absence of any formal system to train managers of community health workers; no systematic approach to supportive

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	Total under-5 deaths in 2011 (thousands)	Under-5 pneumonia and diarrhoea deaths in 2011 (thousands)	Proportion of under-5 deaths from pneumonia and diarrhoea in 2011 (%)	Proportion of children receiving oral rehydration solution for diarrhoea (%)	Proportion of children receiving zinc for diarrhoea (%)	Proportion of children receiving antibiotics for suspected pneumonia (%)	Source of coverage data
Africa							
Angola	120	39	33%	..	..	..	..
Benin	36	10	28%	50%	..	..	DHSp 2011-12
Burkina Faso	101	30	30%	21%	0.4%	47%	DHS 2010
Burundi	39	13	34%	38%	0.1%	43%	DHS 2010
Cameroon	88	24	27%	17%	..	..	DHSp 2011
Chad	79	26	33%	13%	0.2%	31%	MICS 2010
Côte d'Ivoire	75	18	24%	17%	..	..	DHSp 2012
Democratic Republic of the Congo	465	147	32%	27%	2.0%	42%	MICS 2010
Ethiopia	194	67	35%	26%	..	7%	DHS 2011
Ghana	60	12	20%	35%	0.1%	56%	MICS 2011
Guinea	48	13	27%	33%	..	..	DHS 2005
Kenya	107	28	26%	39%	0.2%	50%	DHS 2008-09
Madagascar	45	13	29%	17%	1.4%	..	DHS 2008-09
Malawi	52	11	21%	69%	0.2%	..	DHS 2010
Mali	121	42	35%	14%	..	..	DHS 2006
Niger	89	32	36%	18%	..	..	DHS 2006
Nigeria	756	210	28%	26%	0.7%	23%	DHS 2008
Rwanda	23	7	31%	29%	..	..	DHS 2010
Senegal	30	8	27%	22%	0.2%	..	DHS-MICS 2010-11
Somalia	95	29	31%	22%	0.7%	66%	MICS 2010
Sudan	71	29	41%	13%	..	32%	MICS 2006
Tanzania	122	28	23%	44%	4.7%	..	DHS 2010
Togo	21	5	24%	11%	1.5 %	41%	MICS 2010
Uganda	131	35	27%	44%	1.9 %	47%	DHS 2011
Zambia	46	11	24%	60%	..	47%	DHS 2007
Zimbabwe	24	5	21%	21%	0.1%	31%	DHS 2010-11

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	Total under-5 deaths in 2011 (thousands)	Under-5 pneumonia and diarrhoea deaths in 2011 (thousands)	Proportion of under-5 deaths from pneumonia and diarrhoea in 2011 (%)	Proportion of children receiving oral rehydration solution for diarrhoea (%)	Proportion of children receiving zinc for diarrhoea (%)	Proportion of children receiving antibiotics for suspected pneumonia (%)	Source of coverage data
(Continued from previous page)							
Asia							
Bangladesh	134	26	19%	78%	..	71%	DHSp 2011
Bhutan	1	..	..	61%	0.8%	49%	MICS 2010
North Korea	12	3	26%	74%	19.3%	88%	MICS 2009
India	1655	599	36%	26%	..	13%	DHS 2005–06
Indonesia	134	26	19%	35%	..	..	DHS 2007
Maldives	0	..	..	57%	..	..	DHS 2009
Myanmar	53	13	25%	61%	..	34%	MICS 2009–2010
Nepal	34	8	24%	39%	6.2%	7%	DHS 2011
Pakistan	352	105	30%	41%	..	50%	DHS 2006–07
Sri Lanka	5	..	..	50%	..	..	DHS 2006–07
Thailand	10	1	10%	57%	..	65%	MICS 2005–06
Timor-Leste	2	..	..	71%	5.8%	45%	DHS 2009–10
Vietnam	32	7	22%	47%	1.0%	68%	MICS 2010–11
Totals							
Total under-5 deaths (thousands)	5460	1681	31%	..	..	..	..
Worldwide under-5 deaths (thousands)	6900	1993	29%	..	..	..	..
Proportion of worldwide under-5 deaths (%)	79%	84%	..	..	..	..	..
Totals include deaths in the neonatal period, which are dominated by birth asphyxia, sepsis, congenital defects, and complications of prematurity. The countries listed were those included in activities of the Global Action Plan for the prevention and control of Pneumonia, the Diarrhoea Global Action Plan, and the Diarrhoea and Pneumonia Working Group. DHSp=Demographic and Health Surveys, preliminary report. DHS=Demographic and Health Surveys. MICS=Multiple Indicator Cluster Surveys. Data taken from United Nations Inter-agency Group for Child Mortality Estimation estimates released in September, 2012. ²							
Table 1: Total under-5 deaths, pneumonia deaths, and diarrhoea deaths, and usage rates of key commodities in the 39 collaborating countries							

supervision; and no performance incentives to reward and retain the managerial workforce.

