

One is too many

Ending child deaths from
pneumonia and diarrhoea



unite for
children

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Foreword

For most children around the world, pneumonia and diarrhoea are easily prevented and managed illnesses with simple and effective interventions and rarely life threatening. However, not all children are so fortunate.

Shockingly, in many parts of the world a child dies every 35 seconds of pneumonia; every 60 seconds, another child dies of diarrhoea. Of the nearly 6 million children who do not live beyond the age of 5, nearly one quarter die from these illnesses.

The reality is that pneumonia and diarrhoea are diseases of poverty, concentrated within the poorest populations around the globe. Moreover, childhood deaths from pneumonia and diarrhoea are largely preventable. How have we allowed such profound inequality to continue? More importantly, how can we foster a more equitable future for the world's most vulnerable children?

We know what needs to be done in order to reduce the deleterious effects that these twin scourges have on all children. And we know that we need to focus primarily on those living in the most impoverished situations to reduce pneumonia and diarrhoea as a major cause of death for children under 5.

Based on research and evidence, this report lays out a series of steps that must be taken to reduce death by pneumonia and diarrhoea in children. Protective interventions such as exclusive breastfeeding, adequate complementary feeding and Vitamin A supplementation provide the foundations for keeping children healthy and free of disease, while preventative interventions such as the provision of necessary immunizations, safe drinking water, sanitation and hygiene, and reduced household air pollution prevent children from becoming ill. Proven cost-effective interventions like antibiotics for pneumonia and oral rehydration salts to prevent dehydration from diarrhoea should be scaled-up to reach the most vulnerable and prevent unnecessary deaths.

Improving data collection systems including the expansion of household surveys, strengthening health management information systems and vital registration to better estimate the burden of pneumonia and diarrhoea and to monitor treatment is essential in order to take action based on evidence.

This report describes the face of current pneumonia and diarrhoea-related mortality and illustrates the startling divide between those being reached and the abundant number of children left behind, a divide which threatens sustainable development for the world's poorest nations. By developing key protective, preventative and treatment interventions, collectively we now have the knowledge and the tools to achieve better results for children.

Healthy children are the foundation of robust economies and thriving communities; they are the lifeblood of sustainable development. With greater investment from governments and partners, pneumonia and diarrhoea – two preventable and treatable childhood illnesses – can be overcome, contributing to the achievement of the Sustainable Development Goals, specifically to the Goal 3 target of ending preventable child deaths.

Child deaths due to pneumonia and diarrhoea can be stopped. Let us act to achieve this goal.



Jeff O'Malley
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Executive summary



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The stakes are high. Pneumonia and diarrhoea are responsible for the unnecessary loss of 1.4 million young lives each year and are a threat to sustainable development for the world's poorest nations.

We have the knowledge and the tools to do better. Child deaths due to diarrhoea and pneumonia are largely preventable – even one death is too many. The fact that children continue to die from these diseases is a reflection of deep inequalities.

Pneumonia and diarrhoea are most deadly for the youngest and the poorest children.

Within countries, deaths due to pneumonia and diarrhoea continue to be concentrated within the poorest populations.

Low and lower-middle income countries are home to 62 per cent of the world's under 5 population, but account for more than 90 per cent of global pneumonia and diarrhoea deaths. The very poorest countries carry a disproportionate share of the burden of death: more than 30 per cent of all pneumonia and diarrhoea deaths are concentrated in low-income countries, yet these countries are home to only 15 per cent of the world's under 5 population.

Pneumonia and diarrhoea mortality disproportionately affect the youngest children: around 80 per cent of deaths associated with pneumonia and approximately 70 per cent of deaths associated with diarrhoea occur during the first two years of life.¹

Pneumonia and diarrhoea deaths are dropping – but not quickly enough.

There has already been substantial progress to reduce pneumonia- and diarrhoea-related mortality since 2000: deaths from these two diseases declined by nearly half

between 2000 and 2015, from 2.9 million deaths to the current 1.4 million.

Diarrhoea deaths have dropped more significantly since 2000, falling from 1.2 million to 526,000 in 2015 – a decline of 57 per cent. Deaths due to pneumonia declined at a slower rate during this period, falling from 1.7 million in 2000 to 920,000 in 2015. Indeed, pneumonia mortality rates have declined at a significantly slower rate than those of other common childhood diseases, such as malaria, measles and HIV.

We can end most pneumonia and diarrhoea deaths with a set of tried and tested interventions.

As outlined in the Global Action Plan for Pneumonia and Diarrhoea (GAPPD):

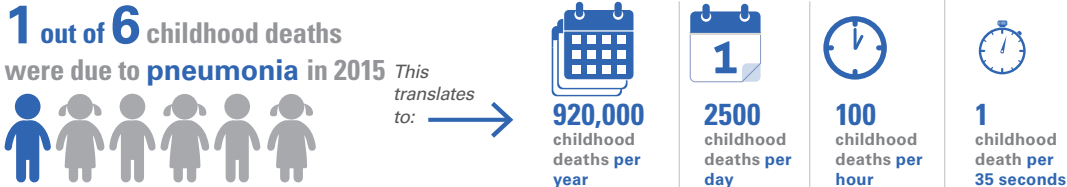
Protecting children with good health practices means:

- Promoting exclusive breastfeeding for the first 6 months of life;
- Facilitating continued breastfeeding until age 2 or longer, with appropriate complementary foods;
- Providing vitamin A supplementation.

Preventing pneumonia and diarrhoea in the first place involves:

- Delivering vaccines – including those for pertussis, measles, Hib, PCV and rotavirus;

No child needs to die from pneumonia or diarrhoea; ending preventable child deaths from these diseases is within our grasp



- Promoting good hygiene, including handwashing with soap;
- Ensuring safe drinking water and sanitation;
- Reducing household air pollution;
- Preventing HIV infection;
- Protecting HIV-infected and exposed children with Co-trimoxazole.

Treating pneumonia and diarrhoea effectively includes:

- Improving care seeking and referral;
- Ensuring appropriate and timely diagnosis and treatment at the community level;
- Ensuring access to medicine and supplies – antibiotics (Amoxicillin DT) and oxygen (for pneumonia) and low osmolarity oral rehydration solution (ORS) and zinc (for diarrhoea);
- Providing nutritious complementary foods and/or breast milk.

An increasing number of innovative technologies and strategies exist with proven potential to accelerate progress on prevention, diagnosis, and treatment of pneumonia and diarrhoea.

More children under 5 are already benefitting from effective interventions than ever before – but progress is too slow and challenges remain in ensuring that key interventions reach all children in need.

Exclusive breastfeeding – despite the benefits of exclusive breastfeeding for survival and lifelong health, in 2015 just over 40 per cent infants aged 0-5 months were exclusively breastfed.²

Adequate complementary feeding – globally, only a shocking one in every six children under 5 is receiving a minimally acceptable diet.²

Vitamin A supplementation – almost 70 per cent of children in priority countries were fully protected with two high-dose vitamin A supplements, in 2014.³

Vaccines – coverage of key pneumonia-related vaccines is increasing and progress in sub-Saharan Africa is improving faster than the global average. Yet despite recent progress, in 2015 just over 60 per cent of children globally received the recommended three doses of Hib vaccine and just over 30 per cent received the PCV vaccine.

Water, sanitation and hygiene – preventative measures to improve access to clean drinking water, sanitation and hygiene are translating into fewer diarrhoea-related deaths in a number of countries.

Air pollution – around half of childhood pneumonia deaths are associated with air pollution. The effects of indoor air pollution kill more children globally than outdoor air pollution. At the same time, around 2 billion children live in areas where outdoor air pollution exceeds international guideline limits.⁴

Care seeking – since 2000, the rate of care seeking for symptoms of pneumonia has increased by only 8 percentage points – from 55 per cent in 2000 to 63 per cent in 2015. Within countries, there are still significant disparities in care seeking for symptoms of pneumonia between the richest and poorest households, across all regions. However, there has been important progress to close the urban/rural gap in care seeking during this time.

ORS and zinc treatment – ORS coverage levels are still unacceptably low across almost all regions, in rich and poor households alike: only two in ten children have access to this essential treatment globally. The gaps in coverage are even greater between the richest and the poorest children. Gender equity in use of ORS varies widely according to region, with the widest discrepancy found in South Asia where 56 per cent of boys are treated, compared to only 49 per cent of girls. In Bangladesh, despite high overall coverage levels, coverage for boys is 81 per cent while girls lag behind at only 73 per cent. Global coverage of zinc supplementation is also extremely low in all regions.

1 out of 10 childhood deaths were due to **diarrhoea** in 2015



This translates to: →



526,000
childhood deaths per year



1400
childhood deaths per day



60
childhood deaths per hour



1
childhood death per 60 seconds

Oxygen therapy – far too many children die because the symptoms of severe pneumonia are not recognized and oxygen therapy is not available.

To bridge gaps in coverage, we need coordinated efforts at all levels.

Recommendations include:

- Implementing recommended policies and guidelines that reflect the latest evidence on managing pneumonia and diarrhoea and allocating adequate national and donor financing;
- Investing in front-line health services, including community management of pneumonia with Amoxicillin DT, to reach vulnerable populations and ensure rapid assessment and treatment of these childhood illnesses;
- Improving household survey data collection, health management information systems and vital registration to better estimate the burden of diarrhoea and pneumonia and monitor treatment;
- Guaranteeing access to essential commodities – such as medical oxygen and Amoxicillin dispersible tablets;
- Leveraging tools and innovations to increase coverage in hard to reach places.

When it comes to public health spending, pneumonia and diarrhoea are seriously underfunded. We need greater targeted financial investments to end preventable pneumonia and diarrhoea deaths for all children.

Pneumonia and diarrhoea have a disproportionately high impact on mortality

and are among the least expensive diseases to treat – yet they continue to receive little attention and only a fraction of global health investment.

In the period between 2003 and 2013, disbursements for these two diseases only increased by slightly more than four percentage points – from 7.3 per cent of all official development assistance and contributions from private donor (ODA+) disbursements for health in 2003 to 11.6 per cent in 2013.⁵

Disbursements were higher to the lower-income countries, while middle-income countries with large populations accounting for nearly half of the burden of disease received a smaller proportion of disbursements. While poverty should continue to drive development assistance, there is a need to increase funding to lower-middle-income countries with high burdens of pneumonia and diarrhoea to ensure that the most vulnerable children are covered with key interventions – no matter where they live.

If we act now, there is great potential to save lives with high coverage of the most effective interventions.

If we continue with business as usual, around 24 million children will die from pneumonia and diarrhoea by 2030. But with adequate protective, preventative and treatment measures that the rest of the world takes for granted, most of these deaths are avoidable.

Approximately 12.7 million children's lives could be saved if all protect, prevent and treat interventions were gradually scaled up

to 90 per cent between 2016 and 2030.⁶ Approximately 4.9 million lives could be saved from pneumonia and 5.6 million lives from diarrhoea.

Faster progress to end pneumonia and diarrhoea deaths is critical to achieving the Sustainable Development Goals.

Healthy children are the foundation of robust economies and thriving communities and nations; they are the lifeblood of sustainable development. But without greater investments from governments and partners, two of the most preventable and easily treatable childhood illnesses will thwart the achievement of the SDGs, particularly Goal 3 target of ending preventable child deaths and reducing mortality.

Targeted funding to scale up effective in-country programme implementation will be critical in driving progress towards the 2030 SDG agenda.

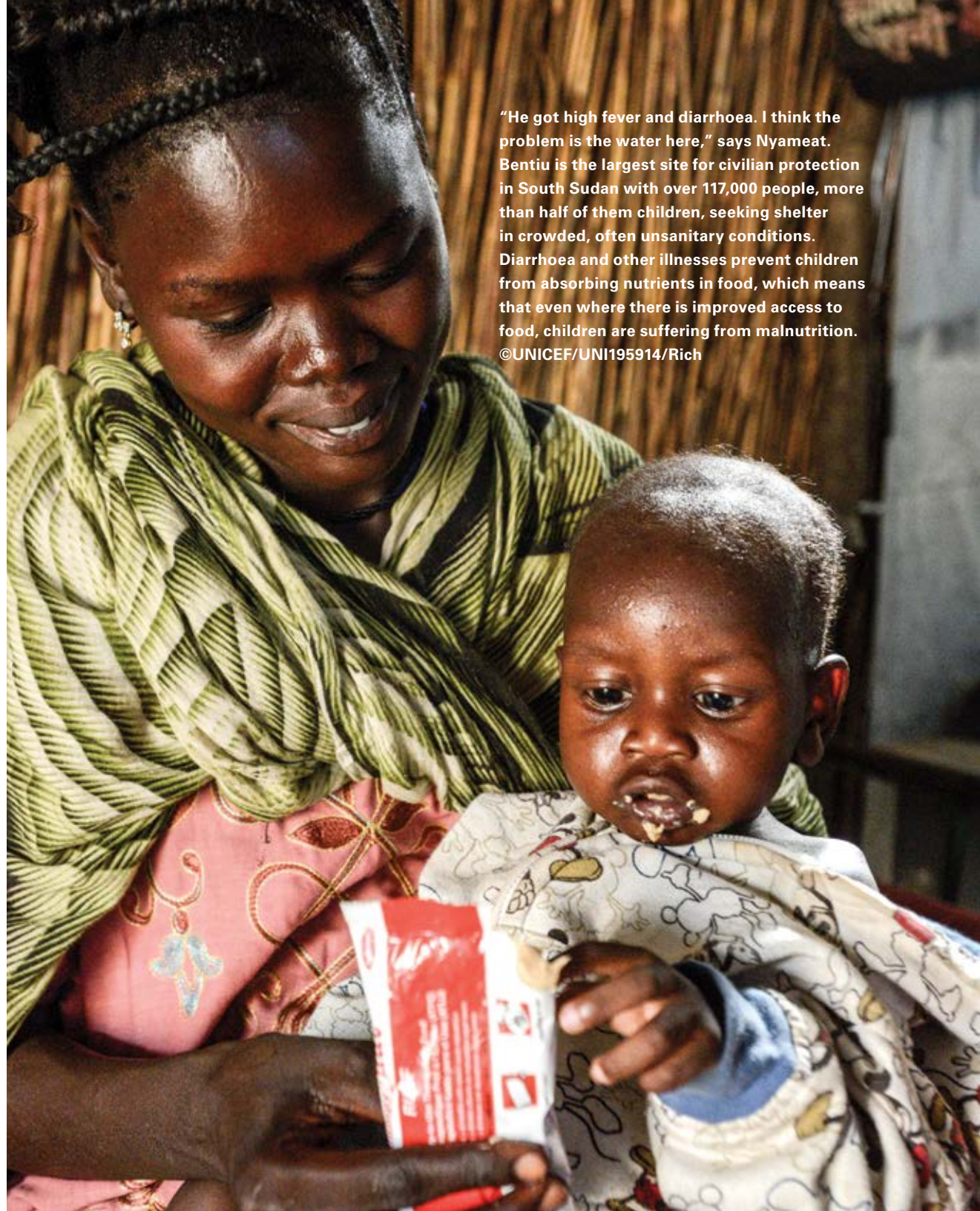


Faster progress to end pneumonia and diarrhoea deaths is critical to achieving the Sustainable Development Goals

1

Introduction

“He got high fever and diarrhoea. I think the problem is the water here,” says Nyameat. Bentiu is the largest site for civilian protection in South Sudan with over 117,000 people, more than half of them children, seeking shelter in crowded, often unsanitary conditions. Diarrhoea and other illnesses prevent children from absorbing nutrients in food, which means that even where there is improved access to food, children are suffering from malnutrition. ©UNICEF/UNI195914/Rich



Pneumonia and diarrhoea kill 1.4 million children every year – more than all other childhood illnesses combined

Background and objectives

Diarrhoea and pneumonia are leading childhood killers; together, they are responsible for almost one quarter of all deaths in children under 5. There is nothing new or exotic about these two diseases. In fact they are some of the oldest and most common in the world; most children contract pneumonia and diarrhoea at some point during childhood. However, in the poorest countries in the world, these commonplace illnesses are also insidious killers. Every year, more than 1.4 million children die from diarrhoea and pneumonia,¹ particularly in settings with limited access to health services, nutritious foods, basic sanitation and hygiene.

No child needs to die from pneumonia and diarrhoea; ending preventable child deaths from these diseases is within our grasp. The burden of child deaths due to pneumonia and diarrhoea has already halved since 2000, reducing from 2.9 million to 1.4 million deaths, owing to an overall decline in child deaths and some modest improvements in coverage of preventive and treatment interventions. But this rate is still low compared with declines in other common childhood illnesses during this time (see Figure 1).

The high concentration of pneumonia and diarrhoea deaths among poor and marginalized populations is a key marker of inequality both across and within countries, and much more needs to be done to reach the most vulnerable children.

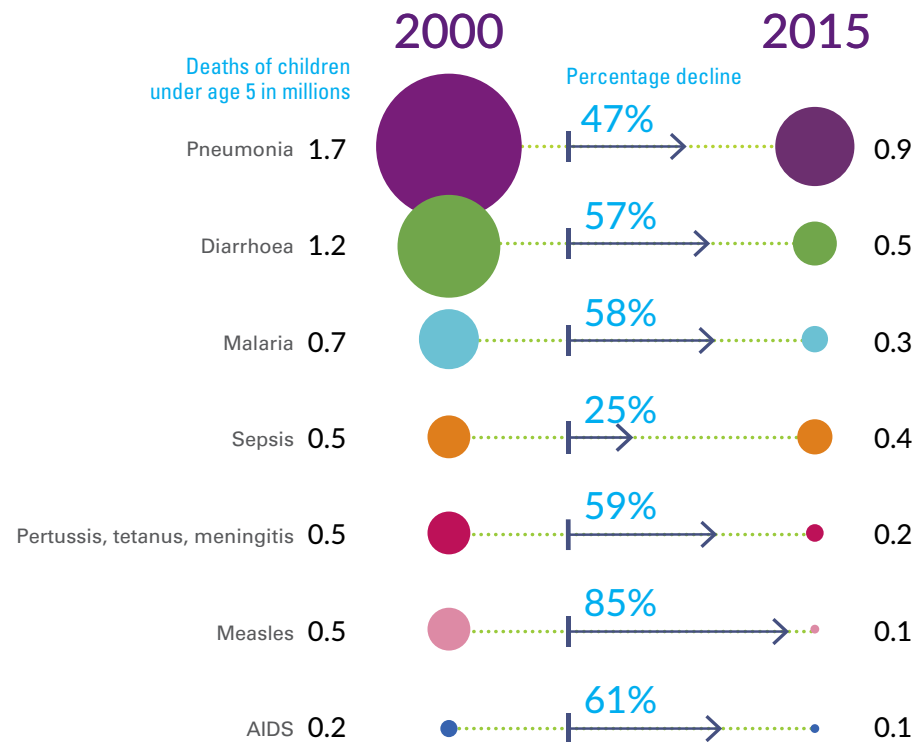
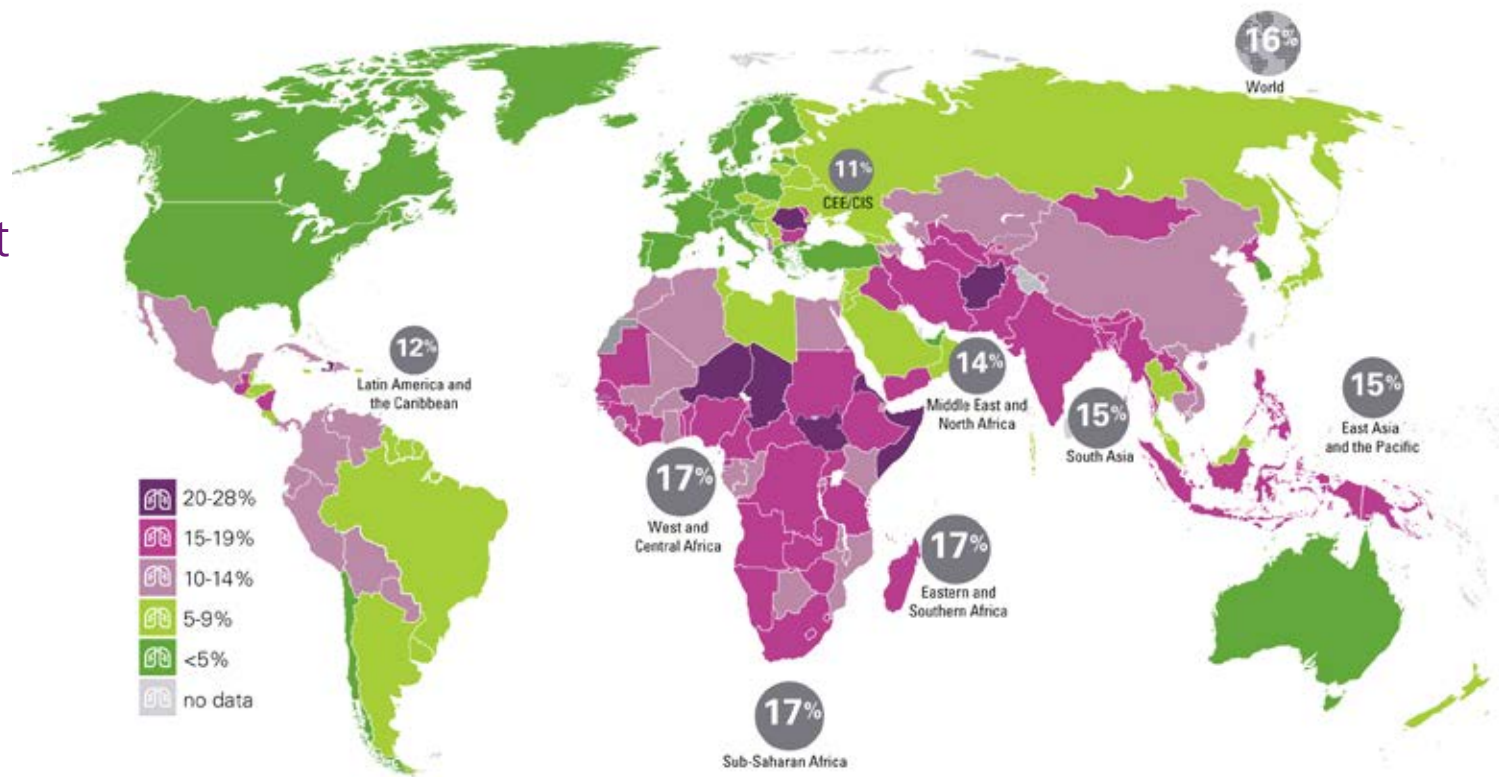


Figure 1: Reductions in child mortality for common childhood illnesses, 2000-2015

Source: WHO and Maternal and Child Epidemiology Estimation Group (MCEE) estimates 2015

Pneumonia claims the lives of the world's most vulnerable children



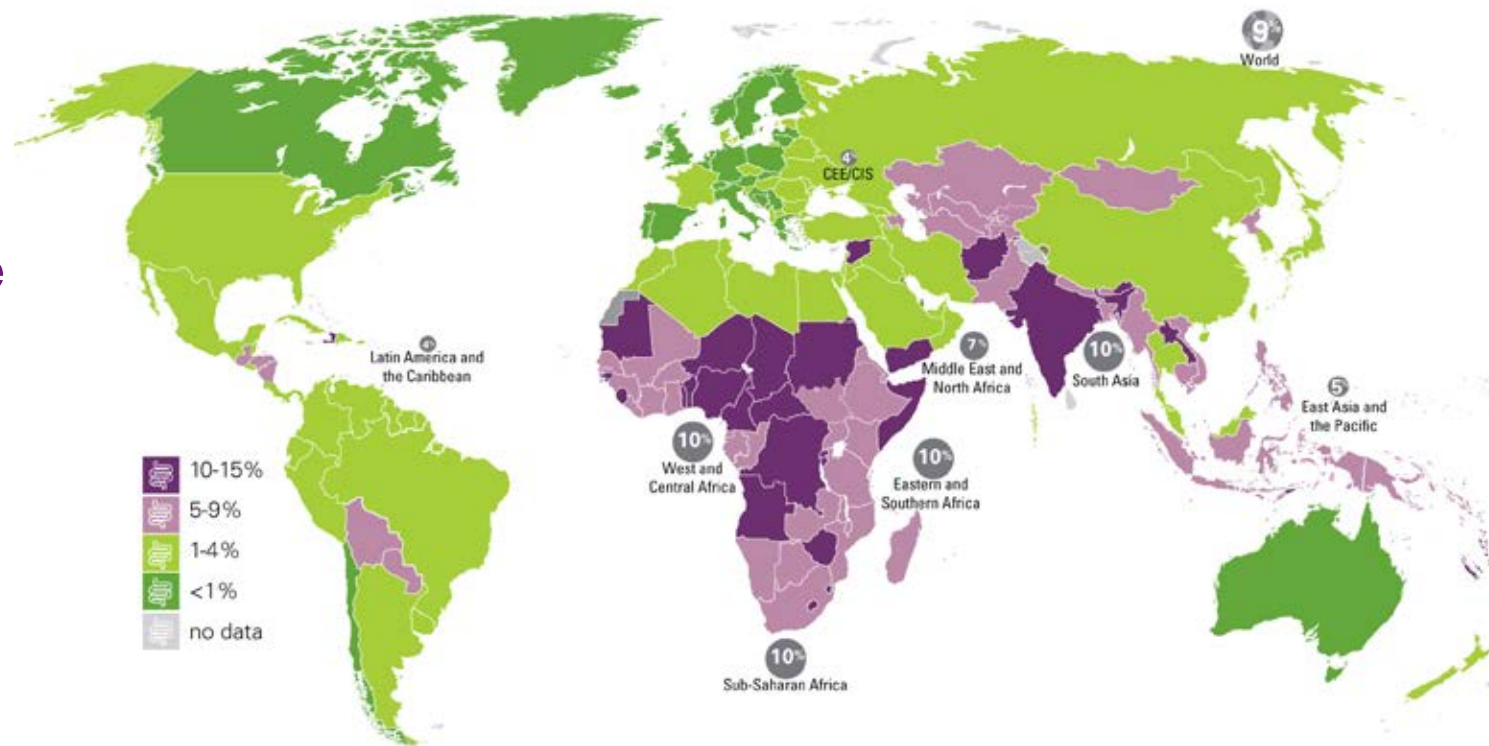
UNICEF's commitment to equity includes addressing the root causes of child mortality to ensure that all children have the same opportunity to survive and reach their full potential. Tackling diarrhoea and pneumonia lies at the very heart of this work: to reduce mortality rates, we must make progress to end these very preventable illnesses.

The Integrated Global Action Plan for Pneumonia and Diarrhoea (GAPPD) sets forth strategies and solutions for reducing the burden of these diseases by 2025. The GAPPD establishes progress goals for the control of pneumonia and diarrhoea, provides a roadmap for

Figure 2: Percentage of deaths among children under age 5 attributable to pneumonia, 2015

Source: WHO and Maternal and Child Epidemiology Estimation Group (MCEE) provisional estimates 2015

Diarrhoea is most deadly in the poorest places in the world



national governments, and calls for coordination and active engagement amongst all stakeholders (see box on page 13).

The Global Strategy for Women’s, Children’s and Adolescent’s Health will fuel progress in reducing the global burden of pneumonia and diarrhoea, which in turn will support the Sustainable Development Goals (SDG) framework. SDG Goal 3.2, to end preventable deaths of newborns and children under age 5, can simply not be achieved without investments to support the scale up of improved prevention, diagnostic and treatment interventions for pneumonia and diarrhoea.

Figure 3: Percentage of deaths among children under age 5 attributable to diarrhoea, 2015

Source: WHO and Maternal and Child Epidemiology Estimation Group (MCEE) provisional estimates 2015

Preventative interventions to improve home environments, sanitation and hygiene, address undernutrition, and ensure access to essential health services are crucial, given the links between pneumonia, diarrhoea and poverty. When children do fall ill, antibiotics for bacterial pneumonia and oral rehydration salts (ORS) and zinc for diarrhoea are proven, affordable and lifesaving interventions. Innovations to improve diagnosis and treatment can help accelerate progress.

We know what works and what needs to be done. Yet progress has been slow compared with progress to improve child survival overall; given their larger burdens, pneumonia and diarrhoea clearly need much greater attention.

In this report, acute respiratory infection (cough with fast or difficult breathing due to a chest-related problem), is referred to as 'pneumonia' or 'symptoms of pneumonia'. This report assesses current status and progress in addressing the burden of pneumonia and diarrhoea in children under 5. It provides an overview of the coverage of high impact preventive and treatment interventions and innovations and explores lessons learned from the implementation of these interventions, including the case management of childhood illnesses. The report also looks forward to project the potential lives saved by scaling up effective interventions in the context of the 2030 development agenda, and provides recommendations to guide policy action at the national level.



A woman does her cooking with clay stoves at a local home in Seedstore, Bhaluka, Mymensingh, Bangladesh. Her daughter plays with her amidst the smoke from the clay stoves.
©UNICEF/UNI133004/Khan

A person is cooking over a traditional wood-burning stove in a rural setting. The stove is made of mud and brick, with a large metal pot on top. The person is wearing a blue shirt and is using a wooden spoon to stir the contents of the pot. The background shows a simple structure made of mud and wood, with some tools and materials hanging on the wall.

Integrated Global Action Plan for Pneumonia and Diarrhoea goals by 2025 are to:

- reduce mortality from pneumonia in children less than 5 years of age to fewer than 3 per 1000 live births;
- reduce mortality from diarrhoea in children less than 5 years of age to fewer than 1 per 1000 live births;
- reduce the incidence of severe pneumonia by 75% in children less than 5 years of age compared to 2010 levels;
- reduce the incidence of severe diarrhoea by 75% in children less than 5 years of age compared to 2010 levels;
- reduce by 40% the global number of children less than 5 years of age who are stunted compared to 2010 levels.

Coverage targets by the end of 2025 include:

- 90% full-dose coverage of each relevant vaccine (with 80% coverage in every district);
- 90% access to appropriate pneumonia and diarrhoea case management (with 80% coverage in every district); at least 50% coverage of exclusive breastfeeding during the first 6 months of life; virtual elimination of paediatric HIV.

By the end of 2030:

- universal access to basic drinking water in health care facilities and homes;
- universal access to adequate sanitation in health care facilities by 2030 and in homes by 2040; universal access to handwashing facilities (water and soap) in health care facilities and homes;
- universal access to clean and safe energy technologies in health care facilities and homes.

2

Pneumonia and Diarrhoea

A primer



Chaurasia Anita who is an Anganwadi health worker beneath a sign advertising the benefits of oral rehydration salts (ORS) and zinc tablets at the local clinic in Rajasan Village, India. ©UNICEF/UNI88334/Crouch

What are pneumonia and diarrhoea?

Pneumonia is a respiratory infection affecting the lungs. During normal breathing, small sacs in the lungs called alveoli fill with air. When children contract pneumonia the alveoli fill with pus and fluid, restricting breathing and making it painful.

Pneumonia can be caused by bacteria, viruses and fungi. *Streptococcus pneumoniae* is the most common cause of bacterial pneumonia in children, followed by *Haemophilus influenzae* type b (Hib). Respiratory syncytial virus is the most common viral cause of pneumonia and *Pneumocystis jiroveci* is responsible for at least one quarter of all pneumonia deaths in infants infected with HIV.

Diarrhoea is characterized by the frequent passing of loose or watery stools; it is a symptom of infection in the intestinal track caused by bacteria, viruses or other parasitic organisms. In low-resource settings, most cases of diarrhoea are caused by *Rotavirus* and *Escherichia coli* (e-coli) bacteria. These germs are spread through contaminated water and food or passed directly from person to person, and are most prevalent in settings with poor hygiene and lack of access to clean drinking water and sanitation.

Diarrhoea depletes the body of fluids and can cause severe dehydration, which if not treated properly can lead to death. Dehydration caused by diarrhoea can also result in the loss of essential nutrients, leading to micronutrient deficiencies and severe malnutrition in children. At the same time, malnourished children have weakened immune systems, making them more susceptible to diarrhoea and pneumonia in the first place.

How are pneumonia and diarrhoea diagnosed and managed?

The most precise way to diagnose pneumonia is with chest x-rays, sputum cultures and blood tests. However, in low-income countries, where access to diagnostics, laboratory personnel and infrastructure to support testing is scarce, health workers must primarily rely on symptom presentation and a set of simple clinical examinations in order to classify underlying conditions and decide a treatment course for patients. Since the 1990s, WHO and UNICEF have recommended the Integrated Management of Childhood Illness (IMCI) strategy to help health workers classify the most common causes of childhood morbidity and mortality in an integrated manner. IMCI aims to improve health worker management of sick children by providing them with an integrated algorithm for assessing and classifying the most common causes of death and disability, and referring severe cases for more advanced care. It also emphasizes disease prevention through immunization and improved nutrition and counselling families on healthy behaviors and practices.

Since many symptoms first present in communities, particularly in the poorest settings, the IMCI algorithm has been simplified and adapted for use by lay health workers in community settings. This is known as integrated community case management (iCCM). When lay health workers in community settings are adequately trained, supervised and supported with medicine and supplies they can effectively classify and treat pneumonia, diarrhoea and other conditions within communities. This is important because the poorest children at highest risk of death are often underserved by the formal health system. Caregivers also play an important role in recognizing the symptoms of pneumonia and diarrhoea and seeking medical attention in a timely manner.

Guided by the IMCI and iCCM approaches, sick children with cough or difficult breathing complaints should be assessed for symptoms of pneumonia by a health worker. The case may be classified as either ‘severe’ or ‘non-severe’ depending on the presence of additional signs, such as chest in-drawing or inability to feed. Health workers follow standard guidance for monitoring the child’s breathing rate with a timer and observing the child for chest in-drawing. For children between the ages of 2-12 months, a diagnosis of pneumonia is identified by a breathing rate of 50 or more breaths per minute. For children from 12 months to 5 years the threshold is 40 breaths per minute. If pneumonia is classified, the child should be given antibiotics (Amoxicillin) and sent home, or referred to a health facility for further care, depending on the severity of the symptoms.¹ Timely careseeking, assessment and treatment go hand in hand with better survival. Newer diagnostic aids for bacterial pneumonia are currently being field tested and it is hoped that these technologies will make diagnosis possible in remote and resource-poor settings (see Chapter 5).

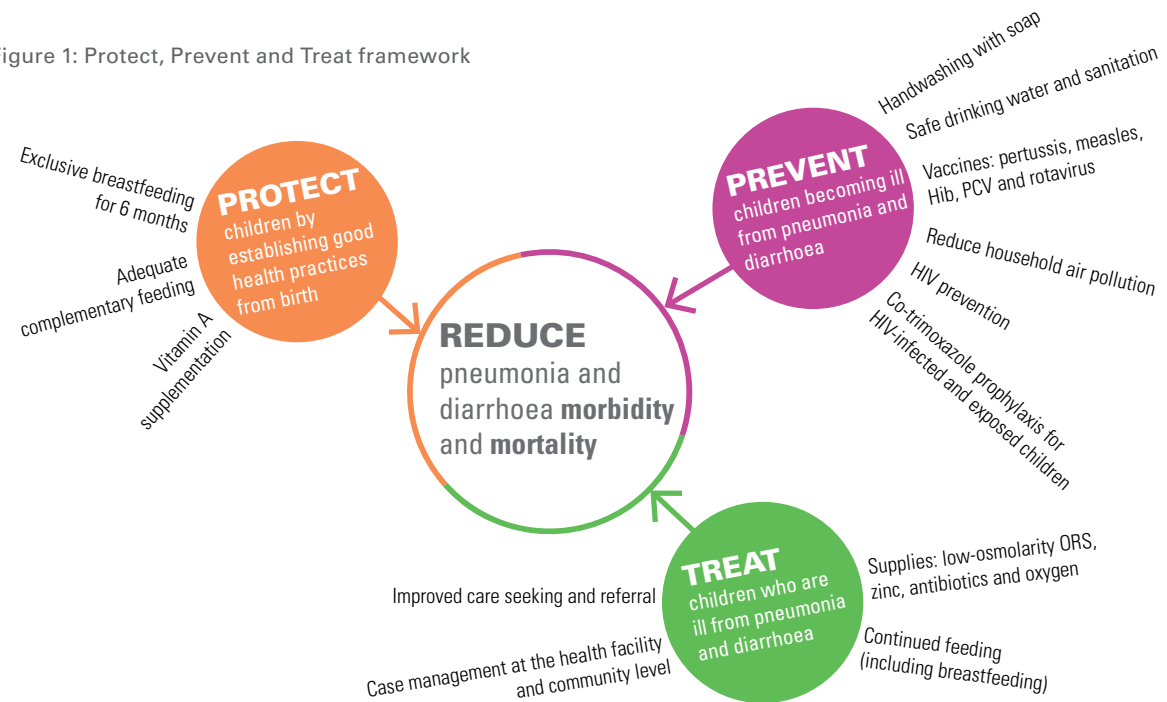
Diarrhoea is classified based on its symptoms and duration into four types: 1) *acute watery diarrhoea* can last several hours and days and can rapidly cause dehydration and weight loss; 2) *acute bloody diarrhoea* (dysentery) can cause sepsis and malnutrition; 3) *persistent diarrhoea* lasting 14 or more days causes malnutrition and serious non-intestinal infection, and 4) *diarrhoea with severe malnutrition* associated with systemic infection, heart failure and

mineral deficiency. Guided by the IMCI guidelines and the child’s symptoms, trained health workers can classify the severity and type of diarrhoea. For basic diarrhoea, the treatment is two sachets of oral rehydration solution (ORS), 10 days of zinc, increasing fluids and continued feeding. If the diarrhoea does not resolve after three days, or if it worsens, is bloody or is accompanied by other danger signs (vomiting, convulsions, lethargy, etc.) then referral is necessary for intravenous (IV) rehydration and antibiotics.

What is the Integrated Global Action Plan for Pneumonia and Diarrhoea?

With similar determinants, preventative strategies and treatment delivery platforms, pneumonia and diarrhoea are best tackled in tandem. The Integrated Global Action Plan for the Prevention and Control of Pneumonia and Diarrhoea (GAPPD) sets forth an integrated framework of key interventions proven to effectively protect children’s health, prevent disease and appropriately treat children who do fall ill with diarrhoea or pneumonia (see Figure 1).

Figure 1: Protect, Prevent and Treat framework



A. Protective interventions provide the foundations for keeping children healthy and free of disease.



Exclusive breastfeeding: exclusive breastfeeding for the first 6 months of life (without additional foods or liquids, including water) protects infants from disease and guarantees them a food source that is safe, clean, accessible and perfectly tailored to their needs. Nearly half of all diarrhoea episodes and one-third of all respiratory infections could be prevented with increased breastfeeding in low- and middle-income countries.²



Adequate complementary feeding and continued breastfeeding: good nutrition supports strong immune systems and provides protection from disease. From 6 months to 2 years of age, adequate complementary feeding – providing children with adequate quantities of safe, nutritious and age appropriate foods alongside continued breastfeeding – can reduce child deaths, including those due to pneumonia and diarrhoea.³ Optimal feeding practices are also essential to helping children recover from illnesses.



Vitamin A supplementation: high-dose vitamin A supplementation helps maintain strong immune systems and can reduce all-cause mortality by 24 per cent and cases of diarrhoea by 15 per cent.⁴ Children between the ages of 6-59 months should be protected with 2 high-dose supplements of vitamin A every year in countries with high under-five mortality or where vitamin A deficiency is a public health problem.

B. Preventative interventions help stop disease transmission and prevent children from becoming ill.



Immunization: the Hib and pneumococcal conjugate vaccines (PCV) are effective in preventing the two most common bacterial causes of childhood pneumonia and the rotavirus vaccine provides protection against one of the most common causes of childhood diarrhoea-related death.⁵⁻⁶ The use of vaccines against measles and pertussis in national immunization programmes substantially reduces pneumonia illness and death in children.^{7,8}



Safe drinking water, sanitation and hygiene: almost 60 per cent of deaths due to diarrhoea worldwide are attributable to unsafe drinking water and poor hygiene and sanitation.⁹ Hand washing with soap alone can cut the risk of diarrhoea by at least 40 per cent and significantly lower the risk of respiratory infections.^{10,11} Clean home environments and good hygiene are important for preventing the spread of both pneumonia and diarrhoea,¹² and safe drinking water and proper disposal of human waste, including child faeces, are vital to stopping the spread of diarrhoeal disease among children and adults.



Reduced household air pollution: more than 40 per cent of the world's population rely on solid fuels (wood, coal, animal dung, crop waste) to cook and heat their homes,¹³ exposing children to household air pollution and almost doubling their risk of pneumonia.¹⁴ Improved household air quality can reduce cases of severe pneumonia while also preventing burns, saving time and reducing fuel costs.¹⁵ The use of chimney stoves can cut household air pollution by half, reducing severe pneumonia by almost 30 per cent.^{15,16}



HIV prevention: preventing HIV and treating HIV infections with antiretroviral drugs helps maintain the immune system and reduce the risk of contracting pneumonia. Co-trimoxazole prophylaxis provides further pneumonia-related protection for HIV-infected and exposed children and can reduce AIDS deaths by 33 per cent.¹⁷

C. Treatment interventions cure children of diarrhoea and pneumonia and ensure survival.



Improved care seeking and referral: timely recognition of pneumonia and diarrhoea and rapid care seeking can ensure that children get to a health provider that can assess and treat them according to WHO and UNICEF recommended IMCI and iCCM guidelines in facility and community settings.

Diarrhoea treatment with ORS and zinc: oral rehydration salt solution (ORS) – a mixture of water, salt and sugar – effectively prevents dehydration associated with diarrhoea by replacing lost fluids and electrolytes. Low osmolarity ORS, combined with zinc supplementation, increased fluid intake and continued feeding, is the UNICEF-WHO recommended treatment for acute diarrhoeal disease. Studies have shown that if ORS coverage was scaled up to 100 per cent it could prevent 93 per cent of diarrhoea-related mortality,¹⁸ and zinc can further reduce the duration of diarrhoea episodes by 25 per cent while preventing recurrence for several months.^{19 20}



Appropriate use of antibiotics: Bacterial pneumonia can be effectively treated with antibiotics, such as Amoxicillin. A systematic review of severe pneumonia cases from 10 countries showed that case management with recommended first line antibiotics at either a front line health facility or in the community was effective and resulted in few deaths. Oral or injectable antibiotics provided to newborns with pneumonia (at home or in first-level facilities, and in-patient hospital care), resulted in a 25 per cent reduction in all-cause neonatal mortality and a 42 per cent reduction in neonatal pneumonia mortality.

WHO's updated recommendations specify Amoxicillin DT (dispersible tablet) as the first line of treatment for pneumonia, delivered via community-based management. Compared with other formulations, and other drugs such as co-trimoxazole, the new DT formulation has the potential to make treatment much simpler and more cost-effective.



Oxygen therapy: children with severe pneumonia require oxygen therapy to treat hypoxaemia (insufficient oxygen in the blood), a fatal complication.²¹ The prognosis for hypoxaemia is provided by pulse oximeter. Improving access to oxygen can significantly reduce pneumonia mortality rates for children under 5.²² In one study in Papua New Guinea, oxygen therapy provided to treat hypoxaemia in hospitals resulted in a 35 per cent reduction in death from severe pneumonia.²³

Timely and accurate diagnosis is critical to preventing pneumonia deaths; facilitating faster and more effective diagnosis should therefore also be considered part of the GAPPD paradigm.



Community-based interventions are effective at achieving higher treatment coverage for both pneumonia and diarrhoea. They can increase ORS usage by an estimated 160 per cent and zinc use by 80 per cent. Interventions at the community level are estimated to increase care-seeking for pneumonia by 13 per cent and care-seeking for diarrhoea by 9 per cent. They may also decrease inappropriate antibiotic use for diarrhoea by 75 per cent, and reduce treatment failure rates for pneumonia by 40 per cent. Community case management for pneumonia by community health workers has also been linked with a 32 per cent reduction in pneumonia-specific mortality.²⁴



How is childhood pneumonia and diarrhoea treatment coverage monitored to track progress? What are the main data sources, indicators and limitations?

Countries monitor the burden and case-management of pneumonia and diarrhoea primarily through national health information systems, national surveys such as USAID-supported Demographic and Health Surveys (DHS), UNICEF-supported Multiple Indicator Cluster Surveys (MICS), and health facility surveys.

For pneumonia, DHS and MICS ask caregivers if any of their children had reported symptoms of pneumonia (cough or difficult breathing due to a chest-related problem) in the previous two weeks and if so, where care was sought and treatments received including antibiotics. Given response reliability concerns, the survey does not further ask about the type of antibiotic used by children with these reported symptoms nor if they had IMCI-classified pneumonia, which is the antibiotic indication for children with these symptoms. It is therefore difficult to measure IMCI treatment recommendations using DHS and MICS. For this reason, monitoring pneumonia treatment coverage relies primarily on the care-seeking indicator, or whether children with these reported symptoms visited a health provider in order to be assessed for pneumonia according to IMCI or iCCM guidelines.

For diarrhoea, the survey interviewer asks caregivers if any of their children had reported diarrhoea in the previous two weeks and if so where care was sought and treatments received, including ORS, other fluids, zinc and continued feeding practices.

There are some limitations to national health information data and to the DHS and MICS surveys. At present, care-seeking for pneumonia is the only recommended indicator to use to measure treatment for pneumonia; however, this indicator needs to be improved given that caregivers often have difficulty distinguishing between pneumonia and cough or other symptoms. This also means that data collected on antibiotic treatment from household surveys may not be representative of the number of children with true pneumonia who are treated with antibiotics.²⁵ In addition, without knowing which antibiotic has been used, it is impossible to know whether or not effective treatment for pneumonia has taken place.

There are also challenges in measuring diarrhoea through national surveys. While caregivers usually know when children have diarrhoea, current survey questions do not distinguish between mild diarrhoea episodes and those that put children at risk for dehydration. Survey monitoring may be improved by additional questions on severity.¹⁶ In addition, community-level activities are often not included in routine health information systems and many countries need to improve mechanisms for ensuring that the data collected by community health workers is recorded in these systems.

Health facility surveys provide information about facility readiness to provide quality treatment and can be used as supplemental data to contextualize population-level coverage monitoring. There is also a need to strengthen health management information systems and vital registration systems to better identify cause of death and improve burden estimations.

When lay health workers in community settings are adequately trained, supervised and supported with medicine and supplies they can effectively classify and treat pneumonia, diarrhoea and other conditions

3

Pneumonia and Diarrhoea

Tracking a devastating global burden



Kokeb Negussie administers antibiotics to her two-month-old son, Moges, to treat his pneumonia, at their home in the sub-district of Romey Kebele in North Shoa Zone, in Amhara Region. ©UNICEF/UNI125763/Getachew

Pneumonia and diarrhoea are responsible for almost a quarter of all deaths among children under 5 in 2015

Every day, pneumonia and diarrhoea kill more than 4,000 children around the world. Globally, that means that 1.4 million children under 5 died from these two diseases in 2015. Pneumonia and diarrhoea deaths are almost entirely preventable. Without faster progress to save lives, these two diseases will be among the greatest road blocks to achieving SDG 3.2 – ending preventable child deaths.

In 2015, pneumonia and diarrhoea infections accounted for almost one in every four deaths in children under 5. The majority of these deaths – 15 per cent – were due to pneumonia, and diarrhoea was responsible for the remaining 9 per cent (see Figure 1).

While diarrhoea and pneumonia deaths have declined over the past decade, they still kill more children than all other infectious diseases combined.

This chapter examines the global burden of pneumonia and diarrhoea deaths in children under 5, including the children most affected, the regions where most deaths are concentrated, and trends and progress over time.

Who are the children most affected by pneumonia and diarrhoea?

Deaths due to pneumonia and diarrhoea disproportionately affect the youngest children: around 80 per cent of deaths associated with pneumonia and approximately 70 per cent of deaths associated with diarrhoea occur during the first two years of life.¹ To have the greatest impact on both mortality and morbidity, protective and preventative interventions should thus focus on the critical first two years of a child's life (see Chapter 4).

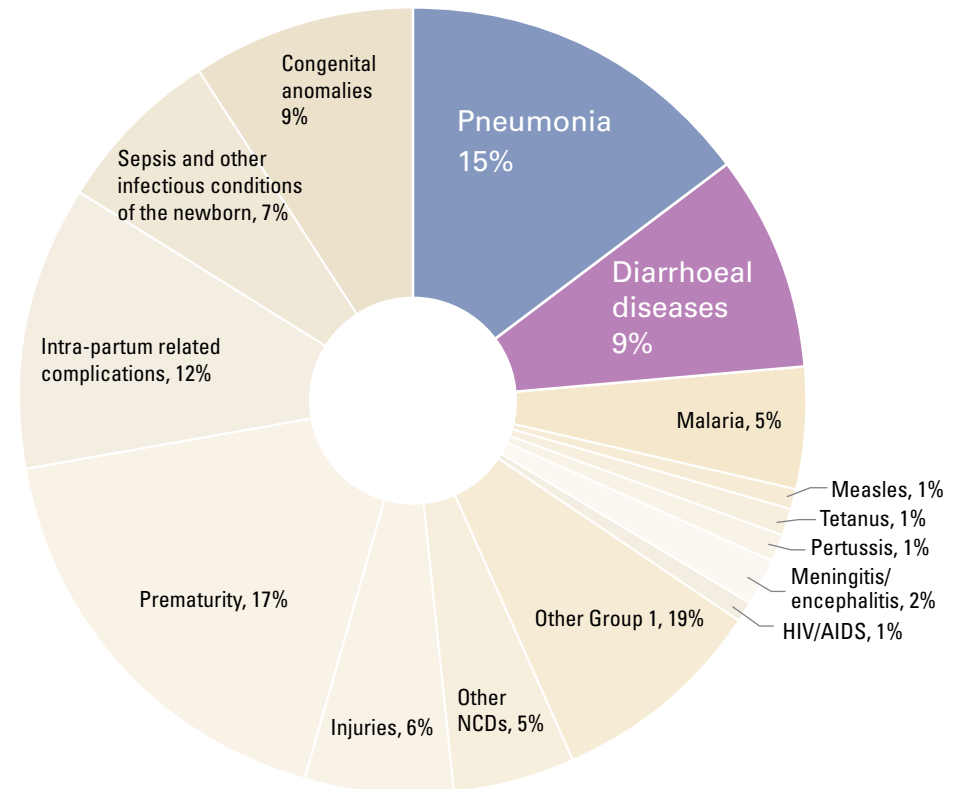


Figure 1: Distribution of causes of death among children under 5 in 2015

Source: WHO and Maternal and Child Epidemiology Estimation Group (MCEE) estimates 2015

Pneumonia and diarrhoea are diseases of poverty; within countries, deaths continue to be concentrated within the poorest populations. Low- and lower-middle income countries are home to 62 percent of the world's under 5 population but account for more than 90 percent of global pneumonia and diarrhoea deaths. The very poorest countries carry a disproportionate share of the burden of death: more than 30 per cent of all pneumonia and diarrhoea deaths are concentrated in low-income countries, yet these countries are home to only 15 per cent of the world's under-5 population (see Figure 2).