Although IMCI is a mainstay of health delivery at facilities in many low-income and middle-income countries, many countries have attempted to expand access to services through the training and deployment of community health workers. A common barrier was that many countries had policies barring community health workers from giving antibiotics to children presenting with clinical pneumonia. This ban had the paradoxical effect of driving the community health workers' patients into the care of unlicensed drug sellers, where they often received the wrong medications at the wrong dose, frequency, and duration. Far better would be to expand the role of well-trained and supervised community health workers to allow antibiotic treatment in settings with poor access to health facilities (such as in Pakistan's Lady Health Worker programme),¹⁷ or to consider accreditation of private sector health-care providers who have been trained to dispense antibiotics. This approach could enhance the credibility of community health workers in their communities, promote the rational use of antibiotics, reduce time to initiation of antibiotics for severely ill children, and create an opportunity for

community health workers to steer patients towards more appropriate treatments (ie, oral rehydration solution and zinc for acute watery diarrhoea, and amoxicillin for pneumonia).

Theme 3: commodities

Supplies of key commodities were erratic and insufficient for local needs. Although zinc is a core component of the IMCI strategy, it was virtually unobtainable in rural settings, and in the few urban areas where it was available, prices were often unaffordable—eg, as high as US\$3.13 per treatment course in Nigeria.¹⁸ This price represents a market trap—a vicious cycle in which low demand for zinc discourages interest to invest in production and distribution (figure 3). To overcome this problem, country stakeholders recommended simultaneous stimulation of supply and demand with coordinated, marketing campaigns, while supporting manufacturers and distributors to ensure widespread availability.

Additional challenges were absent or irregular supplies of key commodities in public health facilities, and weak systems for restocking. One particular issue raised was that many countries relied on so-called push systems, in which health clinics or health workers were provided

Panel 2: Multicountry consultations focused on reduction of deaths from childhood diarrhoea and pneumonia

Data sources

Qualitative data were obtained from key informants representing countries that contribute 80% of the world's pneumonia and diarrhoea deaths (table 1) by the three work streams (see below). These work streams were funded and managed independently, although with extensive consultation among the project leaders; data for this review were combined post hoc.

The Global Action Plan for Pneumonia (GAPP)

GAPP was spearheaded by WHO and UNICEF. It focused initially on pneumonia but soon expanded its mandate to include diarrhoea. After the plan's launch in 2009,¹² GAPP organised a series of multicountry regional workshops to engage key stakeholders around barriers to implementation. The GAPP workshops included 360 people from 36 countries and were held in Bangladesh, Kenya, Rwanda, Senegal, and Sudan between January, 2011 and November, 2012 (table 1). Attendees at the GAPP workshops included representatives from country ministries of health, the private sector, academia, medical practitioners, UNICEF, WHO, bilateral agencies, and representatives from non-governmental organisations. Further workshops and consultations were ongoing at the time of publication. The workshops followed a predefined agenda, to guide the participants through a series of worksheets to identify key barriers to progress, and recommend solutions.

The Diarrhea Global Action Plan (DGAP)

DGAP was spearheaded by Aga Khan University, Pakistan, and focused exclusively on diarrhoeal disease. DGAP was a collaboration between academic institutions (Boston University School of Public Health [MA, USA], Johns Hopkins Bloomberg School of Public Health [MD, USA], and the University of Toronto [Canada]) in consultation with WHO and UNICEF. As part of a larger goal to create seven detailed country case studies (reports available on request), DGAP sponsored workshops at seven representative countries: Bangladesh, India, Kenya, Nigeria, Pakistan, Vietnam, and Zambia (table 1). Workshops were held between December, 2011 and April, 2012, and involved 224 participants who were invited from government ministries, UNICEF, WHO, academia, the private sector, non-governmental organisations, and the medical community. DGAP's methodology was based on that of GAPP, followed a similar structure for its workshops, and used similar worksheets to guide participants through a set of activities related to access to commodities, and programmatic

challenges and recommendations. Data from DGAP was the source for the bottleneck analysis for zinc, oral rehydration solution, and vaccines.