In which regions are deaths most concentrated?

The greatest proportion of pneumonia deaths are concentrated in South Asia and sub-Saharan Africa. The proportion of deaths shouldered by these regions has continued to rise, increasing from 77 per cent in 2000 to 82 per cent in 2015 (see Figure 3a). Diarrhoea deaths are also concentrated in these two regions: 84 per cent of all diarrhoea deaths in 2000 and 88 per cent in 2015 were concentrated in South Asia and sub-Saharan Africa.

Since 2000, four countries – the Democratic Republic of Congo, India, Nigeria and Pakistan – have consistently faced the highest number of pneumonia and diarrhoea deaths worldwide. The top 15 countries with the highest burdens of pneumonia and diarrhoea deaths are nearly identical, with the exception that China and Bangladesh fall in the top 15 countries for pneumonia, and Mali and Cameroon in top 15 countries for diarrhoea. In 2015, 72 per cent of the total burden of pneumonia and diarrhoea mortality in children under 5 was concentrated in these 15 countries.

Children in low- and lower-middle income countries account for a disproportionate share of pneumonia and diarrhoea deaths

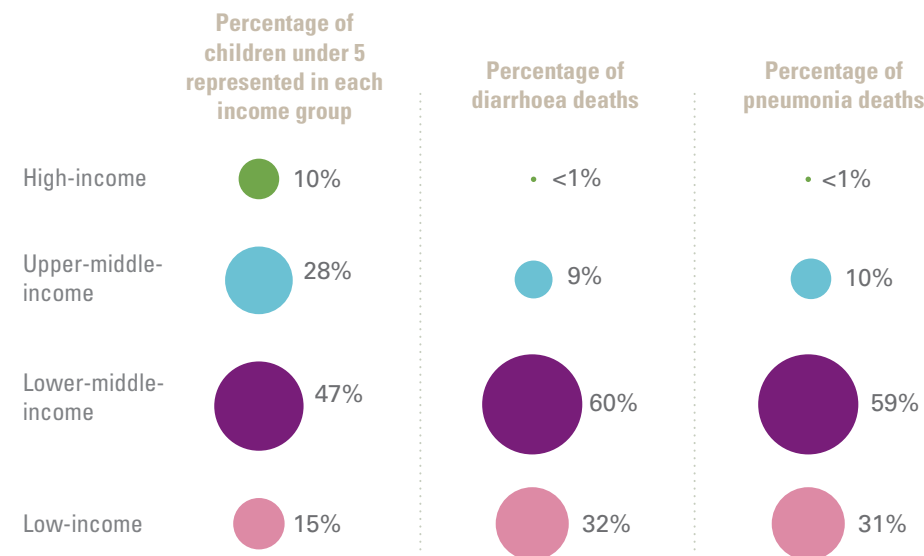


Figure 2: Percentage distribution of population of children under age 5 and distribution of deaths attributed to diarrhoea and pneumonia by income levels

Source: Population of children under age five : United Nations Population Division WPP 2015 Rev.; Cause of death: WHO and Maternal and Child Epidemiology Estimation Group (MCEE) estimates 2015; Income levels: World Bank Income classification 2016

How has pneumonia and diarrhoea mortality changed over time?

While the figures remain stark, there has been substantial progress over the past 15 years: deaths due to pneumonia and diarrhoea declined by nearly half between 2000 and 2015, from 2.9 million deaths to the current 1.4 million.

Diarrhoea deaths have dropped most significantly since 2000, falling from 1.2 million to 526,000 in 2015 – a decline of 57 per cent. Yet diarrhoeal illness still kills more than 1,400 children under 5 every day. Deaths due to pneumonia declined at a slower rate during this period, falling from 1.7 million in 2000 to the current 920,000 in 2015. Indeed pneumonia mortality rates have declined at a slower rate than those of many other common childhood diseases, such as malaria, measles and HIV.²

Most pneumonia and diarrhoea deaths are concentrated in South Asia and sub-Saharan Africa – and the proportion of deaths shouldered by these regions has continued to rise

Figure 3a: Distribution of under-five deaths due to pneumonia in 2000 and 2015 by UNICEF region

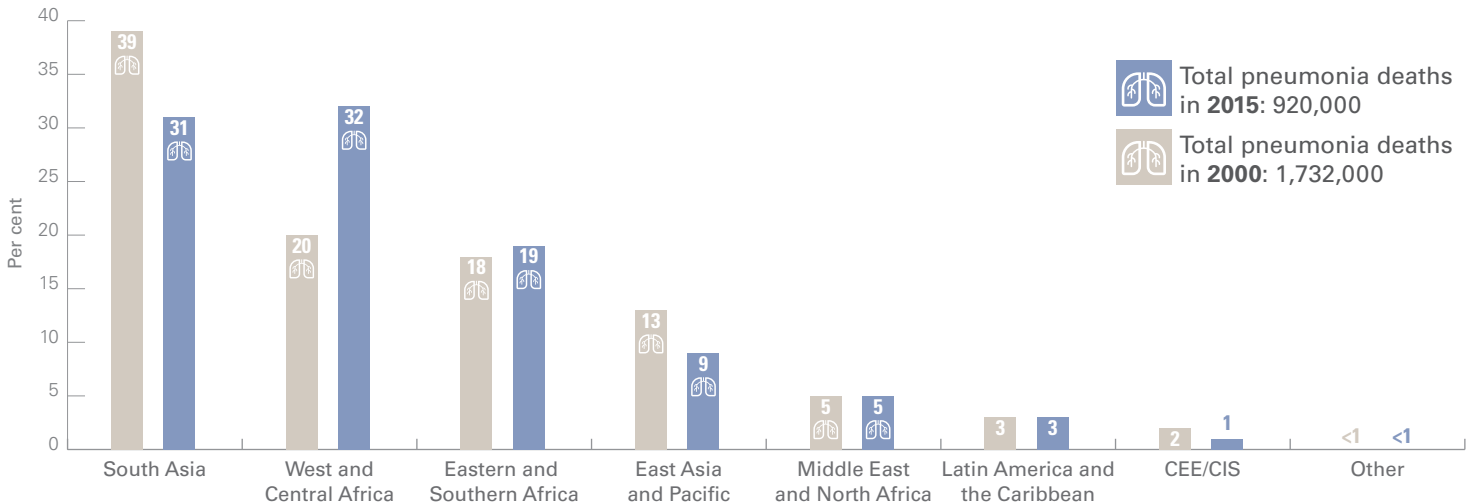
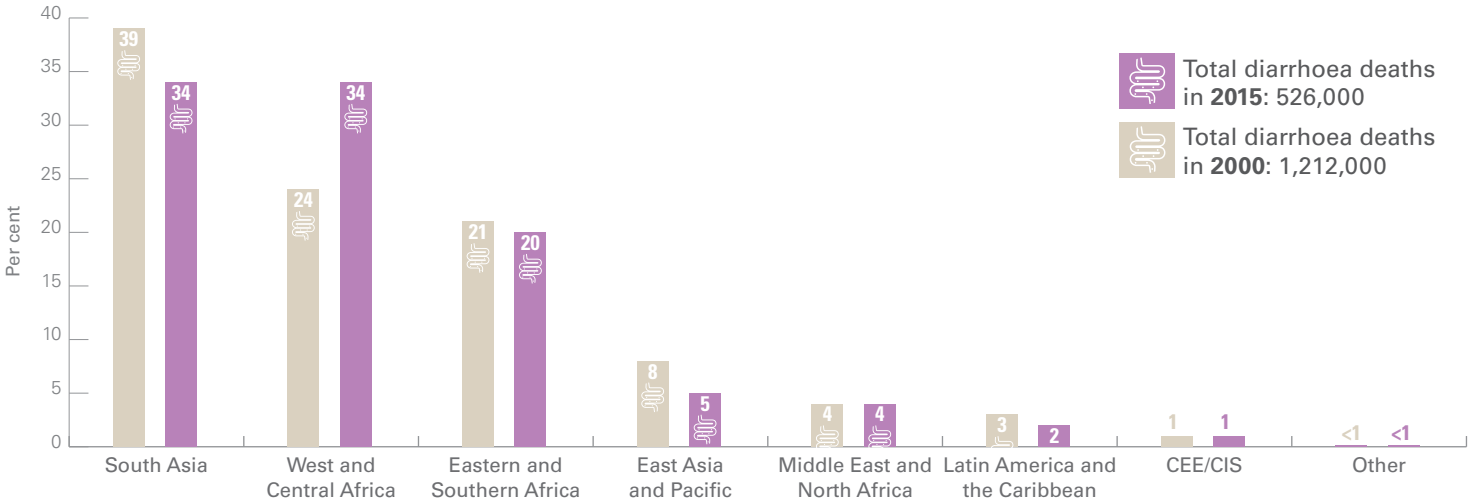


Figure 3b: Distribution of under-five deaths due to diarrhoea in 2000 and 2015 by UNICEF region



Source: WHO and Maternal and Child Epidemiology Estimation Group (MCEE) estimates 2015

Fifteen countries account for 70 per cent of all pneumonia deaths

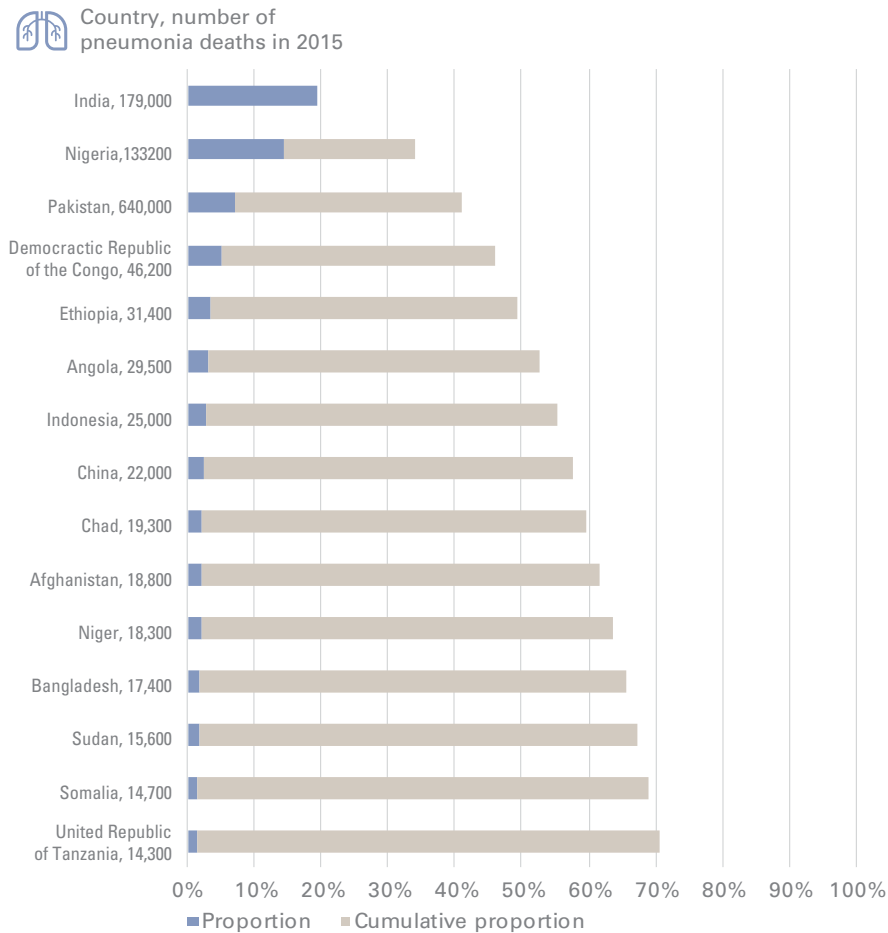


Figure 4a: Top 15 countries with highest number of pneumonia deaths in children under 5 in 2015

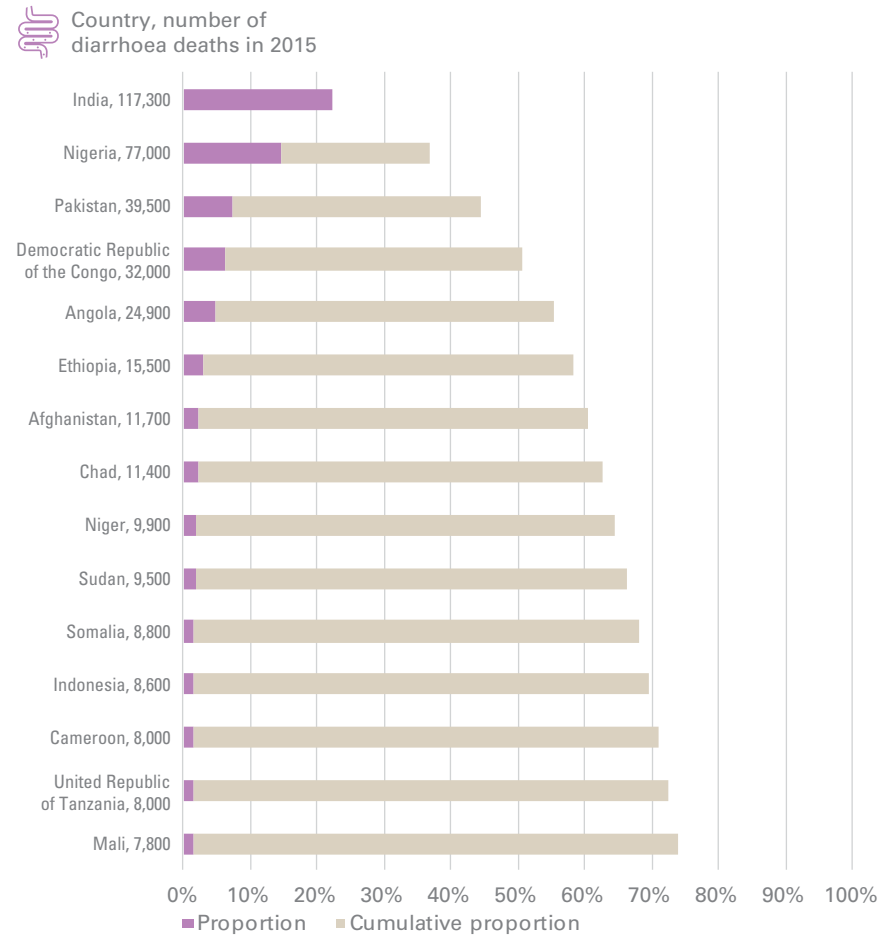


Figure 4b: Top 15 countries with highest number of diarrhoea deaths in children under 5 in 2015

Source: UNICEF analysis based on cause of death estimates from WHO and Maternal and Child Epidemiology Estimation Group (MCEE) estimates 2015

Where has the greatest progress been made in averting deaths – and where do we need to do better?

Cumulatively, 8.7 million pneumonia deaths were averted between 2001 and 2015. In 2015 alone, concerted efforts to control pneumonia infections through prevention and treatment are estimated to have averted more than 1 million deaths (based on additional analysis of the latest cause of death estimates).

Progress to improve pneumonia mortality has been uneven across regions: sub-Saharan Africa, which faces the greatest burden, has also experienced the slowest decline in the number of pneumonia deaths. This is in part because progress in reducing mortality was not fast enough to keep up with population growth during the same period. Deaths have only declined by 28 per cent in this region over the past fifteen years and today half of total pneumonia deaths occur in this region. Within sub-Saharan Africa, the West and Central Africa region only experienced a mere 12 per cent decline in pneumonia deaths.

In contrast, the East Asia and the Pacific and South Asia regions made the greatest strides in reducing pneumonia deaths between 2000 and 2015, with the former region cutting pneumonia deaths by almost two-thirds, or 64 per cent (see Figure 5).

Child deaths due to pneumonia have declined slowly – and regions with the greatest burden have made the least progress

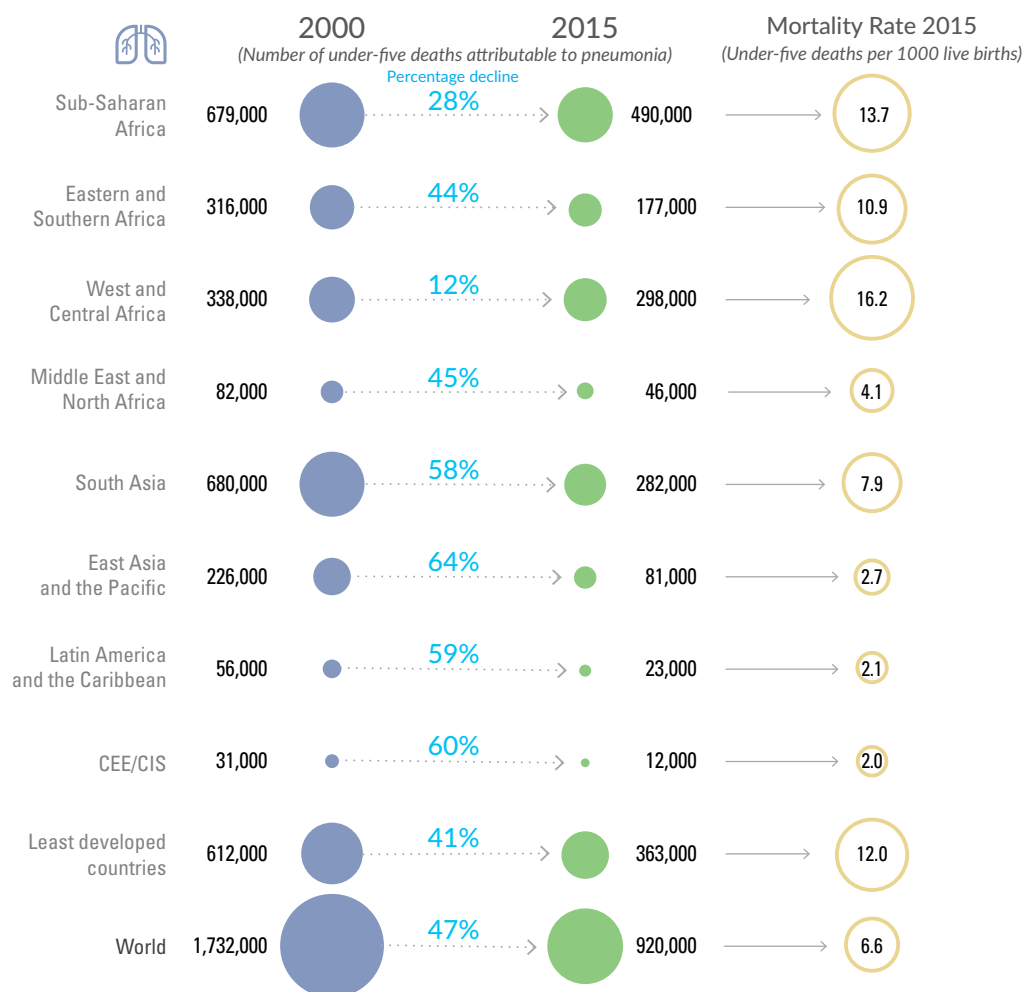


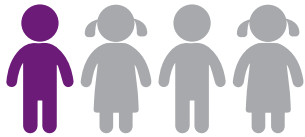
Figure 5: Trends in pneumonia deaths and pneumonia mortality rates by region, around 2000 and around 2015

Source: UNICEF analysis based on cause of death estimates from WHO and Maternal and Child Epidemiology Estimation Group (MCEE) estimates 2015

Approximately 8 million diarrhoea deaths were averted between 2001 and 2015. In 2015 alone, global efforts to protect, prevent and manage diarrhoeal disease in children averted about 900,000 diarrhoea deaths ((based on additional analysis of the latest cause of death estimates)).

Child deaths due to diarrhoea have dropped across all regions over the past 15 years, with declines ranging from 48 per cent in sub-Saharan Africa to 75 per cent in Latin American and the Caribbean (see Figure 6).

1 in 4 deaths



among children under 5 is caused by either pneumonia or diarrhoea

Child deaths due to diarrhoea have dropped substantially over the past decade

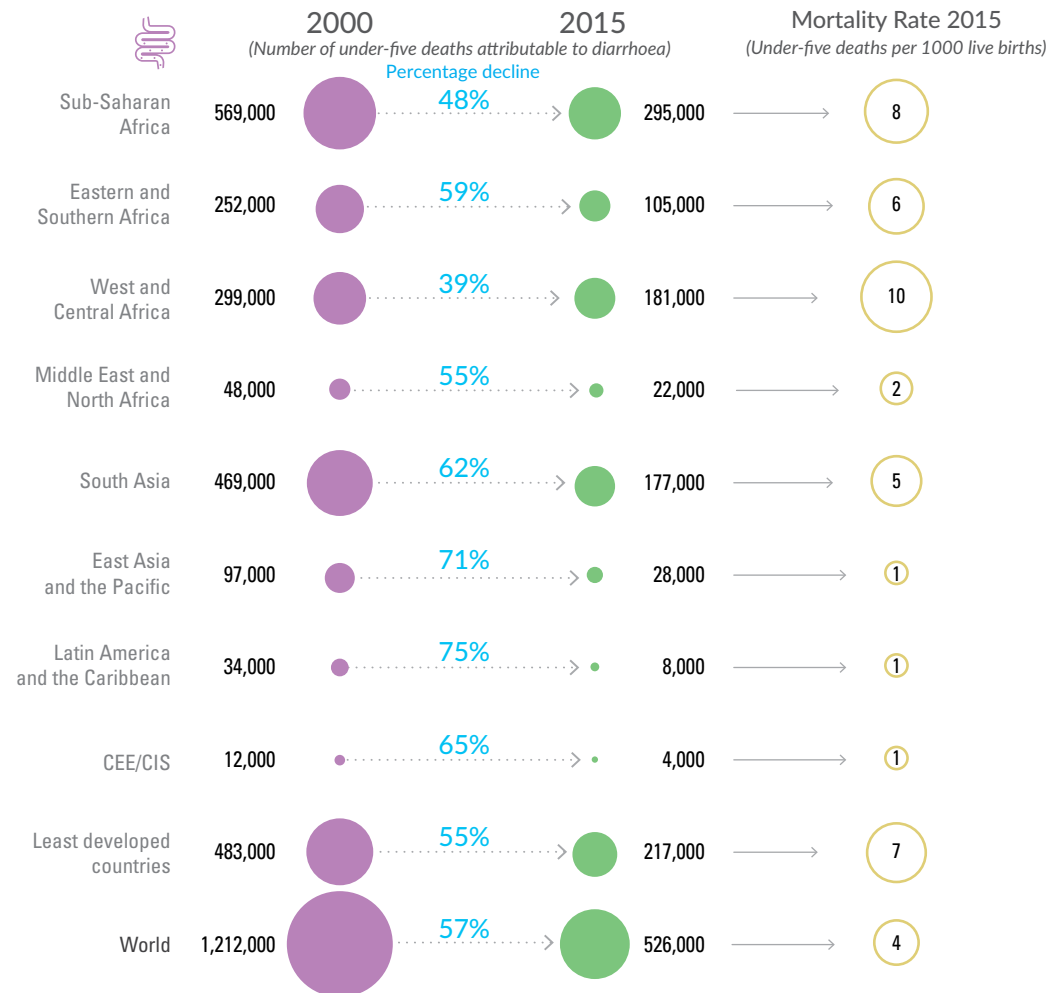


Figure 6: Trends in diarrhoea deaths and diarrhoea mortality rates by region, around 2000 and around 2015


Source: UNICEF analysis based on cause of death estimates from WHO and Maternal and Child Epidemiology Estimation Group (MCEE) estimates 2015



Rahul Debnath, 15 months old, with his mother Shudhangshu Debnath, in Bhabanipur village, Jagannathpur Upazila in Sunamganj on 30 May 2012. Rahul was diagnosed and treated for pneumonia with help from health workers trained under the UNICEF-supported Integrated Maternal, Neonatal and Child Survival interventions, MNCS Programme, which saved his life. © UNICEF/UNI125225/Khan

4

Equity and progress in effective interventions

A close-up photograph of a woman in a patterned sari holding an 18-month-old child. The child is wearing a clear nebulizer mask over their nose and mouth. The woman is looking down at the child with a focused expression. The background is slightly blurred, showing what appears to be a health facility setting.

Quaderul Islam, 18-month old child, suffering from pneumonia, is held by his mother Sohinara Begum as he is given medicine using a nebulizer at the Derai Upazila Health Complex in Sunamganj on 2 June 2012. ©UNICEF/UNI125497/Khan

Too few children are benefiting from the key protective, preventative and treatment interventions that save lives.

We know more than ever about how to protect children's health and prevent pneumonia and diarrhoea from making them ill. The GAPPD provides a framework of key interventions that when coordinated and implemented at scale can effectively control pneumonia and diarrhoea in children under 5. While these interventions are not new, the GAPPD framework proposes an approach to planning, delivering and monitoring them in a coordinated manner, while prioritizing those with the greatest potential impact on child mortality.

Following the GAPPD framework, this chapter reviews the evidence for key protective, preventative and treatment interventions, takes stock of the progress made to date, and asks: who is being reached and who is being left behind? The second part of the chapter looks at how many lives can be saved by 2030 by scaling up key interventions to 90 percent coverage. The final part of this chapter explores the barriers to reaching every child in need and describes opportunities to do better.

I. Are key interventions reaching all children?

Efforts to scale up key interventions are ongoing, yet coverage of core preventive and treatment interventions is still limited. A summary of intervention coverage in Figure 1 illustrates that many interventions with the greatest potential impact remain out of reach for too many children.

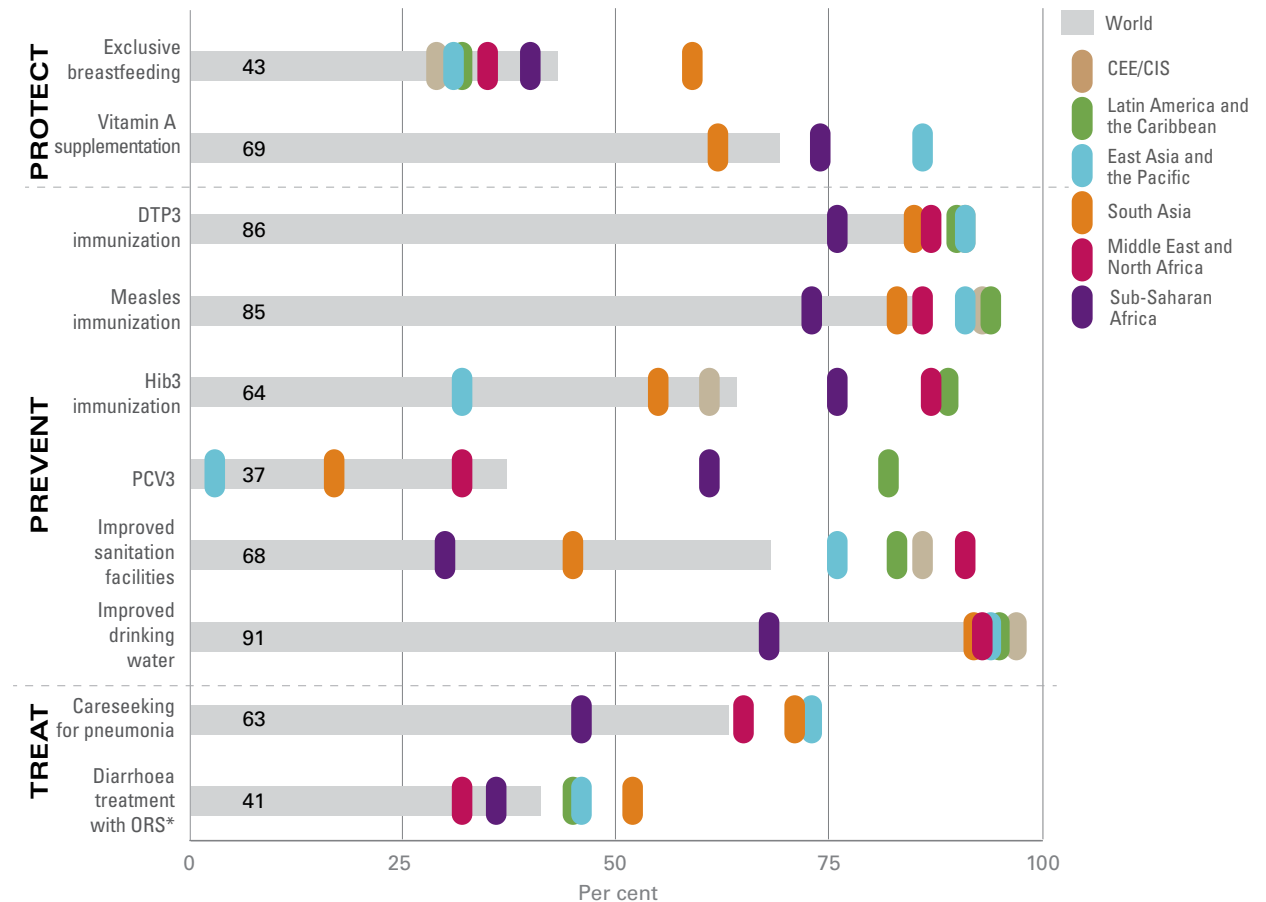


Figure 1: Global coverage of effective interventions, 2015

Source: UNICEF global databases 2016, WHO/UNICEF estimates of immunization coverage 2015, WHO/UNICEF JMP estimates 2015. *Zinc is an important component of diarrhoea treatment recommendation, however data were not enough to calculate global and regional averages.

A. Protective interventions



Exclusive breastfeeding: despite the evidence on the power of breastfeeding for survival and lifelong health, exclusive breastfeeding rates have not increased enough over the last 15 years. In 2015, less than half of all newborns were put to the breast within the first hour of life, and just over 40 per cent of infants aged 0–5 months were exclusively breastfed (see Figure 2).¹

While low levels of appropriate breastfeeding practices affect morbidity and mortality outcomes for mother and child in both high- and low-income countries alike, breastfeeding is one of the few positive health and nutrition behaviours which is more prevalent in low-income countries than high-income ones. Within low- and middle-income-countries themselves, poor women also breastfeed longer than rich women. These breastfeeding patterns contribute to reducing health gaps between rich and poor children, which would be even greater in the absence of breastfeeding.²



Adequate complementary feeding and continued breastfeeding: globally, only a shocking one in every six children under 5 is receiving a minimally acceptable diet – one where meals are provided with the minimum frequency and include at least a minimum number of food groups. The greatest challenge to most children’s diets is the lack of dietary diversity: only about one in four children is eating food from at least four food groups. And infants aged 6–11 months have the lowest rates of minimum diet diversity of all age groups.¹

Globally, the rate of continued breastfeeding is 74 per cent at 1 year of age (for 12–15 month-olds); however, this rate drops to 46 per cent at 2 years of age (for 20–23 month olds).¹



Vitamin A supplementation: In 2014, almost 70 per cent of children in priority countries were fully protected with two high dose vitamin A supplements, with the highest coverage in East Asia and the Pacific (86 per cent) and West and Central Africa (83 per cent).³



Mother Suchirani Mandi, 21 years old, breastfeeding her 3-month-old baby, Sanchita Mandi.

©UNICEF/UNI94987/Pirozzi



A health worker administers a dose of vitamin A to a girl at a nutrition screening in the rural village of Marat, Anseba Region. UNICEF is supporting nutrition screenings and the distribution of vitamin A supplements, which boost immune function, throughout the country. ©UNICEF/UNI9445/Pirozzi

Globally, just over two out of five infants are exclusively breastfed

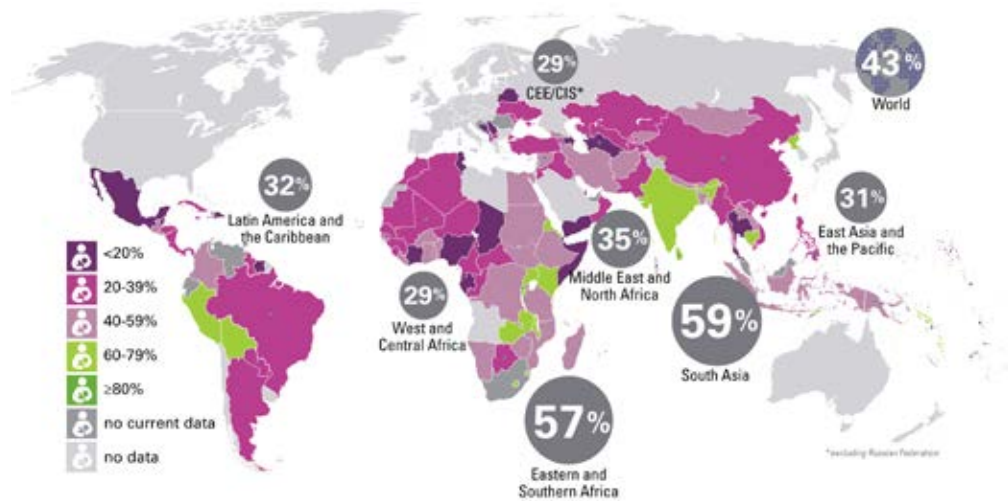


Figure 2: Per cent of infants 0-5 months of age exclusively breastfed, by country and region, 2015

Source: UNICEF global databases, 2016, based on MICS, DHS and other nationally representative sources, 2010-2016 (* denotes countries with older data between 2005-2009; data from these countries are not included in the regional aggregates except for China (2008) which is used for the East Asia and the Pacific and World averages). Countries shaded in dark grey have estimates from 2004 or earlier and are thus represented as having "no current data"; these countries are not included in the regional aggregates. *CEE/CIS does not include Russian Federation.

In West and Central Africa and in East Asia and the Pacific at least 8 in 10 children receive two doses of Vitamin A supplements

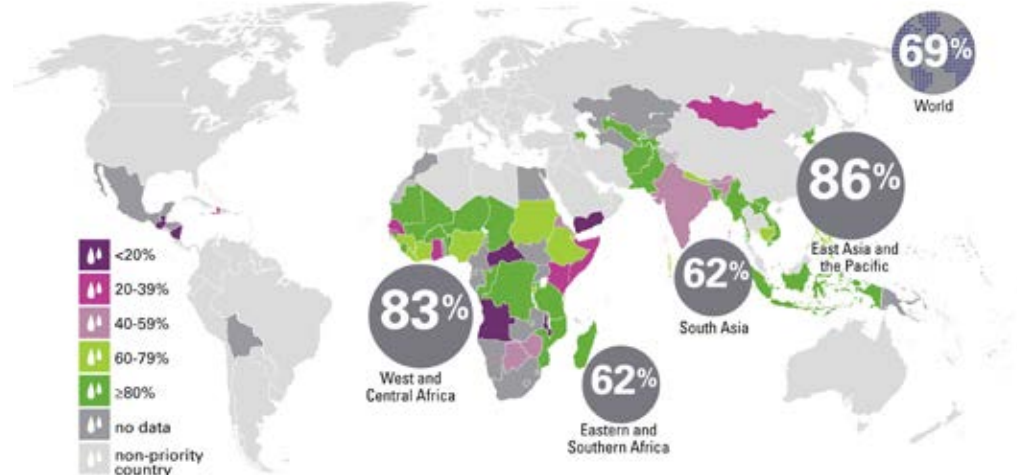


Figure 3: Vitamin A supplementation two-dose coverage, 2014

Source: State Of the World's Children 201

B. Preventative interventions



Immunization: coverage of key pneumonia-related vaccines is increasing and progress in sub-Saharan Africa is improving faster than the global average. Global coverage of the third dose of the Hib vaccine increased from 14 per cent in 2000 to 64 per cent in 2015, and in Sub-Saharan Africa coverage of Hib jumped from 3 per cent to 76 per cent during the same period. East and South Asia are lagging behind. While South Asia had a coverage of just above 50%, less than 2 in 5 children received the HiB vaccine in East Asia and the Pacific in 2015.⁴

Figure 4a illustrates the effect of rapid scale-up of the Hib vaccine over the past 15 years in most regions, though coverage varies across countries (see Figure 4a).

Global coverage of the PCV vaccine increased rapidly in only 4 years – from 15 per cent in 2011 to 37 per cent in 2015. In sub-Saharan Africa, rapid progress brought PCV vaccine coverage from 11 per cent to 59 per cent during the same period.

The Latin America and Caribbean and the East and South Africa regions have seen sharp increases in PCV vaccine uptake. In the former region, coverage increased from 3 per cent in 2008 to 82 per cent in 2015, and coverage in the latter region increased from 8 per cent in 2010 to 74 per cent in 2015.

Other regions such as the Middle East and North Africa, West and Central Africa and South Asia regions are experiencing slower progress, and coverage in the Central

Sub-Saharan Africa has made the greatest progress in giving key pneumonia – related vaccines to children

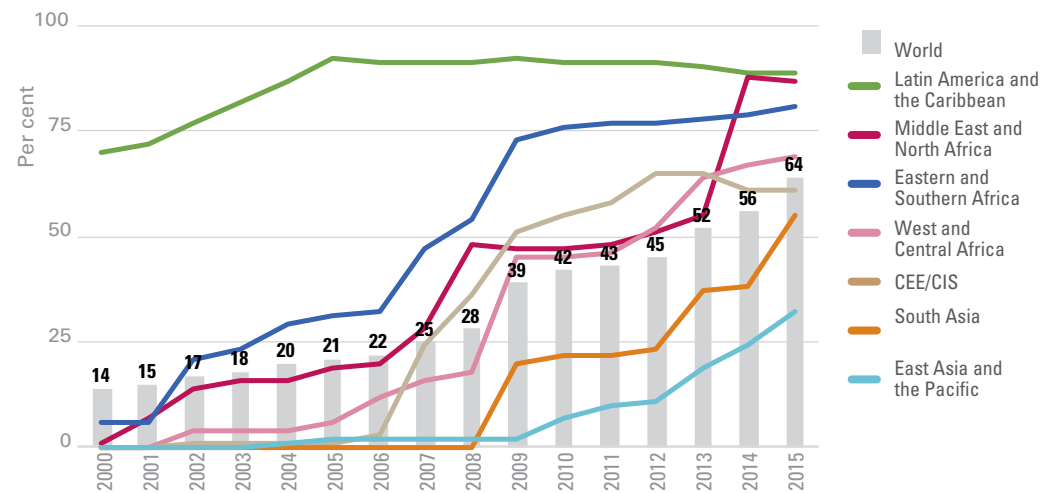


Figure 4a: Percentage of surviving infants who received the third dose of Hib-containing vaccine

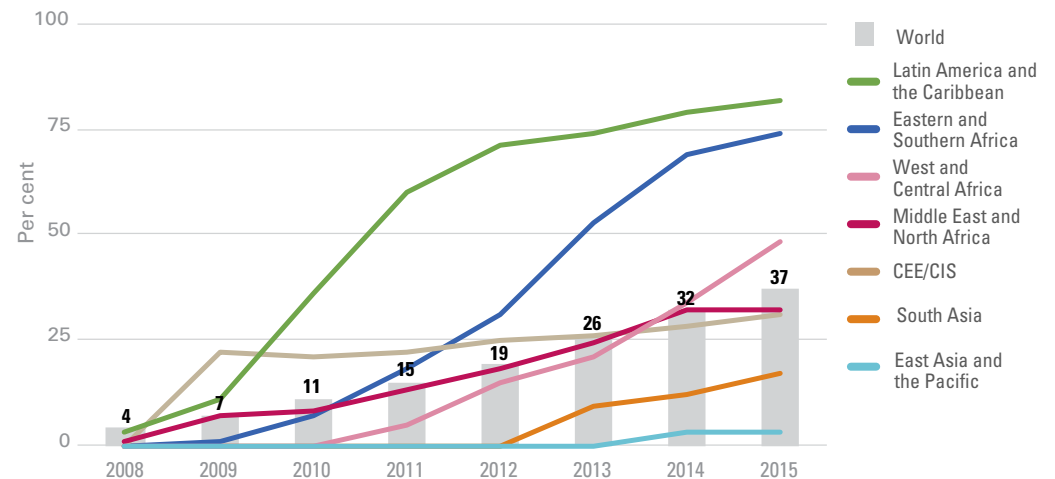


Figure 4b: Percentage of surviving infants who received the third dose of PCV vaccine

Source: WHO and UNICEF estimates of national routine immunization coverage, 2015 revision (completed July 2016).

and Eastern Europe Commonwealth of Independent States has reached a plateau at 28 per cent (see Figure 4b). With UNICEF support, 46 countries introduced PCV and 34 new countries introduced the rotavirus vaccine during the 2011-2015 period.⁵



Safe drinking water, sanitation and hygiene: preventative measures to improve access to clean drinking water, sanitation and hygiene are translating into fewer diarrhoea-related deaths in a number of countries. Figure 5 illustrates the link between the proportion of the population within a country using improved sanitation facilities and the proportion of diarrhoea-related deaths among children under 5.



Reduced household air pollution: around half of childhood pneumonia deaths are associated with air pollution.⁶ In fact, the effects of indoor air pollution kill more children globally than outdoor air pollution. At the same time, around two billion children (0-17 years of age) live in areas where outdoor air pollution exceeds international guideline limits.⁶

Improved sanitation facilities translates into fewer childhood diarrhoea - related deaths

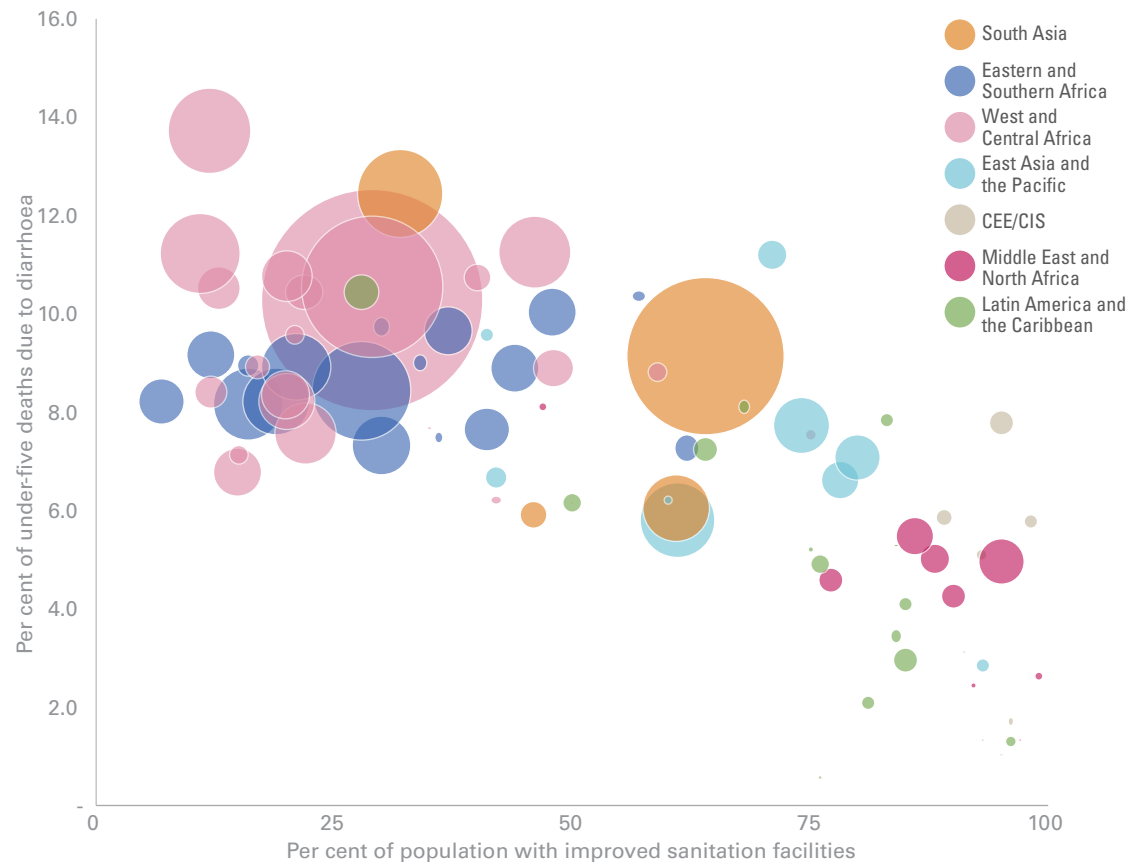


Figure 5: Relationship between population with improved sanitation facilities and under-5 deaths due to diarrhoea

About the chart

- The size of each bubble represents the number of deaths caused by diarrhoea annually among children under 5 in the given country or area in 2015.
- The horizontal axis shows the percentage of population using improved facilities.
- The vertical axis shows the percentage of under-five deaths caused by diarrhoea in the given country.

Source: UNICEF analysis based on WHO and Maternal and Child Epidemiology Estimation Group (MCEE) estimates 2015 and UNICEF global databases 2016

C. Treatment interventions



Improved care seeking and referral: The proportion of children being taken to a health care provider for symptoms of pneumonia (cough or difficult breathing with a chest-related problem) is increasing globally, but the pace is slow: over the past 15 years the rate of care seeking increased by only 8 percentage points – from 55 per cent in 2000 to 63 per cent in 2015 (see Figure 6). Low care-seeking rates in sub-Saharan Africa are particularly concerning given the high burden of pneumonia deaths in this region.

Within countries, there are still significant disparities in care seeking for childhood pneumonia between the richest and poorest households, across all regions. The gap is smallest in the East Asia and Pacific region and widest in the West and Central Africa region, where children in richest households are almost twice as likely to be taken for care when pneumonia symptoms arise compared with children in the poorest households (see Figure 7).

The gap between urban and rural for care seeking for symptoms of pneumonia is however, not as stark as the disparity between the richest and poorest households. All regions are making an ongoing progress towards greater geographic equity (see Figure 8).

Across all regions, more children with symptoms of pneumonia are taken for care to a health provider today than in 2000 – but progress is slow

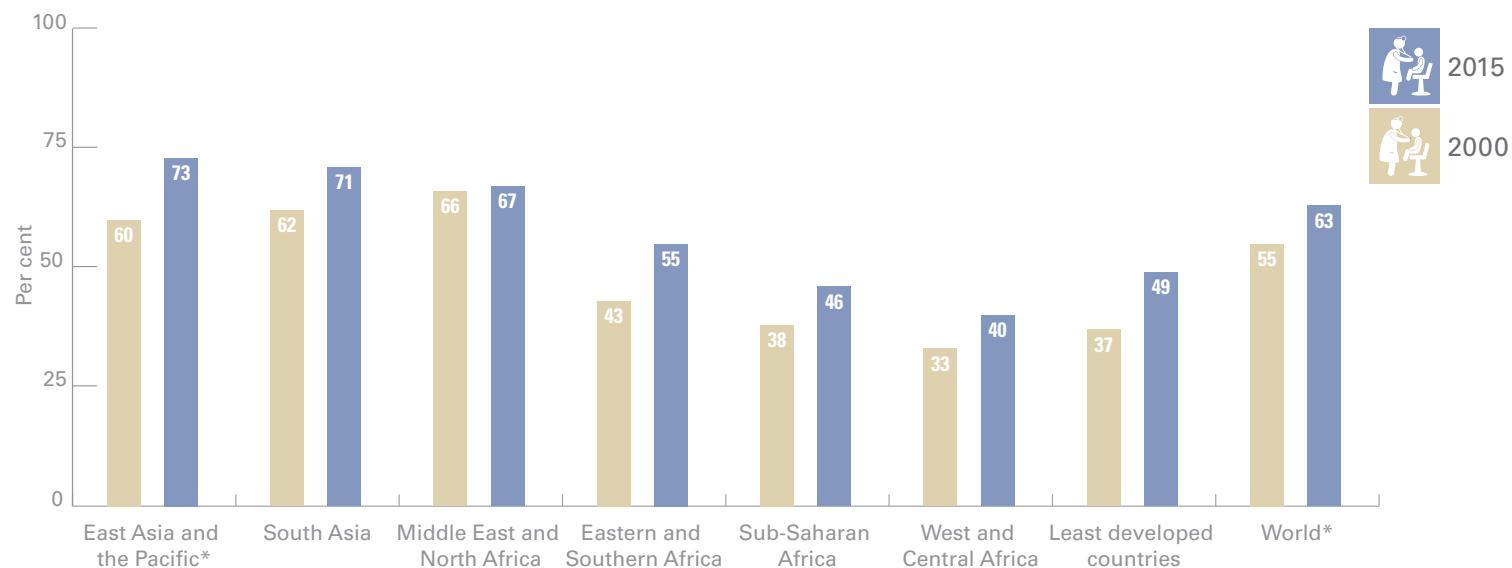


Figure 6: Percentage of children with symptoms of pneumonia taken for care to a health provider, by region, 2000 and 2015

Source: UNICEF Global databases 2016 based on DHS and MICS. *Excludes China. Estimate for 2000 includes data for the 1998-2009 period and estimate for year 2015 includes data for the 2010-2015 period. Global estimates include 81 countries covering 63% of the under-5 population in 2015.



Globally, children in the richest households and in urban areas are most likely to be taken for care for their pneumonia symptoms

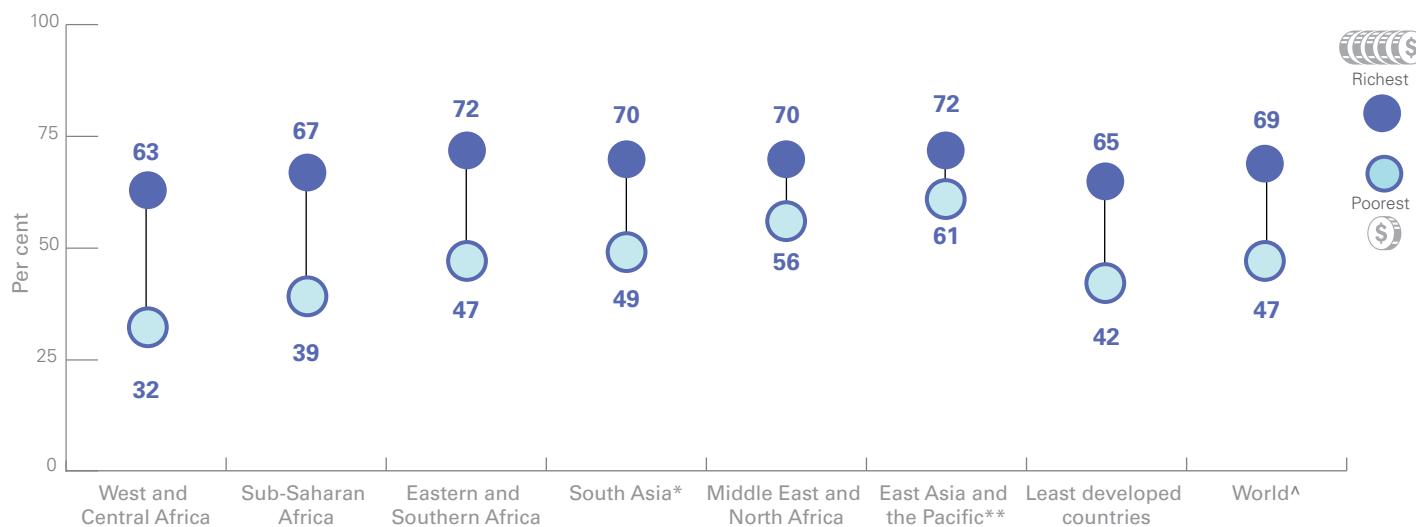


Figure 7: Percentage of children with symptoms of pneumonia taken for care to a health provider, by wealth quintile and region, 2015

Source: UNICEF Global databases 2016 based on DHS and MICS. *Excludes India, **Excludes China, ^Excludes India and China. Estimates for year 2015 include data for the 2010-2015 period. Global estimates include 49 countries covering 56% of the under-five population in 2015 (excluding China and India for which data was not available).