The Diarrhea and Pneumonia Working Group (DPWG)

The DPWG formed in mid-2011 and is cochaired by UNICEF and the Clinton Health Action Initiative. The group aims to support the efforts of the UN Commission on Life-Saving Commodities for Women and Children to mobilise attention and resources for the scale-up of diarrhoea and pneumonia treatment in ten high-burden countries in Africa and Asia: Democratic Republic of the Congo, Ethiopia, Kenya, Niger, Nigeria, Tanzania, Uganda, Bangladesh, India, and Pakistan (table 1). Between 2011 and 2012, the working group has supported these governments and ministries of health to analyse barriers to pneumonia or diarrhoea treatment; to develop detailed national plans and timelines for the scale-up of zinc, oral rehydration solution, and antibiotics; and to mobilise resources for implementation. Data from the DPWG were the source for the bottleneck analysis for antibiotics.

Data collection and analysis

Workshop participants were assigned to working groups, and outputs were reported as the consensus of each working group, rather than as an average of individual responses. Data from the DGAP workshops underwent a semiquantitative analysis as described below. Data from the GAPP and DPWG workshops supplemented the range of barriers and recommendations identified in the DGAP workshops and provided a broader context.

The bottleneck analysis from DGAP followed the models of Tanahashi and Soucat.^{13,14} Country participants were presented with a series of 12 predefined process steps and asked to estimate the contribution at each step to the total inefficiency. These were then converted into a four-level scale and expressed as a heat diagram for each commodity.

For the semiquantitative analysis of barriers and solutions from DGAP, data were solicited across 13 predefined programmatic domains, and then organised into dominant themes and subthemes. Participants provided a priority ranking for their barriers and recommendations. These were extracted to identify the barriers and solutions most frequently identified as top priority. Additionally, the number of times that specified barriers and recommendations were cited generated a second priority ranking.

with prestocked kits of drugs and supplies at fixed intervals that were not responsive to need or patterns of use. During malarial seasons, antimalarial drugs and diagnostic kits were quickly used up, whereas antibiotic availability exceeded demand; the reverse problem emerged during outbreaks of acute respiratory infections. Zinc was rarely provided in these kits.

A far better approach would be to use recently developed computerised systems that couple local use to drive supply of commodities according to need, which can be set to both forecast seasonal needs and to generate alerts when commodities fall below a specified threshold. Because most health-care delivery occurs at the community level, a more responsive supply-chain

management system would substantially improve the effectiveness of health workers. Cobranding or co-packaging of zinc with oral rehydration solution could be another effective way to couple the use of the interventions, and would be relevant to public and private sector outlets.