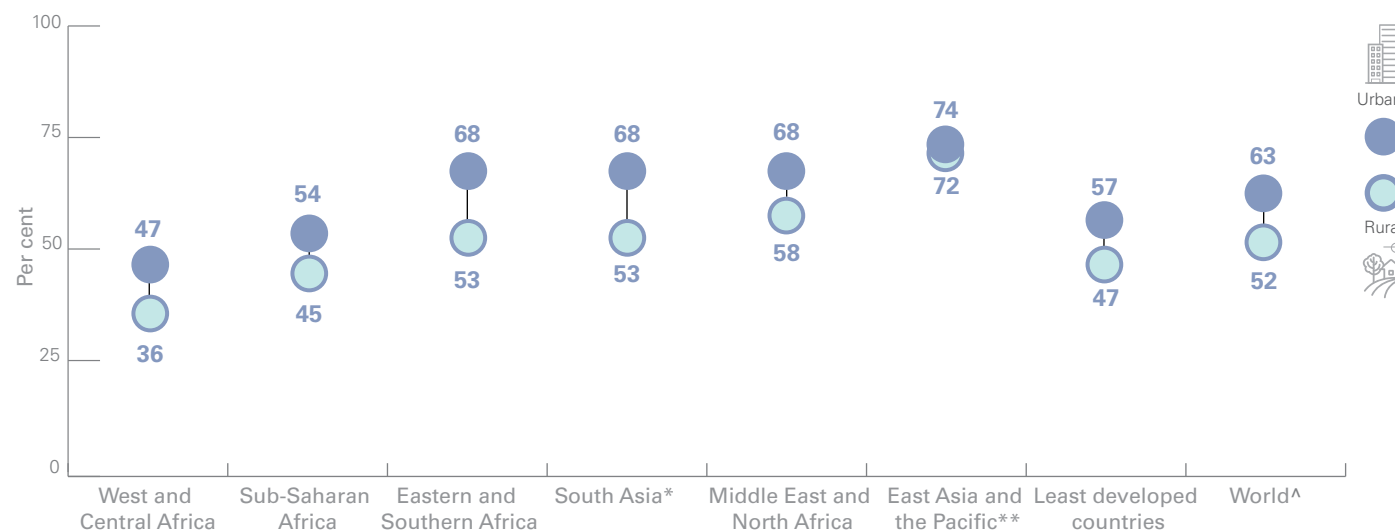


Figure 8: Percentage of children with symptoms of pneumonia taken for care to a health provider, by residence and region, 2015

Source: UNICEF Global databases 2016 based on DHS and MICS. *Excludes India, **Excludes China, ^Excludes India and China. Estimates for year 2015 include data for the 2010-2015 period. Global estimates include 77 countries covering at least 50% of the under-five population in 2015 (excluding China and India for which data was not available).

Diarrhoea treatment

In 2004, UNICEF and WHO published a joint statement with diarrhoea treatment recommendations for low-income countries, which promotes low-osmolarity rehydration salts (ORS) and zinc, in addition to continued feeding. These three components are measured separately to determine treatment coverage estimates.

Globally, the coverage of children receiving oral rehydration therapy (oral rehydration salts, recommended home fluid or increased fluids) and continued feeding to treat diarrhoea has remained stagnant between 2000 and 2015: only two in five children receive this combined intervention.

Sub-Saharan Africa (38 per cent) and the Middle East and North Africa (24 per cent) regions present the lowest coverage. On the other hand, South Asia (not including India) along with East Asia and the Pacific (not including China) present the highest coverage with about half of children receiving this important intervention (see Figure 9).

Recommended treatment for acute diarrhoea



The proportion of children with diarrhoea receiving oral rehydration therapy and continued feeding has remained stagnant for more than a decade



Figure 9: Proportion of children under five with diarrhoea receiving oral rehydration therapy (oral rehydration salts, recommended home fluid or increased fluids) and continued feeding during the illness, by UNICEF region

Source: UNICEF global databases 2016 based on MICS, DHS and other nationally representative sources. Estimate for 2000 includes data for the 1998-2009 period, with 2000 as the median year and estimate for year 2015 includes data for the 2010-2015 period, with 2012 as the median year. Note: Global estimates are based on a subset of 74 countries, covering 60% of population under 5 in 2015. Regional estimates represent data from countries covering at least 50% of regional under-five population. There were not enough data to calculate a regional estimate for Latin America and the Caribbean regions. *Excludes India, **Excludes China, ^Excludes China and India. Note: Zinc is an important component of diarrhoea treatment recommendation, however data were not enough to calculate global and regional averages.

Close up on how to prepare oral rehydration solution (ORS). ©UNICEF/UNI116252/Pirozzi





There has also been slow progress in increasing the percentage of children with diarrhoea receiving the more optimal, low-osmolarity ORS treatment. From 2000 to 2015, the global proportion of children with diarrhoea receiving ORS treatment increased marginally, from 34 per cent to 40 per cent. Progress has been slightly better in least developed countries, rising from 34 per cent in 2000 to 43 per cent in 2015 (see Figure 10).

There are still gaps in access to ORS between the richest and poorest households in most regions, particularly West and Central Africa.

The coverage inequities in sub-Saharan Africa and, in particular, West and Central Africa, are particularly stark (see Figure 11).

The percentage of children with access to ORS rose between 2000 and 2015, but progress to bridge the urban-rural divide has been slow, with South Asia experiencing the greatest improvements (see Figure 12).

Gender equity in use of ORS among children under 5 with diarrhoea varies widely according to region: the most equitable distribution of treatment is in Eastern and Southern Africa,

where access to treatment is almost the same for boys and girls, and the widest discrepancy is found in South Asia where 56 per cent of boys are treated, compared to only 49 per cent of girls.⁷ In Bangladesh for example, despite high levels of coverage overall, coverage for boys is 81 per cent while girls lag behind with a coverage of only 73 per cent. In Pakistan, coverage for boys is very low at 41 per cent and even lower for girls at only 34 per cent. There is a need to further explore the gender dimensions of access to care for both diarrhoea and pneumonia in this region.⁷

Only two out of every five children with diarrhoea are receiving ORS and progress has been too slow

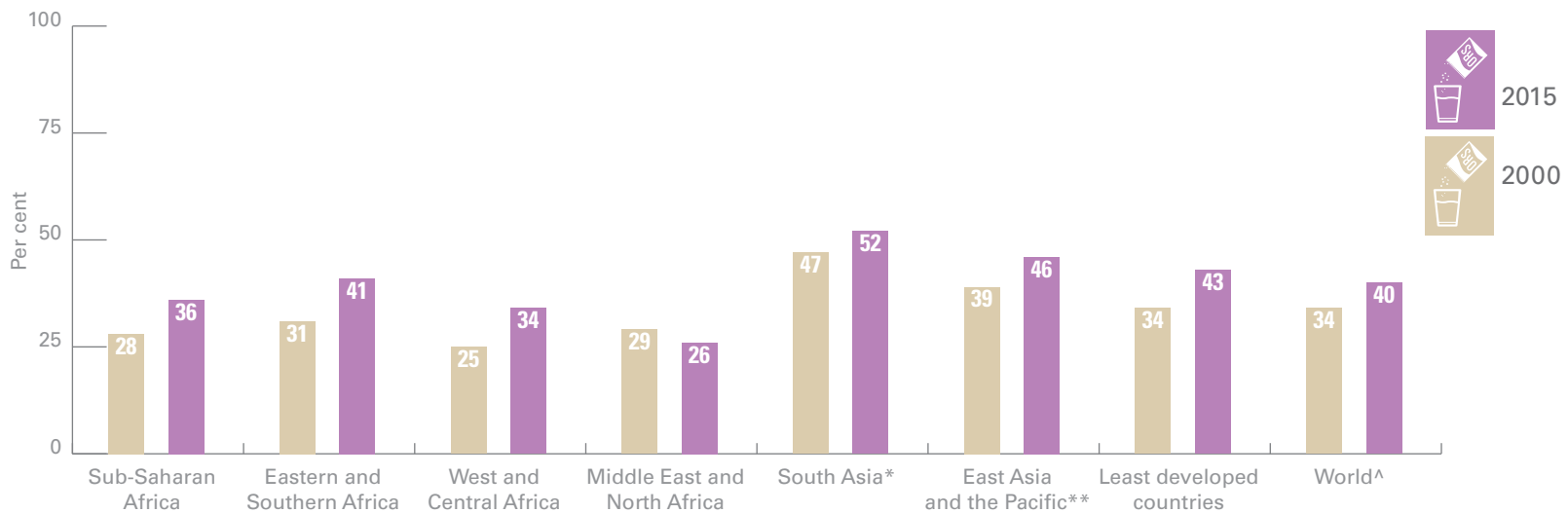


Figure 10: Trends in the percentage of children under 5 with diarrhoea receiving oral rehydration salt solution, UNICEF regions, 2000 and 2015

Source: UNICEF global databases 2016 based on MICS, DHS and other nationally representative sources. Estimate for 2000 includes data for the 1998-2009 period, with 2000 as the median year and estimate for year 2015 includes data for the 2010-2015 period, with 2012 as the median year. Global estimates are based on a subset of 84 countries, covering 65 per cent of population under 5 in 2015. Regional estimates represent data from countries covering at least 50 per cent of the regional under-five population. There were not enough data to calculate a regional estimate for Latin America and the Caribbean regions.*Excludes India, **Excludes China, ^Excludes China and India. Note: Zinc is an important component of diarrhoea treatment recommendation, however data were not enough to calculate global and regional averages.

There are stark gaps in ORS coverage between urban and rural children, and children in the richest and poorest households

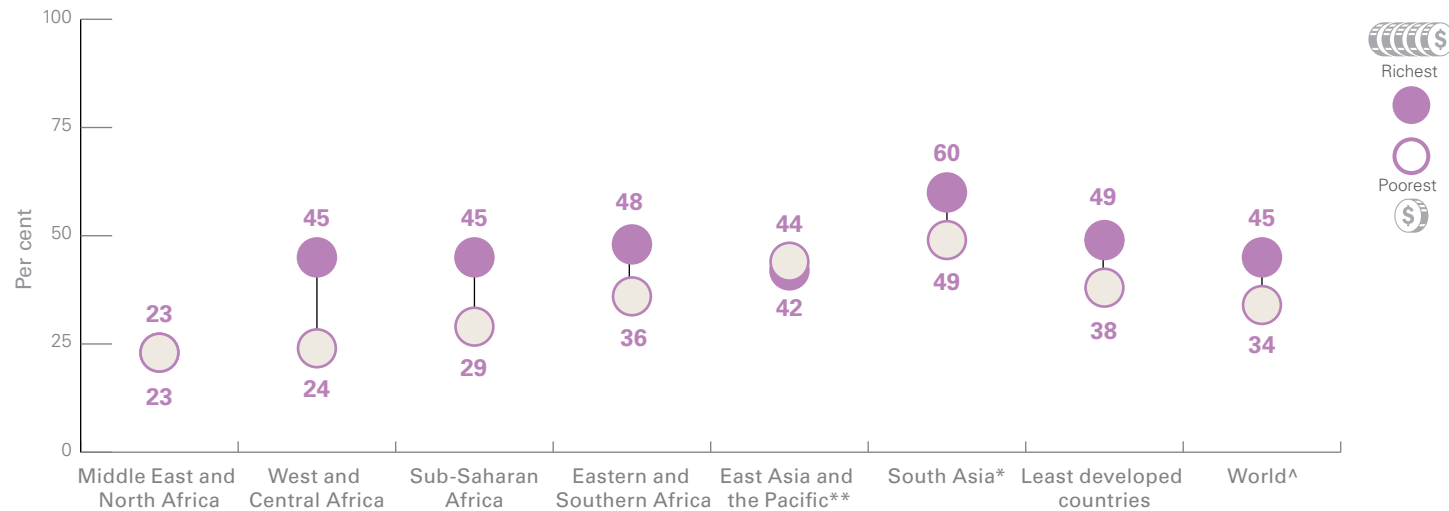


Figure 11: Percentage of children under 5 with diarrhoea receiving ORS, wealth quintiles, UNICEF regions, 2010-2015

Source: UNICEF global databases 2016 based on MICS, DHS and other nationally representative sources. Note: Global estimates are based on a subset of 96 countries, covering 72% of population under five in 2015. Regional estimates represent data from countries covering at least 50% of regional under five population.* Excludes India, ** Excludes China, ^Excludes China and India.

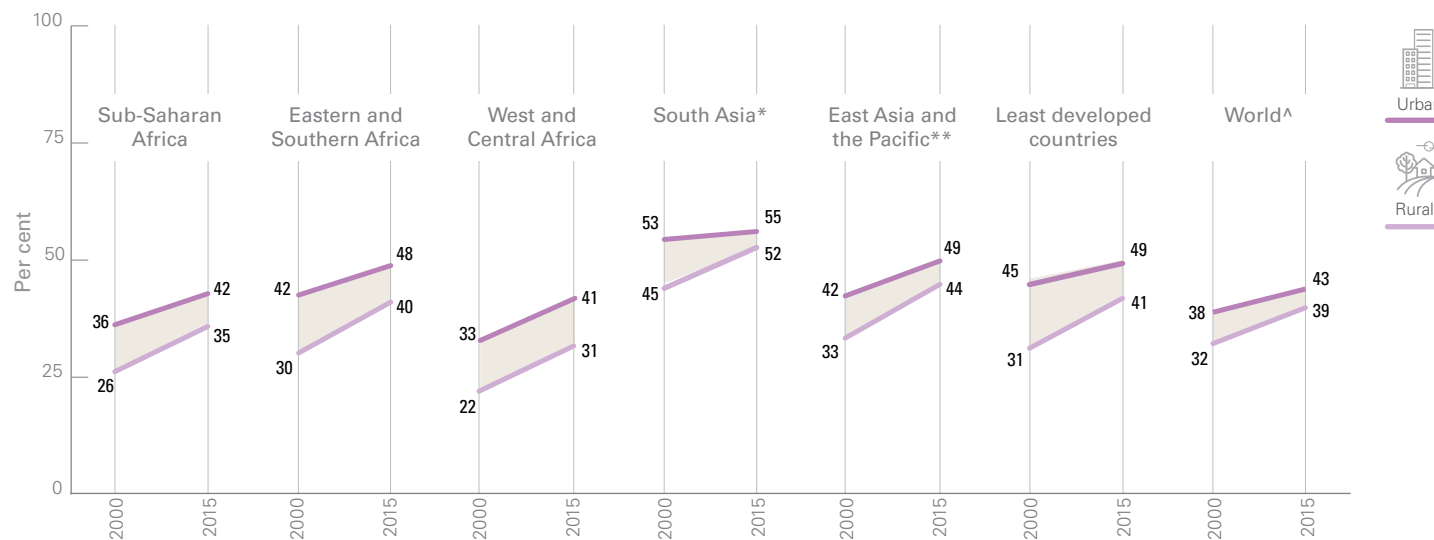


Figure 12: Percentage of children under 5 with diarrhoea receiving oral rehydration salt solution, by residence, UNICEF regions, 2000 and 2015

Source: UNICEF global databases 2016 based on MICS, DHS and other nationally representative sources. Note: Global estimates are based on a subset of 70 countries, covering 50% of population under 5 in urban and 79% in rural areas, 2015. Regional estimates represent data from countries covering at least 50% of regional under-five population.* Excludes India, ** Excludes China, ^Excludes China and India.

Despite the global recommendation to include zinc supplementation for diarrhoea, global coverage of this intervention is extremely low with 4% of children receiving it. There are a few exceptions to this rule in South Asia – namely Bangladesh and Nepal (see Figure 13) – but overall, much more needs to be done to ensure that all children are receiving both ORS and zinc as part of treatment for diarrhoea.

ORS and zinc are essential commodities for diarrhoea treatment yet their availability within health facilities varies across countries. In 14 countries with data from national health facility surveys for the period 2010-2015, an average of 80 per cent of facilities have ORS packets available; however, in two of these countries (Democratic Republic of Congo and Mauritania) only six in ten health facilities have ORS packets available to treat diarrhoea (see Figure 15).

Too few children with diarrhoea receive zinc supplementation in all regions

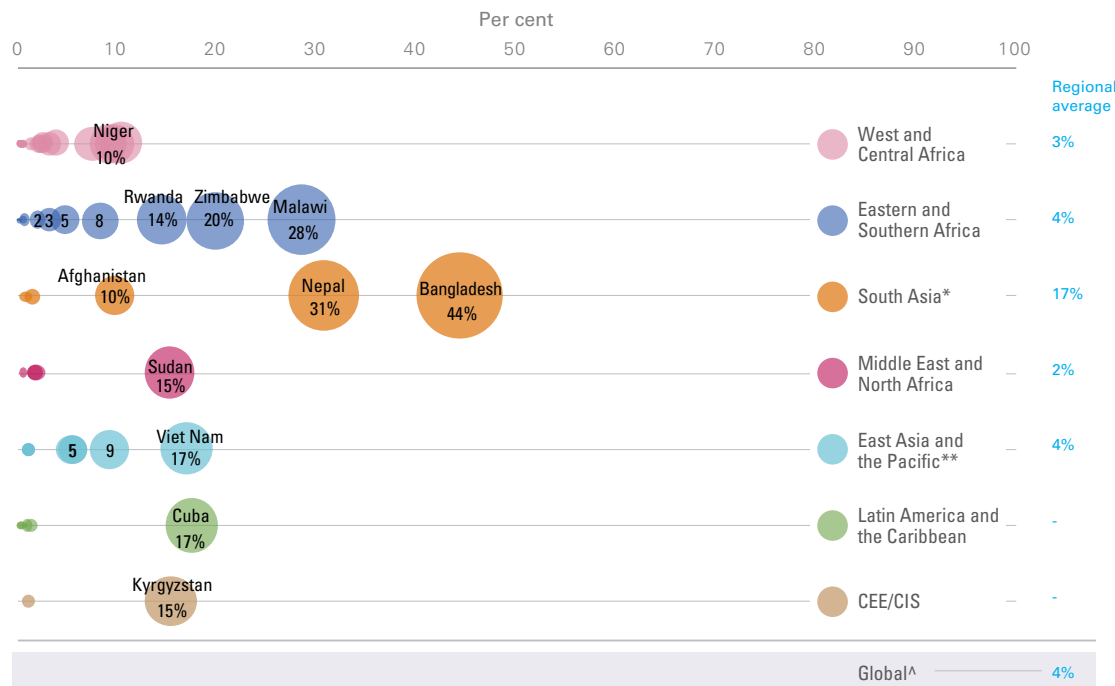


Figure 13: Percentage of children with diarrhoea receiving zinc for diarrhoea treatment, by region, latest available value between 2010 and 2015. Regional estimates indicated on region names.

Source: UNICEF global databases 2016 based on MICS, DHS and other nationally representative sources. *Excludes India, **Excludes China, Excludes India and China.

Evidence of childhood diarrhoea management in 12 high burden countries shows that the prevalence of good diarrhoea management is low and variable across countries, ranging from 17 per cent in Côte d'Ivoire to 67 per cent in Sierra Leone, even among children taken to health facilities for care. The odds of a child receiving good diarrhoea management were equivalent for community versus facility providers in six countries and higher for community providers than for facility providers in Niger and Uganda (see Figure 14).⁸



Antibiotics: In health facilities, the availability of essential commodities, such as antibiotics, varies and is very low in some countries. From the health facilities for which data is available, just over 60 per cent of countries have adequate stocks of Amoxicillin or Co-trimoxazole. In Nepal and Uganda for example, one in four facilities have Amoxicillin available, while in Tanzania, Kenya, Benin, Mauritania and the Democratic Republic of Congo, less than six in ten facilities have it available (see Figure 15).



Oxygen therapy: Despite its importance in recovery from severe pneumonia, oxygen therapy is rarely available in community health centres and district hospitals in low-resource settings. The number of children needing access to oxygen is overwhelming: approximately 13 per cent of children with pneumonia have hypoxaemia, equalling roughly 1.86 million cases each year.⁹ Yet far too many children die because hypoxaemia is not recognized and oxygen therapy is not available, or equipment is poorly maintained and staff lack appropriate training.^{9 10 11}

Prevalence of good diarrhoea management is low and variable across countries, even among children taken for care to health facilities

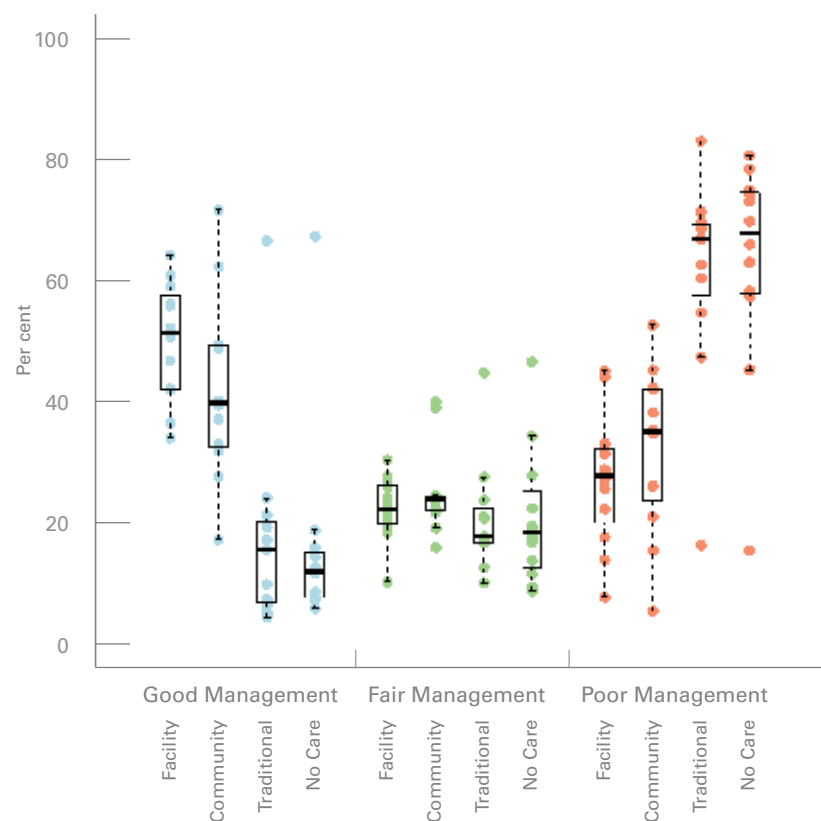


Figure 14: Percent of children 0-59 months with diarrhoea by type of diarrhoea management practice (good, fair or poor) and by source of care. Each point represents a country.

Source: Carvajal-Velez, et al., *Diarrhea management in children under five in sub-Saharan Africa: does the source of care matter? A Countdown analysis*. BMC Public Health, 2016

II. Challenges and opportunities to deliver better

Expanding delivery mechanisms and leveraging community-based strategies

There is a need for improved delivery mechanisms to expand reach and guarantee access for the most vulnerable children. The expansion of integrated community case management (iCCM) of childhood illnesses provides many opportunities. Building on the IMCI approach, the iCCM strategy extends the case management of childhood illness beyond health facilities, so that more children have access to lifesaving treatments. Lay community health workers receive specialized short-term training on iCCM by the Ministry of Health, using simplified IMCI approaches, to provide care and treatment within the community.

Some estimates suggest that iCCM could reduce rates of treatment failure by 40 per cent, reduce pneumonia-specific mortality by 32 per cent, and result in a 160 per cent increase in the use of ORS.^{11 12} One meta-analysis found that the treatment of childhood pneumonia by community-based health workers in hard-to-reach areas was just as effective as treatment provided by physicians traveling in mobile units.¹³ Community health workers have also been effective in increasing ORS and zinc usage with time-limited free distribution, social marketing and the co-packaging of zinc and ORS. As of 2015, 28 countries in sub-Saharan Africa were implementing iCCM for pneumonia, diarrhoea and malaria.⁵

While community health workers have been very effective in some countries such as Ethiopia, the experience has not necessarily transferred to other countries or settings for a diverse set of reasons. Community-based health workers are not consulted by caregivers as frequently as they should be in many countries. This is in part due to their limited coverage and availability in some settings. In other cases, caregivers consult private health facilities and providers (e.g. pharmacists) more often than community-level workers because of convenience or lack of trust.^{14 15} Care seeking patterns differ widely across countries and strategies to improve

Health facilities should carry essential commodities to treat pneumonia and diarrhoea but stocks vary across countries

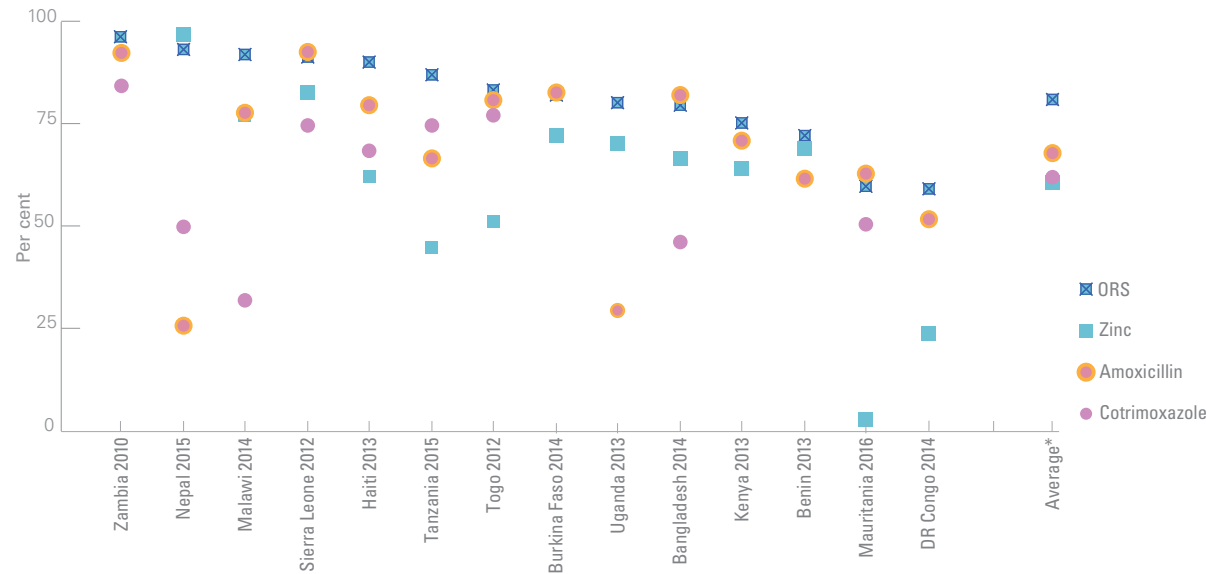


Figure 15: Availability of essential commodities for treatment of pneumonia and diarrhoea in health facilities (countries with available data for the period 2010-2015) *Simple average of countries with available data for the period 2010-2015.

Source: Service Provision Assessment (SPA) and Service Availability and Readiness Assessment (SARA) surveys 2010-2015.

them must be adapted to reflect the local context and priorities.^{14 16}

Addressing low levels of care seeking within the community and expanding community-based care is challenging in many settings. Some countries prohibit community health workers from providing antibiotics to treat pneumonia, and this in turn affects care-seeking behaviours; improving national policies around this issue is therefore critical. Change is underway in Kenya, for example, where UNICEF completed a study to generate the required evidence to support community health workers' treatment of pneumonia in

children. The results will be used for advocacy and programme expansion in the country.⁵

Care seeking for pneumonia can also be improved with better recognition of the symptoms and seriousness of pneumonia by caregivers. Once care is sought, front line health workers need IMCI or iCCM training along with effective supplies and medicines in order to assess and treat suspected cases. The development of innovative diagnostic tools offers important opportunities to improve diagnosis of these conditions in peripheral facilities and communities that currently lack such capacity (see Chapter 5).

There are also policy-related bottlenecks to the provision of ORS and zinc at facilities and within the community. The absence of national policies supporting the use of zinc in the routine case management of diarrhoea, for example, poses a barrier in many countries (see box, page 47).¹⁷ Within the community and in some public health facilities, drug stock-outs and poor quality of care often result in caregivers seeking alternative treatments for pneumonia or delaying treatment seeking altogether.¹⁶

Prioritizing prevention

Improving the coverage of protective and preventative measures presents ongoing challenges. Scaling up coverage of vitamin A supplementation requires improved delivery mechanisms to ensure access for the most vulnerable children. For years, many countries successfully delivered vitamin A supplements as part of polio immunization campaigns. However, as these campaigns phase out, many countries need a transition strategy to ensure that children in priority countries continue to receive life-saving vitamin A. Child Health Days – campaign-style events that extend the health system to communities and offer a package of health and nutrition interventions, including vitamin A supplementation – are effective at achieving high coverage in fragile settings with weak health systems.³ Continued strengthening of routine systems to deliver immunization, vitamin A and other key interventions is also important.

There is work to be done in improving the enabling environment for breastfeeding in many countries, including advocating for

protective legislation (e.g. maternity leave) and the adoption of the International Code of Marketing of Breast milk substitutes and subsequent World Health Assembly resolutions (the Code) into national legislation. The Code aims to protect and promote breastfeeding by prohibiting the promotion of breast milk substitutes including infant formula, bottles, teats, follow-up formulas and growing up milks marketed for feeding infants and young children up to the age of 3 years. Globally, there are 135 countries with some Code provisions in place. However, the strength and comprehensiveness of these measures vary widely across countries.^{1,18} In an effort to accelerate progress, WHO and UNICEF established NetCode in late 2014 (Network for the Global Monitoring and Support for Implementation of the International Code of Marketing of Breast-milk Substitutes and subsequent World Health Assembly Resolutions), which aims to strengthen the development, monitoring and enforcement of national Code legislation by Member States. There is also a need to improve training for community and facility health workers on breastfeeding and complementary feeding, which will in turn improve the quality of counselling and support provided to mothers and caregivers.

Protecting children from air pollution requires greater efforts to minimize children's exposure to it and improve their overall health to make them more resilient against air pollution. There is also a need to strengthen the monitoring of air pollution and its impact on children's health and well-being.⁶ Clean cook stoves and cleaner fuels (see Chapter 5) provide important opportunities to reduce household air pollution and its disproportionate impact on young children.

Further improvements in water quality and access to sanitation facilities are critical to the effective prevention of diarrhoea and pneumonia. In 2015, more than 23,000 communities obtained certification as open defecation free in 47 countries with the direct support of UNICEF, an increase of more than 18 per cent from 2014. In 2015, more than 23,000 communities obtained certification as open defecation free in 47 countries with the direct support of UNICEF, an increase of more than 18 per cent from 2014.¹⁹

Scaling up access to oxygen therapy in Rwanda

Oxygen deprivation due to pneumonia is one of the leading causes of mortality in children under 5 in Rwanda. Within this context, the UNICEF-Frog and ACCESS project supported the Government of Rwanda to reduce under-five mortality due to limited oxygen therapy in the health settings. A pilot project was started in Musanze District with the aim of developing an oxygen-generating plant in Ruhengeri Provincial Hospital with the capacity to produce and fill 50 cylinders of oxygen a day for the hospital itself and other hospitals in the surrounding area. The Ruhengeri hospital is one of seven hospitals in the Northern province and the largest in terms of capacity, workforce and attendance.

UNICEF-Frog and the ACCESS project offered an on-site training programme for the hospital technical staff on repairs and maintenance of the plant during and after installation. Daily operation of the plant is straightforward and requires no special skills: employees fill oxygen cylinders, maintain technical performance records, and release cylinders to other hospitals as needed.

In the pediatric department of the hospital, most admissions are children under 5 with pneumonia and upper respiratory tract infections. At the

outset of the project, the department had only two old oxygen concentrators for an average of 10 children in need of oxygen. Since accessing the new oxygen cylinders, children admitted with pneumonia are being treated and discharged much more quickly. The initial bed occupancy rate of 85 per cent dropped to 40 per cent because children were being treated more effectively.

Before the project was launched, the neonatal unit at Ruhengeri Hospital faced immense challenges in accessing oxygen. Oxygen concentrators were 20 years old, and the quality was so poor that neonatal mortality was more than 12 per cent. According to hospital registers, the project resulted in the following improvements:

- neonatal mortality rate dropped from 12 per cent to 5 per cent after 1 year of using the new oxygen system;
- the average hospital stay duration dropped from 7 to 3 days;
- the bed occupancy rate decreased from 110 per cent to 50 per cent (because of the lack of oxygen, stays in the neonatology department were often lengthy).

Source: CVI and UNICEF. Medical oxygen: an essential medicine in developing countries for sustaining clinical practice, 2016. Data based on facility registers.

Addressing obstacles to effective diagnosis

There is a potential for misdiagnosis between pneumonia and malaria, and pneumonia and other respiratory infections such as tuberculosis. Malaria cases commonly present with fever and respiratory distress, such that there is substantial symptom overlap between pneumonia and malaria. There is a need for better diagnostics to detect bacterial pneumonia as well as reinforced training in IMCI and iCCM to assess and treat multiple conditions and to provide dual assessment and treatment if children meet the IMCI/iCCM thresholds for classifying different conditions.

There is also potential for misdiagnosis between pneumonia and tuberculosis. An estimated 1 million children aged 0-14 years fell ill with tuberculosis in 2016, and at least 210,000 of them died. However, only about one third of the estimated cases were reported to National TB Programmes, suggesting that large numbers of children remain undiagnosed.²⁰ Data from autopsies and clinical studies suggests that tuberculosis is commonly found in children with severe pneumonia; however, it is unclear whether as a cause or co-morbidity.^{21 22} The data suggest that tuberculosis may remain undiagnosed in children with respiratory disease and might be misdiagnosed or treated as pneumonia. Underlying tuberculosis might also increase a child's susceptibility to secondary bacterial pneumonia. Tuberculosis should therefore be routinely considered in children presenting with signs and symptoms of pneumonia, depending on its prevalence within the local context, and given the overlap in symptoms for both diseases. Generic iCCM materials have been adapted by WHO and UNICEF to include risk assessment for both tuberculosis and HIV. These are recommended for scale-up in high TB and HIV burden settings.²³

New, innovative and low-cost diagnostic tools are paving the way for better accuracy in diagnosing pneumonia in low-resource settings (see Chapter 5).

Expanding the reach of vaccines

Estimates suggest that 27 per cent of childhood diarrhoea and pneumonia deaths could be averted with the use of three vaccines: Hib, PCV and rotavirus vaccine.²⁴ Despite their effectiveness, there is still room for improvement in vaccine uptake in low and middle income countries. The GAPPD recommends the introduction of new vaccines into national immunization programmes along with behaviour change messaging to empower families to undertake preventative measures at household-level and seek care for pneumonia and diarrhoea when necessary. Many countries are at the early stage of this process and bottlenecks include a lack of vaccine guideline formulation and limited funding to support vaccination programmes.

Ensuring availability and effective use of essential commodities

Improved supply forecasting for essential commodities like Amoxicillin, ORS and zinc is critical in many countries. This includes addressing in-country supply chain barriers that prevent commodities from reaching the health facilities and communities that need them. Even with modest financing, the experiences of countries like Ethiopia and Tanzania show that quantification exercises for child health commodities can make a critical difference in treatment coverage (see box, page 48). Amoxicillin DT provides particularly good value for money and opportunities for cost savings (see Chapter 5).

Strong health systems are key to ensuring children have appropriate access to antibiotics while also preventing the overuse and misuse of these medicines.





Three and a half year old Majoue suffered from acute diarrhoea; she became very ill and dehydrated but the use of ORS helped her get back on her feet quickly.
©UNICEF/UNI177125/Estev

Lessons learned in the scale-up of ORS and zinc supplementation

The report *Progress over a Decade of Zinc and ORS Scale-up: Best practices and lessons learned*, published by the Diarrhoea and Pneumonia Working Group, provides a framework for scale-up and outlines four key success factors for implementation:

1. **Securing a strong enabling environment:** A national scale-up plan—in line with GAPPD and other global frameworks—helps to align government and partners around a common framework and a government-led national coordinating mechanism can drive its implementation. Achieving over-the-counter status for zinc is also needed to ensure the products can be widely distributed and marketed to consumers.
2. **Improving availability of supply:** The local market for high-quality, affordable, and optimal zinc and ORS products has improved dramatically, particularly in sub-Saharan Africa, with the introduction of new suppliers. In the public sector, robust forecasting, procurement, supply chain, and distribution practices help to ensure a consistent supply for health facilities and community health workers. In the private sector, partnerships with actors along the supply chain expand the reach of products to rural areas where most children die from diarrhea.
3. **Generating demand among caregivers:** A strategy informed by the latest market evidence and tailored to address local barriers has the greatest potential for improving awareness and usage of recommended products among target audiences. Updating product packaging and presentations also has a strong influence on consumer appeal and adherence.
4. **Improving knowledge and skills of providers:** Frontline workers (both public and private sector)—often the first and only point of care for child diarrhea in remote areas—should be adequately equipped with the knowledge, skills, and motivation needed to manage and treat diarrhoea.

Source: Diarrhoea and Pneumonia Working Group, *Progress over a Decade of Zinc and ORS Scale-up: Best practices and lessons learned*. 2016

This is particularly important given the increasing burden of antimicrobial resistance. Strengthened iCCM and IMCI strategies are effective in improving quality of care and facilitating rational antibiotic use.²⁵

Providing life-saving treatment for severe pneumonia

The effective treatment of severe pneumonia requires oxygen therapy, yet there are a number of challenges in introducing oxygen concentrators within low-resource settings.

These include logistical barriers, the absence of a distribution infrastructure, weak regulatory frameworks, poor staff training and capacity, lack of consistent and reliable electricity and lack of resources available for maintenance.²⁶

To ensure that all children with hypoxaemia receive oxygen therapy, there is a need for better trained health workers, and improved access to diagnostic technology such as pulse oximetry (which measures blood oxygen concentration through a sensor, often placed on the child's finger), as well as access to sustained treatment once hypoxaemia is

identified.⁸ High flow oxygen tanks are a useful alternative to concentrators, as they provide the same level of oxygen flow needed, but without requiring any electricity (see Chapter 5).

Addressing barriers to effective monitoring

There are a number of challenges in monitoring coverage of pneumonia treatment interventions (discussed previously, in Chapter 2). There are also challenges in measuring diarrhoea treatment with ORS via household surveys, given that such surveys do not monitor the severity of diarrhoea cases and are therefore limited in distinguishing mild cases where use of ORS is not always necessary. In addition, survey questions about other fluid intake or increased fluids may be confusing for caregivers. Research has yielded recommendations for improving household survey measures to provide a more accurate picture of key coverage indicators and identified areas in need of further research (see Chapter 7).²²

The Diarrhoea & Pneumonia Working Group is a global coordinating body focused on accelerating access to treatment for diarrhoea and pneumonia in ten high-burden countries by supporting large-scale increases in coverage of ORS, zinc, and Amoxicillin. To measure progress across the 10 countries, the Working Group endorsed a common evaluation framework—including a set of performance indicators that will be revised as more evidence on the validity and appropriateness of new indicators becomes available. The list of performance indicators²⁷ is intended to serve as a basis for discussions at global and country levels around evaluating progress against treatment scale-up and facilitating alignment of monitoring and evaluation efforts across programmes.

Improved supply forecasting for Amoxicillin

In 2015 and 2016, the governments of Ethiopia and Tanzania, with support from implementing partners, including Results for Development (R4D), led improved quantification exercises for child health commodities.

In Ethiopia, the Federal Ministry of Health forecasted the volume of Amoxicillin DT 250mg needed to meet the demand for pneumonia treatment at the community and lower-tier facility levels from 2016 to 2018. This was later expanded to include demand for treatment at all health facilities assuming an improved rate of care seeking and antibiotic treatment coverage.

In neighboring Tanzania, the government and partners led a national-level quantification of commodities for reproductive, maternal, newborn and child health, including Amoxicillin DT, for the period of 2016 and 2017. The methodology used to forecast Amoxicillin DT was updated and aligned with WHO guidelines.

These forecasts revealed that even with modest financing, millions of children could be provided life-saving treatment for pneumonia (assuming other system barriers have been addressed). In Ethiopia, US\$4.5 million was forecasted to treat almost 9 million pneumonia cases in children under five from 2016 to 2018. A little over US\$0.8 million would be needed to treat an estimated 1.3 million pneumonia cases in children under five in Tanzania in 2016 and 2017.

Country progress to scale up key interventions

In line with the 'A Promise Renewed' strategy, many countries are scaling up efforts to bring health services closer to underserved communities to address high under-5 mortality rates through ICCM. From April 2013 to December 2015, a UNICEF-led project in four sub-Saharan countries (Ethiopia, Kenya, Niger and Tanzania), supported by the Government of Canada, aimed to improve effective treatment coverage for diarrhoea and pneumonia, guided by the following objectives:

- To increase public awareness and generate demand for appropriate diarrhoea and pneumonia treatment care-seeking;
- To increase availability of essential medicines used in the management of diarrhoea and pneumonia through strengthening procurement and supply chain management;
- To expand access to effective integrated treatment services for diarrhoea and pneumonia at community and front-line health facility levels;
- To strengthen public-private partnerships and make better use of private sector channels for appropriate diarrhoea and pneumonia treatment.

Coverage of effective treatment interventions improved in the four project countries, with specific results in the following areas:

Demand generation: In all four countries, demand generation activities – including the dissemination of personal communication materials, mass media campaigns, and advocacy initiatives – were effective in increasing care seeking for treatment. In Ethiopia, care-seeking for pneumonia increased from a baseline of 26 per cent to an endline of 57 per cent. Care seeking for diarrhoea similarly increased, from 31 to 51 per cent.

Supply chain management: the project aimed to increase the availability of essential medicines used in the management of diarrhoea and pneumonia, including advocating for 'over the counter' (OTC) status for zinc, registration of Amoxicillin dispersible tablets (DT) (see section E), and strengthening national procurement and distribution systems for ORS, zinc and Amoxicillin. As a result of successful advocacy, ORS and zinc were deregulated in Kenya. With UNICEF support, all four governments were better able to forecast, procure and distribute essential commodities. Tanzania, for example, conducted a quantification exercise to develop a two-year forecast for ORS, zinc and Amoxicillin. In Ethiopia, more than 128,000 packs of Amoxicillin DT were distributed to health posts.

Service delivery: access to effective iCCM at community and front-line health facility level improved over the course of the project. Community health workers and supervisors were trained on iCCM in Ethiopia, Kenya and Niger and frontline health workers and supervisors were trained in Tanzania. Training and supportive supervision were successful in improving the quality of care provided by front-line health workers.

Private public partnerships: while the primary focus of the project was public sector service provision, the project also helped expand access to effective and quality treatment through the private sector. Private sector health workers were trained on the treatment of childhood diarrhoea and pneumonia in Ethiopia, Kenya and Tanzania, where 948 private sector dispensers and pharmacy owners were trained on the use and management of Amoxicillin DT and co-packed ORS/zinc. The project also supported local production and distribution of essential commodities. These efforts were successful in catalyzing private sector production of essential commodities in Ethiopia, Kenya and Tanzania.

Key achievements:

In Ethiopia, the percentage of children under 5 with suspected pneumonia receiving antibiotics in project implementation areas increased from 7 to 52 per cent; 17 per cent of children under 5 with diarrhoea were treated with ORS and zinc in project implementation, compared with 0 per cent at baseline.

In Kenya, the percentage of children under 5 with suspected pneumonia receiving antibiotics in Homa Bay County increased from a baseline of 40 per cent to an endline of 59 per cent, while in Siaya, the coverage rate increased from 28 per cent to 56 per cent over the same period; 58 per cent of children under 5 with diarrhoea were treated with ORS and zinc in Homa Bay, and 52 per cent in Siaya.

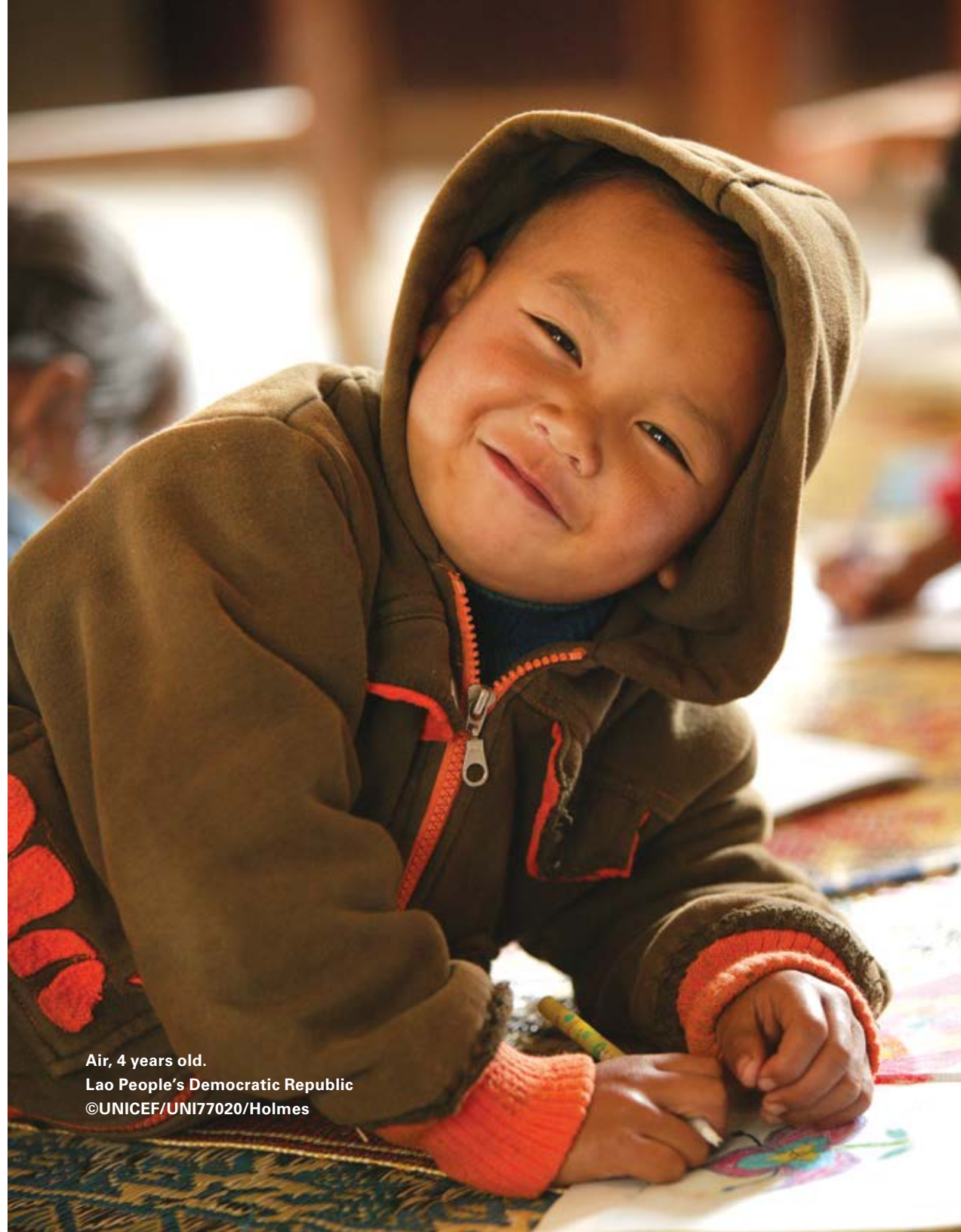
In Niger, 53 per cent of the expected cases of children under 5 with pneumonia received adequate treatment; diarrhea treatment reached a coverage rate of 88 per cent, compared to the baseline of 26 per cent.

In Tanzania, approximately 72 per cent of children under 5 with suspected pneumonia received antibiotics across the six project areas; 51 per cent of children under 5 with diarrhoea received ORS and zinc treatment through health facilities and pharmacies in the target areas.

The project reaffirmed the critical role of community health workers in accelerating child survival and development interventions. Better training and supervision of community health workers can help ensure high quality of care. The project also shed light on the significant role of private sector health workers and the need to provide them with appropriate training, and the impact of demand generation activities in improving care-seeking behaviours. Lastly, mobile technology provided an opportunity to improve linkages between facility-based healthcare providers and community health workers.

5

Strategies and innovations



Air, 4 years old.
Lao People's Democratic Republic
©UNICEF/UNI77020/Holmes

While there has been progress in effective interventions to manage pneumonia and diarrhoea, we know that these lifesaving measures are still not reaching the most vulnerable children. Barriers at every level – from prevention, to diagnosis, to treatment – must be urgently addressed if we are to improve child survival and achieve the SDG goal on ending preventable child deaths.

There is consensus that new approaches are needed to solve old problems; innovations are essential to bridging the gap to ensure that every sick child seeks appropriate care, is accurately diagnosed and receives the treatment he or she needs in a timely manner. Pneumonia deaths in particular have not declined at the same pace as deaths related to malaria, diarrhoea, measles and AIDS, and new technologies and service delivery models are urgently needed to accelerate child pneumonia death reductions.

Global networks aiming to foster such innovations have been gaining momentum. The Pneumonia Innovations Team, a global network of more than 350 organizations aims to accelerate the development and adoption of innovative technologies with the greatest potential to reduce child deaths from pneumonia. The group includes a mix of leading experts from academia, industry, NGOs, and other UN agencies who look at innovations in four primary areas: diagnostic and prognostics (respiratory rate devices, pulse oximeters) treatments such as oxygen therapy, antibiotics and areas of programmatic intervention such as household air pollution and treatment guides. Examples of innovations in each area are discussed further below.

Innovative technologies can provide more reliable methods of diagnosis, simplified treatment regimens, and an improved and sustainable quality of care in even the most challenging settings.



Only **3** out of **5** children globally are seeking care for pneumonia symptoms



Innovative technologies can provide more reliable methods of diagnosis, simplified treatment regimens, and an improved and sustainable quality of care in even the most challenging settings. A strong foundation of iCCM is often key to their effectiveness. When community health workers are well-trained, empowered and supported, they are the critical link to putting these innovations into practice.