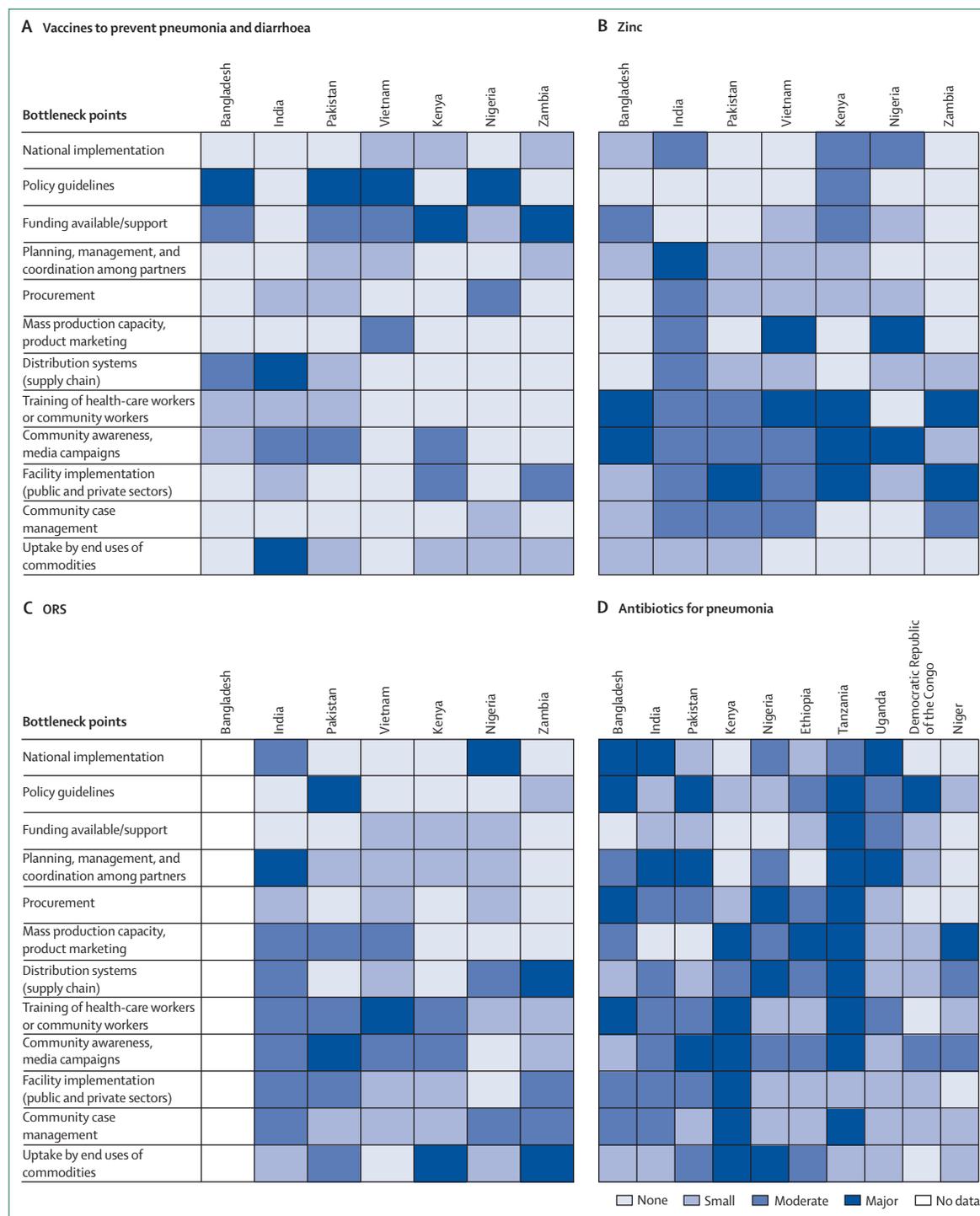


Figure 2: Bottlenecks impeding use of treatments for pneumonia and diarrhoea, by country (A) Vaccines to prevent pneumonia and diarrhoea. (B) Zinc. (C) ORS. (D) Antibiotics for pneumonia. Through the Diarrhea Global Action Plan, six countries contributed data for ORS and seven countries did so for zinc. Ten countries contributed data for antibiotics for pneumonia through the Diarrhea and Pneumonia Working Group. ORS=oral rehydration solution.

Theme 4: programme management

Frustration about the failures of existing health information systems to support programmatic monitoring and assessment was nearly unanimous. Even when collected and accurate, data were not collated or analysed within a meaningful timeframe, nor were the synthesised results of these analyses fed back to the local agencies responsible for allocation of resources. Poor coordination between partners resulted in redundant collection of data and indicators. Three main

proposals emerged, the first of which was to harmonise data collection activities across partner agencies to avoid redundant collection, and to agree on a common set of key metrics. The second proposal was to invest in basic data collection systems that can be adapted flexibly to several settings, are self-explanatory and user friendly, use common formats for data processing, and can be aggregated and analysed at multiple levels. The third proposal was to include stakeholders at all levels of the health-care system, since those who collect

Recommendations to overcome barriers	
Theme 1: coordination	
Poor coordination between ministries and partners	
Lack of coordination across different ministerial branches	Cross-departmental alignment of strategic priorities; coordination of investments and resource allocation
Poor coordination between ministries and implementing partners (ie, non-governmental organisations)	Ministries to play stronger part in organising activities of non-governmental organisations around national strategic priorities
Absence of coordination between governments and donors	Donors and host governments need to coordinate activities to meet consistent objectives
No clarity about national strategic priorities	Ministries of health or other agencies must play a stronger role to ensure activities are coordinated with national priorities
Planning, management, and coordination	
National policies often do not translate into action	Formulate guidelines and action plans to turn policies into action; scale up existing programs to the national level
Redundant initiatives	Minimise parallel or redundant initiatives
Existing guidelines obsolete	Periodic review of all policies and guidelines/action plans
Existing policies do not translate into implementation plans or guidelines	National action plans should not be hypothetical; national action plans needed to target required resources
Public-private partnerships	
Weak or absent public-private partnerships	Targeted governments incentives for partnerships
Procurement from private sector is irregular	Incentives for private sellers to stock/supply key commodities
Lack of coordination leading to redundancies or conflicting goals	Ministries should coordinate activities; create incentives for private agencies to work in support of ministry objectives
Scepticism about sustainability of many public-private partnerships	Success stories could be disseminated
Theme 2: resources	
Financial resources	
Existing funds insufficient	Funding commensurate with burden of disease
Bureaucratic barriers to accessing available funds	Fast track pathways for funds to be accessed readily
Funds controlled centrally but required locally	Decentralise control of budget for greater flexibility
Mismanagement of funds/corruption	Better management to reduce waste/corruption
Allocation of funds based on donor preference, not local need	Ministries should be more assertive in negotiating with funders to support national priorities
Inadequate resources to improve sanitation infrastructure	Engage multilateral donors for sustained, large-scale infrastructure development projects
Inadequate resources to support individual or household sanitation systems	Foundations should invest in local sanitation systems as bridge to definitive solutions or outside areas targeted for large-scale investments in sanitation systems
Human resources	
Not enough health workers	Living wages for health workers
Health worker retention is poor	"Pay for performance" incentives
Health workers are poorly trained	Prioritise resources to train health workers
Health workers do not adhere to guidance or training	Continuing medical education of the health worker labour force
Poor quality of health worker/community health worker supervision and management	Training in supervisory supportive management; managers also need work plans and incentives
Allow community health workers to provide antibiotics for suspected pneumonia or sepsis	Adjust policies to allow community health workers to give antibiotics in particular settings; training must be given in parallel

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Recommendations to overcome barriers	
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Theme 3: commodities	
Supply chain management	
Irregular supply of commodities	Deploy digital supply chain management systems to track use and trigger automatic restocking
Poor/absent forecasting and restocking systems for key commodities	Electronic forecasting software/systems to manage seasonal requirements
Supply is not linked to need	Discourage so-called push supply systems; automated use/restock systems
Low supplies of key commodities	
Perverse incentives for health workers to offer antibiotics over zinc or oral rehydration solution	Incentives promoting zinc or oral rehydration solution over antibiotics for acute watery diarrhoea
Procurement, production, and distribution of oral rehydration solution and zinc are inefficient	Governments must create policies/incentives for private sector to invest in supply chain management systems
Locally produced zinc or oral rehydration solution often too expensive	If imported oral rehydration solution or zinc is cheaper, that should be used instead; consumers should not be subsidising local industries
Low demand	
Low consumer demand for oral rehydration solution and especially for zinc	Campaigns to encourage consumer demand for oral rehydration solution and zinc
Theme 4: programme management	
Data in decision making	
Quality control/feedback loops are poorly coordinated	Reduce cycle time between data collection, analysis, and action (eg, electronic data capture systems)
Local decision making seems to be divorced from burden of disease or commodity use data	Data should not just flow up from health centres to ministries, but must flow back down and be shared at all levels
Absence of partner coordination and sharing of information leads to redundant data collection	Eliminate redundant data collection, establish common sets of indicators, and reduce the burden on staff for collecting/entering data
Monitoring and evaluation, and health information systems	
Data are not collected routinely or systematically	Establish health information systems when absent
Collected data are inaccurate	Data quality must be improved
Accurate data not collected, aggregated, or analysed in a useful timeframe	Electronic data capture systems to reduce time from data collection to analysis and dissemination
Health centres overburdened by data collection for diverse partners	Harmonise data collection items across projects to eliminate redundant or irrelevant elements
Redundant data collection; key indicators, such as supplies of zinc and oral rehydration solution, are absent from existing systems	Eliminate redundant/irrelevant indicators; add key indicators
Service delivery and referral	
Poor access to key services	Strengthen referral linkages within the health-care system
Referral linkages are weak	Strengthen communication within health system through mobile phones
Clients do not seek care or are unaware of services	Community outreach to increase awareness and drive demand
Quality of care	
Poor quality of available services	Client feedback as part of health worker and clinic assessments
Guidelines are not disseminated	Dissemination of guidelines supporting target behaviours
Health workers are poorly trained/supported	Continuing medical education and incentives to motivate health workers
Theme 5: advocacy	
Child survival not prioritised	
Scarce interest in pneumonia and diarrhoea globally and nationally	Strong, sustained advocacy at national/international levels promoting this issue
Communities do not see pneumonia or diarrhoea as a priority	Include community leaders in planning and promotion of activities
Insufficient social mobilisation	
Sanitation and hygiene not perceived to be a priority	Promotion of hand hygiene, chlorine tablets, and sanitary practices
No community ownership of problem	Include community leaders in planning and promotion of activities
Inadequate promotion of key health-seeking behaviours	Social marketing to restrict use of antibiotics to treatment of severe pneumonia and bloody diarrhoea; to discourage antibiotics for coughs and colds and acute watery diarrhoea; and to promote zinc/oral rehydration solution as the first-line treatment for watery diarrhoea

Table 2: Barriers and recommendations to reduce childhood deaths due to diarrhoea and pneumonia

the data should be informed about the results of their efforts.