A. Preventative innovations



Clean household energy solutions

Safe and affordable clean household energy solutions can dramatically reduce fossil fuel consumption and improve household air quality by limiting exposure to harmful cooking smoke.¹ Research conducted in Cambodia by Berkeley Air Monitoring Group and commissioned by SNV Netherlands Development Organization, compared the impact of two types of clean cook stoves on household air pollution: an advanced biomass stove, designed to burn wood, charcoal and other biomass more efficiently through cleaner combustion, and a biogas stove, which uses clean biogas fuel.

Both clean cook stoves reduced air pollution in the home. Use of the advanced biomass stove resulted in an almost 40 per cent reduction in mean kitchen air pollution and a 28 per cent reduction in personal exposure. 49 per cent of study participants in urban settings replaced their traditional stove with the cleaner biomass option, versus only 8 per cent in rural settings. The biogas stove also reduced kitchen air pollution by 80 per cent and personal

exposure by just over 60 per cent, compared to traditional methods. Overall, 83 per cent of biogas stove study participants replaced their traditional stove with the biogas stove.¹

Governments in a number of countries are investing in cleaner cooking solutions to improve household air quality. In India, for example, the Ministry of New and Renewable Energy invested in producing state of the art, clean and culturally appropriate cook stoves, distributing more than 2.7 million cook stoves in the country, and in Chile, the Ministry of Environment exchanges old cook stoves with new and clean cook stoves to minimize pollution from residential wood burning.²

There are also a number of programmes underway to support clean household energy solutions in low- and middle-income countries. In Bangladesh, for example, 40,000 households have been equipped with fuel-efficient cook stoves which have improved children's and mothers' health, reduced greenhouse gas emissions, decreased local environmental degradation and deforestation, and improved household income savings. In Burundi, the use of safer lighting in rural households has lowered carbon emissions and reduced costs and air pollution.



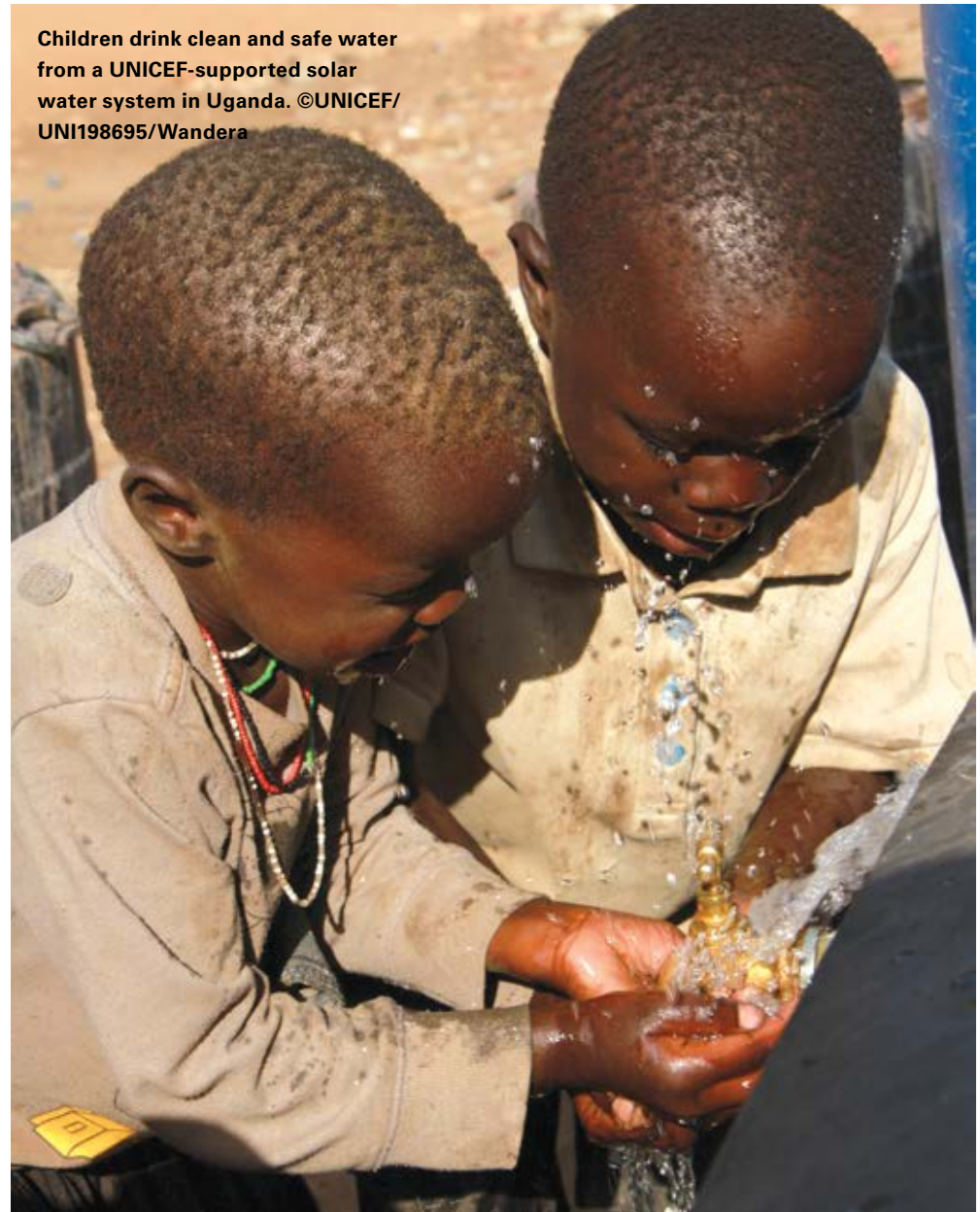
A girl cooks in the village of Kabe, Mali. ©UNICEF/UNI100808/Asselin



Improved water and sanitation

Innovative solutions for improving water and sanitation are key to preventing diarrhoeal illness, and can improve access to clean drinking water at limited cost. Gravity-fed water supply schemes, for example, use the force of gravity to transport river water by pipework to taps, thereby reducing the work required to carry water.³ Solar water irrigation pumps provide farmers with solar-powered alternative grid electricity and fossil fuels. Desalination plants, which remove salt and minerals from water are effective in places with limited safe drinking water supply and quality. These innovations provide a consistent water supply without relying on scarce fuel for pumping.

UNICEF provides technical assistance and supports training for communities to operate and maintain gravity-fed water schemes in Afghanistan, Madagascar, Timor-Leste and in Lao People's Democratic Republic. UNICEF programmes are increasingly employing solar pumping systems as technology costs drop and reliability increases, even in emergency situations. In Eritrea, for example, UNICEF support produced standard designs for solar water supply schemes that will provide improved access to safe water for an estimated 41,000 people in 24 communities.⁴ In the State of Palestine, a new seawater desalination plant, supported by UNICEF and the European Union, will provide 75,000 Palestinians with safe drinking water in Gaza.⁵



Children drink clean and safe water from a UNICEF-supported solar water system in Uganda. ©UNICEF/UNI198695/Wandera

Access to breastmilk

Innovative solutions are being developed to provide lifesaving access to breastmilk for babies who cannot breastfeed and who are at an increased risk of infection, especially from pneumonia. Experts at PATH have developed a small, spouted feeding cup for providing breast milk to infants with breastfeeding difficulties, such as those born prematurely or with a cleft palate. The Nifty Cup – Neonatal Intuitive Feeding Technology – allows mothers to express breast milk directly into the bowl of the cup’s reservoir and the spout helps the baby to control the pace of the feeding. The Nifty Cup, and other similar innovative feeding cups, could allow millions of the most vulnerable and high-risk infants in developing countries to reap breast milk’s protective benefits.⁶ PATH recently announced a partnership with Laerdal Global Health to make the Nifty Cup widely available in low resource settings.

Brazil is leading the way in increasing access to donor breastmilk for babies who cannot breastfeed. There are more than 200 milk banks across the country – the largest network of human milk banks in the world. More than 150,000 Brazilian mothers arrange to donate their breast milk via toll free hotlines and home visits are provided by lactation experts to help pump, sterilize and store breastmilk. The milk is tested, sorted and pasteurized, before being distributed to neonatal intensive care units in hospitals for premature and sick babies. PATH is now working with several Indian hospitals to expand access to human milk banks with support from the Breastfeeding Innovations Team, a global network of more than 200 organizations committed to the development of new technologies that increase breastfeeding rates, especially among the most vulnerable babies.

B. Diagnostic innovations

Acute respiratory infection diagnostic aids (ARIDA)

Devices that diagnose pneumonia easily, accurately and at low cost could avert countless deaths and allow children to be effectively treated close to home. Advanced diagnostic tools, such as chest x-rays and laboratory tests, are not readily available in low-resource settings and community health workers must diagnose pneumonia based on breath counting and clinical observation. Since the 1990s, acute respiratory infection (ARI) timers, as well as clocks and watches, have been used to support health workers to count breathing rates for 60 seconds in order to classify pneumonia according to iCCM and IMCI guidelines, but counting breathing rates can be difficult, and even trained providers can misclassify pneumonia using timers. Research done with community health workers in Ghana and Uganda confirmed a number of additional drawbacks to the timer: the continuous ticking sound can be distracting when counting breaths and the alarm often startles children and parents. Research with health workers suggested that the ideal device should be durable enough to withstand extreme environmental conditions, function independently of a power source, and demonstrate the diagnosis to the caregiver to instill confidence.

With this in mind, UNICEF Supply Division’s Innovation Unit and Program Division, launched a Target Production Profile on World Pneumonia Day 2014 to communicate the ideal

features and functionality of an automated ARIDA device to help measure a sick child’s respiratory rate and check for fast breathing. Developers were invited to begin innovating a product that would be relevant in primary health care clinics and would also improve the quality of care provided by community health workers.

The ARIDA devices developed in response to the project range in their methods of diagnosis, and to a certain extent, in their definition of what a ‘breath’ is. Some proposed devices record the child’s cough and breathing rate through smart phone technology to offer a diagnosis. Others use sensors to detect a child’s respiration rate through an accelerometer, measure exhaled CO₂ or through waveforms in the blood, or use thermometer-like devices to monitor inhalation and exhalation waves.

In partnership with “la Caixa” Foundation, UNICEF will conduct field trials of the innovative ARIDA devices⁷ in Bolivia, Côte d’Ivoire, Ethiopia, Nepal and the Philippines, amongst other countries to determine how the ARIDA devices function against the current best-practice method of counting respiratory rate in each country (ARI timer, watch etc.), including the ease with which health workers are able to use them, their preferences and the feasibility of use of the ARIDA device at the lowest levels of healthcare. The results of an external evaluation will help determine which ARIDA device functions best in various settings (e.g. community versus facility). A cost effectiveness analysis of this project will determine the health impact (cost per

additional lives saved) of the improved ARIDA devices in poorly resourced settings as compared to the current best practice.

Pulse oximetry

Pulse oximetry is a simple and effective tool for identifying children in urgent need of oxygen yet it is unavailable in most low-resource settings, contributing to an estimated 120,000 child deaths from lack of access to oxygen.⁸ Pulse oximeters use only a small sensor against the skin, usually finger or toes, and are thus less invasive than other diagnostic measures, such as blood gas analysis.

Innovations in the technology used to produce pulse oximeters have meant that portable pulse oximeters have become available, including phone-based oximeters. Sensors have also been adapted to meet the needs of the smallest neonate. The Bill and Melinda Gates Foundation is partnering with pulse oximeter manufacturer Masimo to measure the impact of its adapted tool on management of child pneumonia. The Foundation is also partnering with the Clinton Health Access Initiative to support governments of several African countries to scale-up pulse oximetry in healthcare systems.



Sample ARIDA device



Medications and beads used to count child respirations in the village of Cheshegu in the Northern Region of Ghana. ©UNICEF/UNI191134/Quarmyne

Low-tech solutions

Creative low-tech innovations to aid community health workers in classifying pneumonia have also been piloted. In Ghana, Uganda and South Sudan, international partners including Save the Children, the International Rescue Committee and UNICEF field tested the use of counting beads in settings where community health workers have limited formal education. When used in conjunction with the ARI timer (discussed above), the colour-coded and age-specific strands can greatly improve the accuracy of pneumonia diagnosis. The beads also assist the health worker in explaining the diagnosis to caregivers, making it less likely that caregivers would insist on antibiotics when they are not necessary.⁷

While counting beads appear to have potential, there is a need for more evidence on their effectiveness in different contexts. At the same time, there is also a need to develop higher-tech diagnostic tools for use in remote and resource-poor peripheral health centres and communities with inadequate access to diagnostic tools, trained laboratory personnel and infrastructure to support standard diagnostic procedures.

C. Treatment innovations



Drugs and commodities



Drug innovations have aimed to simplify the delivery of antibiotics and improve effectiveness. Co-trimoxazole, followed by Amoxicillin in the form of a syrup or suspension formula have traditionally been provided to treat bacterial pneumonia in children. The introduction of new Amoxicillin DT (dispersible tablets), which dissolve in small quantities of water or breast milk, has the potential to make treatment much simpler – and at less than 50 cents per treatment – more cost-effective. Treatment follows a 5-day regimen, with the number of tablets per day shifting according to the child’s age.

The shift from Amoxicillin suspension to Amoxicillin DT results in important cost savings. Due to the difference in cost between the two formulations, every childhood pneumonia treatment that is diverted to Amoxicillin DT saves the equivalent of one extra childhood pneumonia treatment. In 2014, Amoxicillin DT resulted in \$1.6 million in cost savings and in 2015, this number increased to \$3.3 million for all countries that changed formulas. Over a two year period, the switch in formulations could result in \$8 million in cost savings (see Figure 1).

Combined treatment interventions, such as the co-packaging, or bundling of ORS and zinc to treat diarrhoea, can also help improve coverage.⁹ As discussed in Chapter 4, achieving over-the-counter status for zinc

is also needed to ensure the products can be widely distributed and marketed to consumers. Seven countries—DRC, Kenya, India, Niger, Nigeria, Uganda, and Tanzania—have recently introduced co-packaged zinc and ORS in public health facilities.¹⁰

Supply: Shifting demand from Amoxicillin Oral Suspension to DT results in cost savings

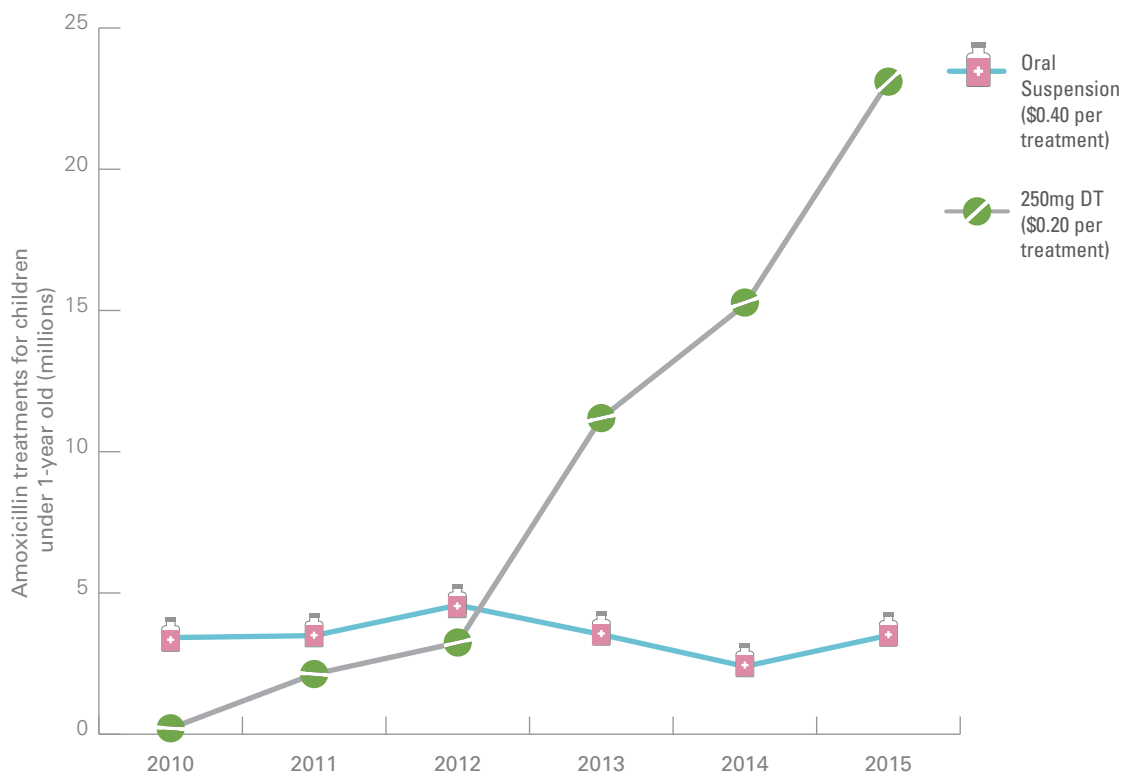


Figure 1: Procured Amoxicillin for childhood pneumonia: under one year old equivalent treatments

Source: UNICEF, Supply Division, 2016.



Oxygen

Several new oxygen technologies are emerging which are adapting oxygen cylinders (see box at right), concentrators, and bubble Continuous Positive Airway Pressure (CPAP) for use in low-resource settings.

Oxygen concentrators draw in air from the environment and extract nitrogen, leaving almost pure oxygen. They are reliable and cost-efficient compared to oxygen cylinders, which typically produce oxygen through a much more expensive, complex and energy-consuming process. Oxygen concentrators are an innovative solution for low-resource settings, but they require regular maintenance and a continuous power source: electricity or even solar power.¹² Solar-powered oxygen concentrators use the sun to extract oxygen from the air using solar panels and are a lifesaving technology in settings where there is poor access to electricity or no access at all. Grand Challenges Canada and the University of Alberta are testing solar-powered oxygen concentrators across facilities in Uganda, and a team from Melbourne University has pioneered a new oxygen concentrator that runs on water called the FREO2.

Bubble CPAP is a simple, non-invasive and low cost way to support breathing for infants experiencing respiratory distress. Several efforts are underway to increase access to bubble CPAP by Adara Development in Uganda, by Columbia University in Ghana, by Rice University's Pumani device in Africa and



Saving lives in Kenya, one breath at a time¹¹

Hewa Tele is a sustainable social enterprise focused on saving lives by providing affordable, accessible and sustainable quality medical oxygen solutions to healthcare service organizations in East Africa. Owned by the Center for Public Health and Development in Nairobi, Hewa Tele sells and distributes oxygen cylinders to health facilities with an aim of increasing access to improved quality maternal and child health services.

Hewa Tele piloted its operations in Western Kenya and is currently supplying oxygen to a network of approximately 53 public and private health facilities. Hewa Tele leverages an innovative technology that facilitates production of quality ready-to-use oxygen which is distributed in cylinders at an affordable price in a reliable manner. The solution includes local production and distribution of oxygen, installation and maintenance of oxygen delivery infrastructure, and training for lower level health workers.

An impressive 83 per cent of the health facilities in Western region of Kenya are being served by Hewa Tele. There are opportunities to engage policy makers to scale up this model in other regions as well. With UNICEF's Kenya country office, the development of a similar but larger oxygen model in Nairobi is also underway.

With the help of Hewa Tele, health facilities are now able to access and purchase oxygen as per their needs. Improved procurement and utilization of oxygen in the region has increased the preparedness and capacity of most of the health facilities in handling critical cases like pneumonia, sepsis and prematurity. More than 120 health workers have been trained in oxygen administration in the more than 53 facilities and those facilities have reported no days without oxygen available.

Source: Center for Public Health and Development. Saving lives, one breath at a time: Hewa Tele's journey, 2014-2016. February, 2016.

by International Centre for Diarrhoeal Disease Research, Bangladesh (icddr,b) in Bangladesh. A recent study by icddr'b concluded that bubble CPPA was also effective when used to support oxygen therapy for severe pneumonia in children under 5 and further studies are underway to replicate the Dhaka results in rural settings.



D. Innovative financing, advocacy and communications

Despite the magnitude of the problem and the simplicity and cost-effectiveness of solutions, there are still too few global resources directed to tackling diarrhoea and pneumonia compared with overall disbursements for child health (see Figure 4, Chapter 6). Trends in official development assistance for pneumonia and diarrhoea are detailed further in chapter 6.

To address inadequate global funding allocated to pneumonia relative to its burden on children, UNICEF, Speak up Africa and partners launched

the global advocacy campaign 'Every Breath Counts', with funding in part from the UN Commission on Lifesaving Commodities. The campaign aims to raise global awareness and spur investments in pneumonia prevention, diagnosis and treatment. The Every Breath Counts campaign, with partnership from WHO, UNEP, Save the Children, Gavi and others, integrates efforts around child pneumonia advocacy, from air pollution, nutrition and immunization to antibiotics, diagnostics and oxygen.

There is potential to leverage innovative funding modalities to harness more resources for pneumonia and diarrhoea. The Global Fund to Fight AIDS, Tuberculosis and Malaria's new funding model includes funding for strengthening community health systems, including those which support care for diarrhoea and pneumonia. This will increase the availability of life-saving medicines such as antibiotics for pneumonia and ORS and zinc for diarrhoea, which are delivered, working with governments, through iCCM. The funding does not include commodities, which is still a bottleneck for most countries and collateral funding needs to be identified to fill this gap.

Innovative behaviour change communication initiatives have been effective at improving preventative health practices and care seeking behaviours in some countries (see box, next page). In addition, communication around new products and technologies is critical to ensuring appropriate uptake. For example, despite WHO's updated recommendations specifying Amoxicillin DT as the first line of treatment for pneumonia, there has been little

demand for and uptake of the DT formulation thus far. In response, PATH and UNICEF developed a series of color-coded, age-specific product presentations and job aids to stimulate demand, improve adherence and train health workers in its correct dispensing within the community and at facilities.

Research has been completed in Bolivia, Niger, the Solomon Islands and Zimbabwe (by UNICEF), in the Democratic Republic of Congo (by the non-profit, Management Sciences for Health) and in Bangladesh and Kenya (by PATH), to assess the acceptability, usability and feasibility of the job aids and the new product itself. The initial results from an analysis of seven countries show not only a marked increase in acceptability and usability by the health workers and caregivers of the new product presentations, but a three to four times increased rate of adherence to the full regimen when using the product presentations than when not using them. These materials will be part of a pneumonia-specific communication and education package provided to countries by *Every Breath Counts* to help improve existing IMCI/iCCM training schemes. The package includes training materials such as videos and mobile health tools for providers, as well as education and awareness-raising materials for caregivers in the community. These materials were pre-tested in the ten highest-burden countries and were effective at improving the training schemes in these countries, and several countries have already incorporated the materials into their existing training programmes.



'Husband schools' – a vehicle for improving care-seeking behaviours in Niger

Families play an important role in adopting behaviours and practices to prevent the spread of disease, such as hand washing with soap, and ensuring appropriate nutrition for young children. Children also rely on their families to take them to a health care provider in a timely manner when they fall in. However, in many countries, the lack of awareness about these essential preventative and care-seeking practices poses a barrier to keeping children healthy and ensuring they receive the treatment they need when they do become sick.

In Niger, 'Husband Schools' (*Ecoles des maris*) are an innovative community-based approach to involving men in promoting essential health behaviours within the family. A United Nations Population Fund (UNFPA) initiative, Husband Schools aim to develop 'husband role models' who can effectively share positive health practices with others in their communities. Trainings facilitate discussion among men and health providers and involve participants in tracking the adoption of care behaviors within the community and encouraging the use of health services. This process builds capacity within communities and allows men to carry out and evaluate activities on a participatory and sustained basis to make lasting improvements in the health of children and their families. The programme also contributes to redefining gender roles and positive social norms.

6

Looking ahead

The 2030 development agenda

Children and women get warm by a stove in a UNICEF child-friendly space at the processing centre in the southern border town of Preševo. ©UNICEF/UN03024/ Gilbertson VII Photo



Healthy children are the foundation of robust economies and thriving communities and nations; they are the lifeblood of sustainable development. To meet the SDG goal of ending preventable child deaths, we must make faster progress to tackle the two deadliest – and most easily treatable – childhood diseases.

Scaling up key interventions to save lives

Almost 34 million young lives have been lost to pneumonia and diarrhoea since 2000. If we continue with business as usual, approximately 24 million children will die from pneumonia and diarrhoea between now and 2030 (see Figure 1).¹ But we have the power to change our course. If we act now, there is great potential to save lives with high coverage of the most effective interventions.

What could be accomplished if key interventions were scaled up to 90 per cent coverage by 2030?

Approximately 12.7 million children’s lives could be saved from pneumonia and diarrhoea if all protect, prevent and treat interventions were scaled up to 90 per cent between 2016 and 2030. Approximately 4.9 million lives could be saved from pneumonia and 5.6 million lives from diarrhoea (see Figure 1, see Annex 3 for further details). This means we have the opportunity to avert close to 44 per cent of all pneumonia and diarrhoea deaths by 2030 with high coverage of the life-saving interventions that much of the world takes for granted.