Theme 5: advocacy

Workshop participants believed that childhood deaths from pneumonia and diarrhoea rated low on the list of worldwide priorities, far below HIV/AIDS or malaria. To improve this situation, sustained and effective advocacy campaigns to boost awareness and motivate donors were needed. Failure by countries to promote key interventions was a major barrier, especially for zinc and oral rehydration solution. Consumers' insufficient knowledge about the availability and importance of these interventions was both a consequence of this failure and an additional barrier. Awareness and support for the water, sanitation, and hygiene initiatives was low or absent in many countries, and indicated the perceived magnitude of resources that are needed to upgrade (or develop de novo) effective sanitation systems, and the difficulty in achievement of sustained, widespread behavioural change regarding hand hygiene, water safety, and food preparation.

To improve this situation, social marketing should be used to aggressively promote desirable behaviours and discourage undesirable practices, such as prescription of antibiotics for acute watery diarrhoea. Health workers should be included as messengers for these efforts. Community health workers in particular tend to have a strong sense of ownership over the health of their communities and could be ideally suited to promotion of the lifesaving role of oral rehydration solution, zinc, and early antibiotics for pneumonia.

Similarly, advocacy will also be essential nationally and transnationally to motivate donors and policy makers to support childhood survival programmes; to build an effective and motivated health worker force; to invest in long-term, large-scale public infrastructure projects to develop or modernise sanitation systems; and to convince communities of the benefits of hand, water, and food hygiene.

Prioritisation of barriers and recommendations

With some redundancy across working groups and countries, the DGAP workshop participants cited a total of 371 barriers and 222 recommendations across 13 pre-defined programmatic domains. The top five areas differed slightly in their rank order for the barriers and recommendations (appendix); they were: inadequate monitoring and assessment of programmes, poor coordination of efforts, insufficient human resources, weak supply chains, and low uptake and poor quality of services. Within all these areas, a set of specific barriers and recommendations were extracted from the worksheets and ranked. This method yielded a representative list of the consensus view from the DGAP workshop participants about the priorities for initial investments (appendix pp 2–3). The top recommendations in each area were:

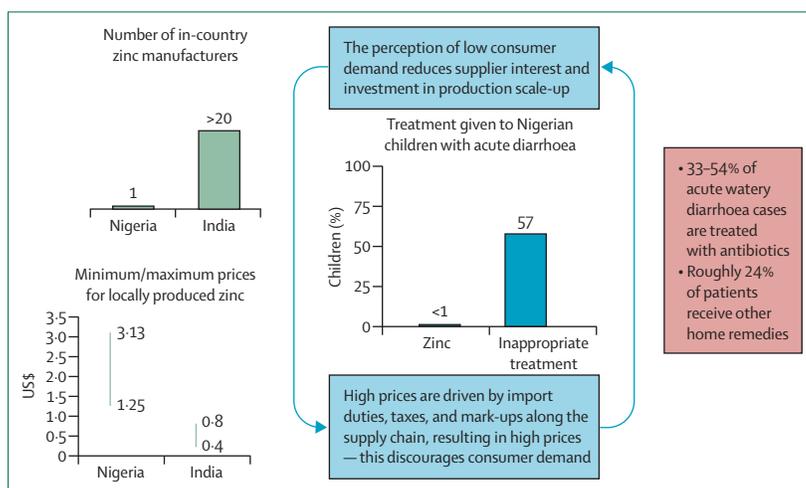


Figure 3: Why zinc is so expensive in Nigeria: the market trap

Data taken from references 19,20.

develop appropriate clinical guidelines; increase training and support for health workers; strengthen systems for procurement and production of key commodities; improve government coordination of programmatic efforts; and improve the accuracy, completeness, and quality of data for monitoring and assessment.

Discussion

On the basis of the perceptions of several hundred key informants (the workshop attendees) from high-burden countries in Africa and Asia, the most pressing challenges in reduction of childhood deaths from pneumonia and diarrhoea were inadequate financial and human resources; poor coordination of efforts; insufficient access, production, distribution, and promotion of key commodities; weak monitoring and assessment systems; and ineffective advocacy to promote systemic structural changes and motivate donors.

Our analysis was based on an especially large sample of key informants across 39 countries, and is consistent with the types of challenges and recommendations that have been described previously during the past decade.^{21–23} Indeed, such issues are quite typical of challenges faced by health-care systems in low-income and middle-income countries in general, and are not necessarily specific to diarrhoea or pneumonia. Whether this news is good or bad depends on one's perspective. Encouragingly, the challenges and recommendations focused on pragmatic issues in the areas of programme management and resource allocation. These solvable problems can build upon the existing literature for improving health systems.¹⁴ However, on the negative side, the following question is created: if these problems are so well known and so solvable, why haven't they been solved already?

One key factor could be that our recent child survival investments in low-income and middle-income countries have favoured technically sophisticated, expensive

See Online for appendix

solutions targeting specific pathogens or diagnostic challenges, at the expense of broader-based investments in health-care systems. The recent licensure of several highly effective vaccines targeting key pathogens responsible for pneumonia and diarrhoea, *Streptococcus pneumoniae*, and rotavirus, is emblematic.^{24–28} Both vaccines are welcome additions to our public health armamentarium, but neither vaccine covers the full range of pathogens that cause pneumonia and diarrhoea, and neither is completely effective. Some children, including some who were fully vaccinated, living in communities with high vaccine coverage, or both, will still fall acutely and seriously ill. Without basic treatments (zinc, oral rehydration solution, and antibiotics) many will die.

To elaborate further, if the global uptake of rotavirus vaccines matched that of the DPT (diphtheria–tetanus–pertussis multivalent) vaccines, an estimated 2·6 million child deaths could be prevented in a 20-year period (roughly 189 000 deaths per year).²⁹ With the assumption that vaccines could be delivered equitably, which is probably optimistic, all-cause under-5 mortality could be reduced by about 2%. By contrast, the combination of oral rehydration solution and zinc could avert an estimated 75% of diarrhoeal deaths, reducing overall under-5 mortality by 20%; antibiotics for sepsis or pneumonia could reduce mortality by a further 12%.³⁰

We do not make this point to devalue vaccines, which are an essential component of a coordinated strategy to reduce childhood mortality. However, the high cost and time needed to develop new vaccines demands a balanced approach that allocates resources to prevention and treatment according to need. Vaccination of a child represents a substantial investment in that child's survival, and a failure to invest in treatment jeopardises our investments in prevention.

A second key factor could be that the global health community has lost focus on paediatric pneumonia and diarrhoea in the past few decades. As leaders in child survival, UNICEF and WHO bear some of the responsibility, although both agencies have refocused on childhood mortality in recent years.^{12,31,32} One sign of progress is that most African countries now have policies promoting the IMCI strategy (although coverage and quality of care have lagged),^{33,34} and efforts are underway to expand community case management of pneumonia^{11,15,16,35} (eg, Pakistan's Lady Health Worker Programme).¹⁷ However, a crucial distinction is that IMCI is an effective “strategy” to reduce childhood mortality, but it is not a “programme” in the sense of the United States President's Emergency Plan For Aids Relief (PEPFAR), the President's Malaria Initiative (PMI), or the Stop TB Partnership.³⁶ Whether the effectiveness of IMCI and related initiatives could be improved if operationalised as a programme in the model of PEPFAR or PMI is an open and intriguing question.

A third factor is that childhood diarrhoea and pneumonia have not achieved the same priority status as has

HIV/AIDS, malaria, or tuberculosis, which have received most new investments in the past decade, but contribute to only 13% of childhood deaths.³⁷ Diarrhoea and pneumonia combined contribute 2971 disability-adjusted life-years (DALYs) per 100 000 people per year, which is more than double the 1184 DALYs per 100 000 people per year for HIV/AIDS.³⁸ Yet diarrhoea and pneumonia programmes do not receive twice the funding for HIV/AIDS—quite the opposite in fact. In 2008, US\$13·7 billion dollars were allocated solely to HIV/AIDS programmes in low-income and middle-income countries.³⁹ By contrast, in 2010, a total of US\$3·9 billion were allocated to all maternal, newborn, and child health activities combined, of which roughly US\$1·3 billion were allocated to areas that might have included pneumonia and diarrhoea.⁵ However, the problem is not that we spend too much on HIV/AIDS, but that we spend far too little on childhood pneumonia and diarrhoea.

Our successful response to HIV/AIDS is a powerful reminder of what can be achieved when political will and finances align.⁴⁰ A key contributor was advocacy. Because advocacy has been passionate and persistent, the public health community aligned itself around a shared goal, resources were mobilised, action plans developed, commodities purchased, and infrastructure developed. Effective advocacy broke the logjam of inertia around the misplaced belief that the HIV/AIDS problem in less developed countries was too big, too expensive, and too complicated to solve. The era of intense advocacy appropriately developed into the existing state of continuous programmatic quality and improvement, which is where management, co-ordination, monitoring and assessment, supply-chain logistics, patient support, and human resources become the key determinants of success or failure, and is ultimately where most lives are saved.

We believe that the solutions to reducing childhood pneumonia and diarrhoea deaths are well within our capacity. What is absent is the ambition and coordination to bring proven interventions to scale (see the second paper in this Series),⁴¹ and modest resources to fill implementation gaps, promote consumer demand, train health workers, and improve health information to allow us to track progress and strengthen accountability. We also need to explore new ways to organise these efforts. The Control of Diarrheal Diseases programme is an example of the old paradigm. This programme focused on a short list of interventions that were delivered exclusively through the public sector and focused on one disease. Although the programme achieved some successes, this model was eventually abandoned after it proved inflexible, and because of its failure to capitalise on many opportunities to improve child health and to integrate with other initiatives. The emerging new paradigm instead emphasises plurality: many cadres of providers across several care delivery settings; integrated care across many disorders; many sources for commodities; and ownership of

and responsibility for programmes distributed across both public and private sectors.

The ingredients of success start with a coordinated action plan; a committed, well trained, motivated, and fairly compensated health worker force; and a vocal public health information campaign to explain to donors and policy makers at every level how these initiatives will save children's lives, why they are worth investing in, and what our priorities for interventions should be.⁴² Our response to the HIV/AIDS crisis is proof that even expensive treatments that rely heavily on public sector support can reach high coverage rates sustainably. Moreover, the successful platforms created by the HIV and malaria scale-up efforts and the introduction of new vaccines could be leveraged to address diarrhoea and pneumonia interventions.

Admittedly, some of the barriers identified by the workshop participants were generic, and some of their proposed solutions were merely the opposite of the challenges. However, such limitations are inherent in a qualitative exercise of this type, and should not distract from the main conclusion of this analysis: the pathway to reduce child deaths from pneumonia and diarrhoea depends on how we prioritise child survival and the investments that we choose to make.

Hopeful indications suggest that political will is starting to coalesce around solving this problem. In April, 2012, the UN Commission on Life-Saving Commodities for Women and Children was formed, and oral rehydration solution, zinc, and amoxicillin were included in their mandate in recognition of the potential of these drugs to substantially reduce preventable child deaths.⁴³ In June, 2012, India, Ethiopia, and the USA convened a worldwide Call to Action summit for child survival. The follow-up to this summit, *Committing to Child Survival: A Promise Renewed*, constituted an historic opportunity for the global community to essentially end preventable child deaths due to diarrhoea and pneumonia.⁴⁴ The question is, will we take it?

Contributors

CJG led the Boston University School of Public Health DGAP team. He was involved in developing data collection instruments for the workshops, analysing data, and writing the reports, and was the lead author for this review. SQ and SA jointly led the Global Action Plan for the prevention and control of Pneumonia (GAPP) work from WHO; they provided data from GAPP workshops used in this report; and actively participated at all stages in this review. MM was the project manager for the Boston University School of Public Health DGAP team; worked closely with CJG on data collection, analysis, and interpretation; and was involved in drafting of this review. MY and KS jointly led the Diarrhoea and Pneumonia Working Group efforts; they were responsible for data collection, and actively participated in the work plans in the ten Diarrhoea and Pneumonia Working Group reports that emerged. They actively participated in all aspects of this report. LC-V is a statistician at UNICEF, and compounded the disease incidence and intervention use data presented in this report; she also contributed to the writing of the review. ZB was the principal investigator for DGAP, secured the funding for the project, identified the project objectives, coordinated the collaborating teams, and was a key contributor to this Series paper.

Conflicts of interest

We declare that we have no conflicts of interest.

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