Over 12 million lives of children under age 5 could be saved by 2030 from pneumonia and diarrhoea by scaling up protect, prevent and treat interventions

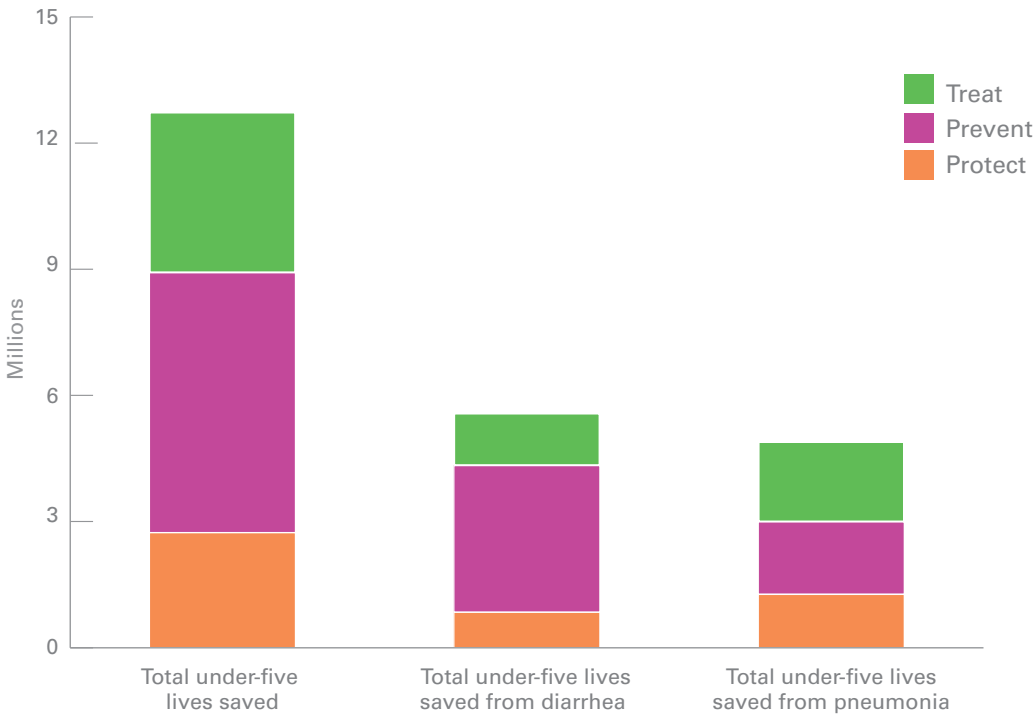


Figure 1: Estimated lives saved (2015 to 2030) from scaling up protect, prevent and treat interventions

Source: Johns Hopkins University, Lives saved estimates using the Lives Saved Tool (LiST), October 2016

These projections are based on an analysis estimating the effect of scaling up coverage of interventions that have proven impact on reducing diarrhoea and pneumonia mortality for countries with high mortality burden (the 75 Countdown countries). Interventions were grouped into packages of ‘protect’, ‘prevent’ and ‘treat’ as well as a combined package (see Annex 2). The coverage of the interventions in each package was scaled up linearly from current coverage in 2015 to 90 per cent in 2030. The combination of protect, prevent and treat interventions together has the greatest potential to save lives.

Striving for greater equity in coverage between the richest and poorest children is an important goal for countries as they work towards the more long-term goal of universal coverage for all.

Assessing official development assistance for pneumonia and diarrhoea

Pneumonia and diarrhoea have a disproportionately high impact on mortality and are among the least expensive diseases to treat – yet they continue to receive only a fraction of global health investments (see Figure 2). This needs to change.

Global funding for pneumonia and diarrhoea increased by almost 400 per cent since 2003, from about US\$570 million in 2003 to more than US\$2.8 billion in 2013 (see Figure 3).²

This increase in funding is mainly the result of greater funding for immunization and nutrition interventions (see Figure 3). These estimates are based on a UNICEF-commissioned analysis of Official Development Assistance to child health over the 11-year period between 2003 and 2013, using the Countdown to 2015 Financing Group database (see Annex 3).

Funding of interventions specific for pneumonia have increased at a higher rate than those specific for diarrhoea

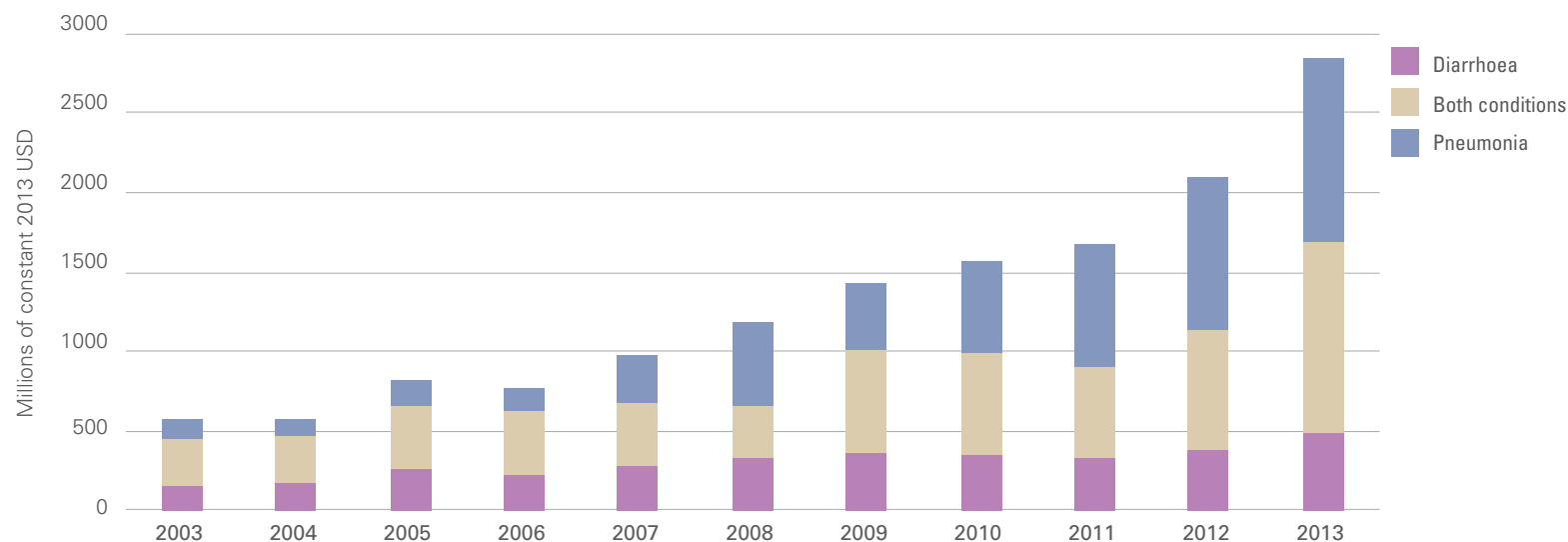


Figure 2: Trends in disbursements for diarrhoea and pneumonia between 2003 and 2013, disaggregated by condition targeted

Source: Estimates based on the Countdown to 2015 dataset on ODA+ for reproductive, maternal, newborn, and child health.

While these increases in funding for pneumonia and diarrhoea have coincided with important reductions in child mortality over the 11-year period, much more remains to be done. Pneumonia and diarrhoea are still the biggest killers of children under 5, and they should therefore receive the bulk of health spending; however, in the period between 2003 and 2013, disbursements for these two diseases only increased by slightly more than 4 percentage points – from 7.3 per cent of all official development assistance and contributions from private donor (ODA+) disbursements for health

in 2003 to 11.6 per cent in 2013 (see Figure 4). This is despite the fact that disbursements for child health (estimated by the Countdown to 2015 Financing Group) grew from US\$1.7 billion in 2003 to US\$6.7 billion in 2013 – a 285 per cent increase.

According to the UNICEF-commissioned analysis, Ethiopia, Bangladesh, Pakistan, India, and Democratic Republic of the Congo were the top five recipients of donor spending among 75 Countdown priority countries, receiving US\$642 million over the 11-year period.

Disbursements were higher to the lower-income countries, while middle-income countries with large populations accounting for nearly half of the burden of disease received a smaller proportion of disbursements. While poverty should continue to drive development assistance, there is also a need to increase funding to lower-middle-income countries with high burdens of diarrhoea and pneumonia to ensure that the most vulnerable children are covered with key interventions – no matter where they live.

Greater funding for immunization and nutrition interventions related to pneumonia and diarrhoea over the years

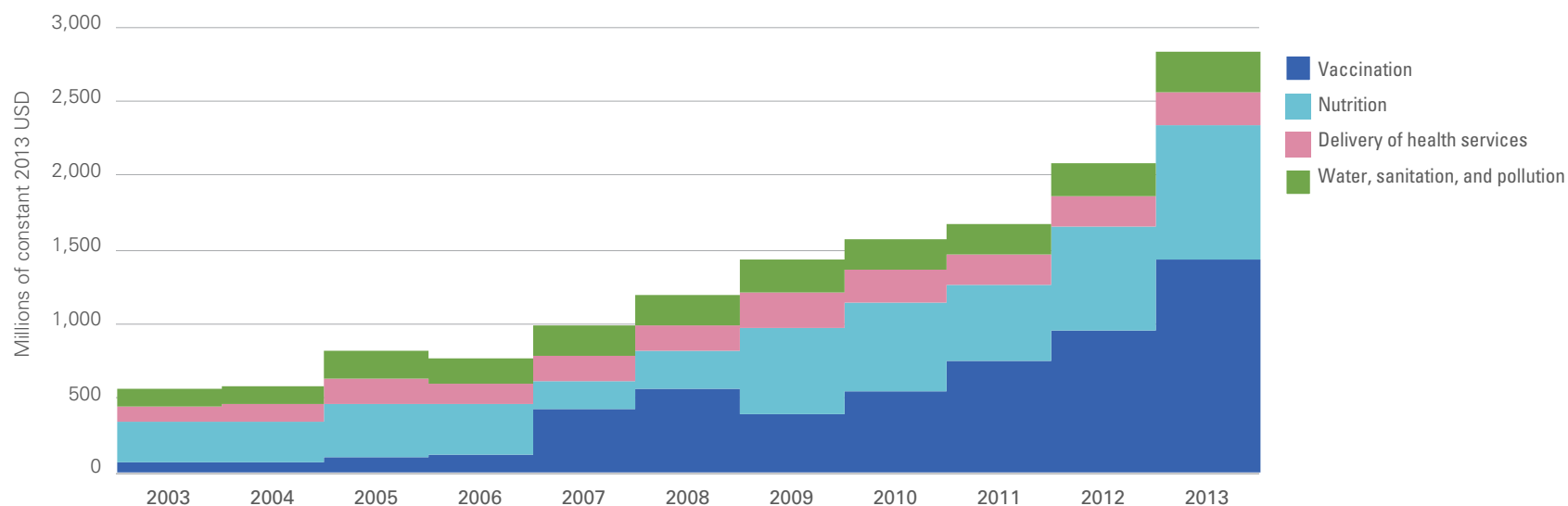


Figure 3: Trends in disbursements for diarrhoea and pneumonia related interventions between 2003 and 2013, disaggregated by intervention

Source: Estimates based on the Countdown to 2015 dataset on ODA+ for reproductive, maternal, newborn, and child health.

The United States, Canada, the United Kingdom, Japan, and Germany were the top bilateral donors to pneumonia and diarrhoea, with US\$4.4 billion over the 11-year period, representing 31 per cent of all disbursements. EU institutions, the World Bank's International Development Association, and UNICEF were the top multilateral donors with US\$2.8 billion (19 per cent of the total). GAVI (Global Alliance for Vaccines and Immunization) was overall the largest donor with US\$4.2 billion (29 per cent of the total).²

The UNICEF-commissioned pneumonia and diarrhoea financing analysis makes a strong case for increased funding for effective interventions given the direct link between higher coverage of those interventions and lower mortality rates. At the same time, these estimates required a number of assumptions, which introduce a level of uncertainty and they should therefore be interpreted as a baseline that may be further improved in future assessments.

Spurring greater investments

Targeted funding to scale up effective in-country programme implementation will be critical in driving progress towards the 2030 SDG agenda. The GAPPD calls on governments and other stakeholders to prioritize investment in the population groups with the poorest access to services to prevent and treat pneumonia and diarrhoea. Sub-Saharan Africa and South Asia must take priority given that nearly 90 per cent of pneumonia and diarrhoea deaths in children

Pneumonia and diarrhoea continue to receive only a fraction of global health investments.

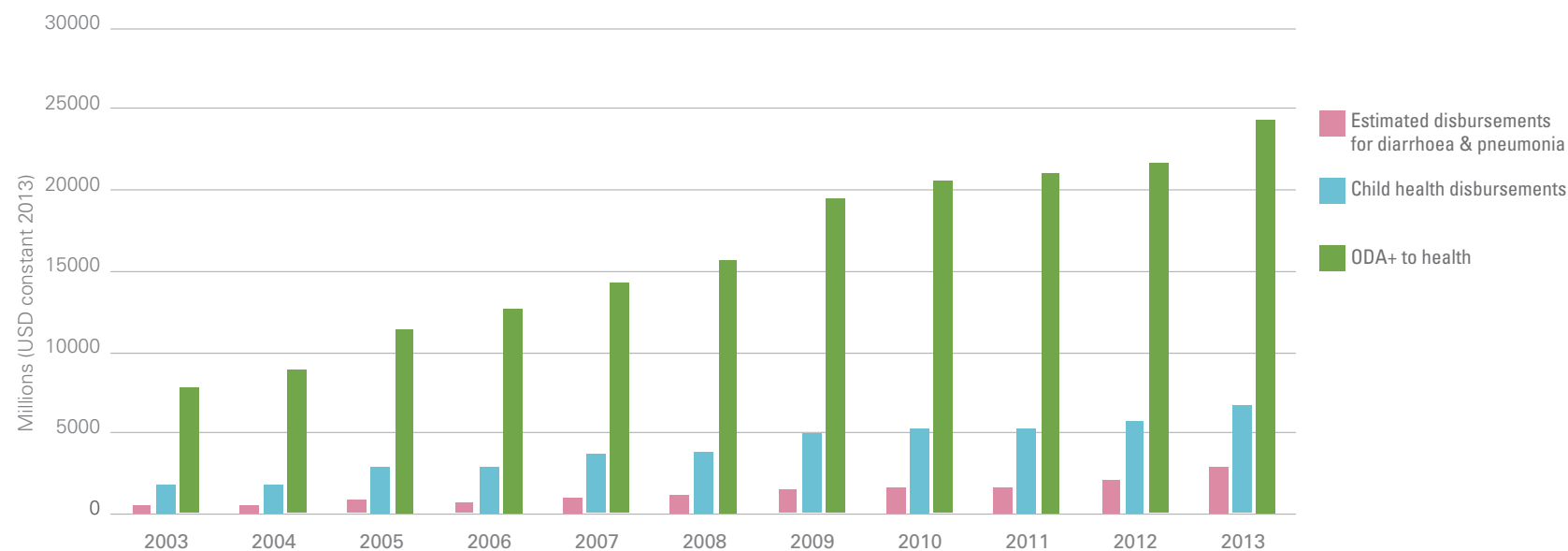


Figure 4: Trends in disbursements targeting diarrhoea and pneumonia relative to child health disbursements

Source: Estimates based on the Countdown to 2015 dataset on ODA+ for reproductive, maternal, newborn, and child health.

occur in these regions. Innovative technologies, strategies and service delivery models will be critical to driving down deaths to the levels required to achieve the SDGs and the Global Strategy for Women's, Children's and Adolescents' Health.

There are currently very few domestic and donor resources being earmarked for pneumonia and diarrhoea, including for drugs and commodities. The difficulty of accessing resources to prevent, diagnose and treat these two diseases at the community level has remained a persistent challenge. For example, effective treatment with Amoxicillin DT costs less than 50 cents (USD), yet this remains a significant barrier for many developing countries. Global initiatives, such as *Every Breath Counts*, are working to raise awareness and spur greater investments in prevention, diagnosis and community treatment.

The Global Financing Facility – a partnership with the goal of bridging the financing gap to end preventable maternal and child deaths – will mobilize at least US\$12 billion over the next five years for the following countries: Democratic Republic of the Congo, Bangladesh, Cameroon, Ethiopia, India, Kenya, Liberia, Mozambique, Nigeria, Senegal, Tanzania and Uganda; all of which have some of the highest burdens of pneumonia and diarrhoea mortality. This will provide important support to countries to fill the commodity gap and improve delivery platforms such as IMCI and iCCM. Country and regional-level advocacy will also be crucial to unlocking targeted resources from domestic budgets.

Nang Choy, 20 years old and her daughter, Nang Phet, 10-months old. A large group of villagers gather when the District Mother and Child Health outreach team visits the village. Integrated MCH includes, immunization, child health, nutrition and safe motherhood. ©UNICEF/UNI76549/Holmes



7

Recommendations



A boy and a girl play together while sitting on the edge of a street in Freetown, Sierra Leone. ©UNICEF/UNI171295/Bindra

Any child in the world can contract pneumonia and diarrhoea, but only the poorest and most vulnerable children will die from these diseases. This is one of the most profound injustices of our time.

The GAPPD provides a framework and action plan for countries to move progress forward in tackling two of the world's most deadly childhood diseases. In implementing the GAPPD framework, countries commit to coordinating efforts and enhancing investments in protection, prevention and treatment with closely monitored progress. Timely and effective diagnosis is critical to preventing pneumonia deaths and must also be part of the GAPPD equation going forward.

The following recommendations can further accelerate progress and bridge the greatest gaps in equity:

Implementing recommended policies and allocating budgets

There is a need to improve national-level policies and guidelines reflecting the latest evidence on managing pneumonia and diarrhoea in many countries, as outlined in the GAPPD. Far too many countries lack budgets with an appropriate level of financing for a comprehensive and integrated approach to prevent and control both diseases.

Investing in front-line health services

With the right resources, both pneumonia and diarrhoea can be effectively treated by front-line health services – i.e. lower-level health facilities, health centres as well as within the community – using a primary health care approach. Both IMCI and iCCM are therefore central to an integrated

approach for prevention and treatment of both diseases. This approach is about more than simply delivering treatment interventions; it must also include high overall quality of care. Building the capacity of front-line health workers as well as the capacity of health systems to deliver quality services, is therefore critical.

The management of pneumonia and diarrhoea within the community has important benefits. It not only reduces the burden on health facilities, but ensures early identification, classification, diagnosis and treatment of children where they need it the most: close to home. Ensuring a robust referral system for severe pneumonia cases is crucial; such cases should be referred to a nearby health facility with a functioning supply of oxygen in a timely manner.

For diarrhoea, experience has shown that improving ORS and zinc treatment coverage requires four factors for success: a strong enabling environment, supply availability, provider demand, and caregiver demand. In the case of pneumonia, greater focus must be placed on behavior change, health system strengthening, community access to care, and life-saving commodities.¹

Improving indicators and monitoring progress

Increased attention and funding should be directed towards developing better measurements of correct identification and treatment of childhood pneumonia. While careseeking remains the most widely measured indicator for pneumonia it is not sufficient. There is a need to improve the measurement of pneumonia prevalence, which will in turn improve our ability to measure antibiotic treatment rates. Measuring prevalence

The greatest test of our commitment to equity is that we do not continue to allow millions of children to die from pneumonia and diarrhoea – two preventable and curable diseases.

and treatment are key to developing country-specific quantifications, which allow countries to budget specifically for pneumonia management, especially Amoxicillin DT. The analysis of health facility data along with household survey data can provide clearer insight on both the service supply and client demand side.

Leveraging tools and innovations to increase coverage

The development and adoption of innovative strategies, technologies and delivery mechanisms will drive progress in settings where mortality rates have been most stagnant. Countries should prioritize those with the greatest potential to save lives. Diagnostic innovations, particularly those that can be used effectively within community settings, can help improve accuracy and timely care seeking for severe pneumonia and improve survival.

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Annex 1

GENERAL NOTES ON THE DATA

Data sources

Prevention and treatment coverage estimates are derived from a series of public access databases compiled by UNICEF and reflect data available in 2016 (see www.data.unicef.org). These databases are based on information from nationally representative household surveys routinely administered in low-income countries, notably UNICEF-supported Multiple Indicator Cluster Surveys (MICS) (see www.mics.unicef.org), U.S. Agency for International Development-supported Demographic and Health Surveys (see www.measuredhs.com), and others. Some coverage estimates are derived using a combination of survey data and other sources, such as data on water supply and sanitation and on immunization.

Cause-specific mortality estimates are based on the work of the World Health Organization and the Maternal and Child Epidemiology Estimation Group (MCEE) estimates from 2015¹

Prevention indicators

Immunization coverage estimates are developed jointly by WHO and UNICEF (see www.data.unicef.org). The WHO Department of Immunization, Vaccines and Biologicals tracks the year when the PCV, HIB vaccine and rotavirus vaccine were introduced into national immunization programmes.

Water, sanitation and hygiene coverage estimates are developed jointly by the WHO and UNICEF Joint Monitoring Programme for Water Supply and Sanitation, which released its latest estimates in March 2015 (see www.wssinfo.org).

Nutrition coverage estimates are based largely on nationally representative household surveys, such as Multiple Indicator Cluster Surveys (MICS) and Demographic and Health Surveys (DHS), without adjustments.

Exclusive breastfeeding: Percentage of infants aged 0–5 months who only drank breastmilk the previous day.

Early initiation to breastfeeding: Percentage of children born in the last 24 months who were put to the breast within one hour of birth.

Continued breastfeeding (at 1 and 2 years of age): Percentage of children aged 12–15 months and percentage of children aged 20–23 months who were fed breast milk the previous day.

Complementary feeding: Adequate complementary feeding is measured by the proportion of children 6–23 months eating the minimum acceptable diet (those who were fed the minimum number of meals/ snacks as well as food from at least 4 food groups the previous day) (<https://data.unicef.org/wp-content/uploads/2016/08/From-the-first-hour-of-life.pdf>).

Vitamin A supplementation: Percentage of children aged 6–59 months reached with 2 doses of vitamin A supplements approximately 4–6 months apart in a given calendar year.

Treatment indicators

Diarrhoea

Diarrhoea treatment programme recommendations were set out in the 2004 UNICEF and WHO Joint Statement² and the main

indicators to monitor these recommendations were agreed on during a WHO and UNICEF advisory meeting on child survival indicators in 2004 and reconfirmed in a 2007 technical meeting on Countdown indicators.³ These treatment recommendations are under review and may be updated soon.

Diarrhoea treatment with oral rehydration therapy and continued feeding

is the proportion of children ages 0–59 months with diarrhoea in the two weeks prior to the interview receiving oral rehydration therapy (oral rehydration salts, recommended home fluid or increased fluids) and continued feeding during the illness.

Recommended homemade fluids are the proportion of children ages 0–59 months with diarrhoea in the two weeks prior to the interview receiving a government-recommended homemade fluid (to be customized at the country level based on national guidelines) during the illness.

Increased fluids are the proportion of children ages 0–59 months with diarrhoea in the two weeks prior to the interview receiving more to drink than usual during the illness.

Continued feeding is the proportion of children ages 0–59 months with diarrhoea in the two weeks prior to the interview receiving more, the same or somewhat less to eat than usual during the illness.

Diarrhoea treatment with ORS is the proportion of children ages 0–59 months with diarrhoea in the two weeks prior to the interview receiving oral rehydration salts (either a special

packet of ORS or prepackaged ORS fluid) during the illness.

Zinc supplementation is the proportion of children ages 0–59 months with diarrhoea in the two weeks prior to the interview receiving zinc during the illness. Although the recommendation is very specific (provide children with 20 mg per day of zinc supplementation for 10–14 days: 10 mg per day for infants under 6 months old), the indicator as collected from household surveys can only measure whether the child received zinc or not.

Pneumonia symptoms

Care seeking for symptoms of pneumonia is the proportion of children ages 0–59 months with symptoms of pneumonia (cough and fast or difficult breathing due to a problem in the chest) taken to a health care provider during the illness. Excludes pharmacies, drug shops and traditional practitioners.

Symptoms of pneumonia for measurement in household surveys have been defined as ‘cough and fast or difficult breathing’ without specifying a chest-related problem. Estimates based on this denominator are used as denominator for the care seeking indicator.

Measurement issues

Several measurement issues need to be taken into account when interpreting treatment data from household surveys.

Caregiver recall of drugs or treatment used for childhood illnesses is limited by their knowledge of treatments received; research indicates low validity of such reports in household survey interviews.⁴

Once diagnosed, pneumonia is treated effectively with antibiotics. However, recent studies have shown that results from surveys have low validity for pneumonia measurement as many of the suspected cases identified through surveys are in fact, not true pneumonia. While this limitation does not affect the level and patterns of care-seeking for symptoms of pneumonia, it limits the validity of the level of treatment of pneumonia with antibiotics, as reported through household surveys⁵. Given these validity issues, this report did not include analysis based on household survey data on antibiotic use for suspected pneumonia.

Information is not collected on the type of antibiotic used for pneumonia symptoms or on whether the proper dose was given. Information is also not collected on early administration of ORS for a child with diarrhoea, the number of ORS packets received during the course of the illness, or whether these fluids were correctly prepared. In addition, for recommended homemade fluids country guidelines differ on what constitutes an alternative appropriate fluid that could also prevent dehydration (for example, cereal-based solutions). These policies are not always defined and thus survey questions may not be adequately customized according to specific national guidelines prior to starting survey work. The recommended homemade fluid indicator is limited by this lack of customization in many surveys.

Numerous slight wording changes have been made to the construction of diarrhoea treatment questions over time as well as to their response categories. And survey questionnaires are translated into different languages, which may result in slight differences in the wording of questions across countries and over time. Further analysis is needed to determine the extent to which these slight wording changes affect overall coverage values. In particular, the

change in response categories for the continued feeding question around 2000 has affected data availability for this indicator and for the oral rehydration and continued feeding indicator. This limits analysis of trends over time prior to 2000 for these diarrhoea treatment indicators.

Zinc supplementation is measured through an open-ended question. Respondents are asked ‘What (else) was given to treat the diarrhoea?’ Low proportions of zinc supplementation could be the result of underreporting if the respondent does not know what was given to the child or does not recall.

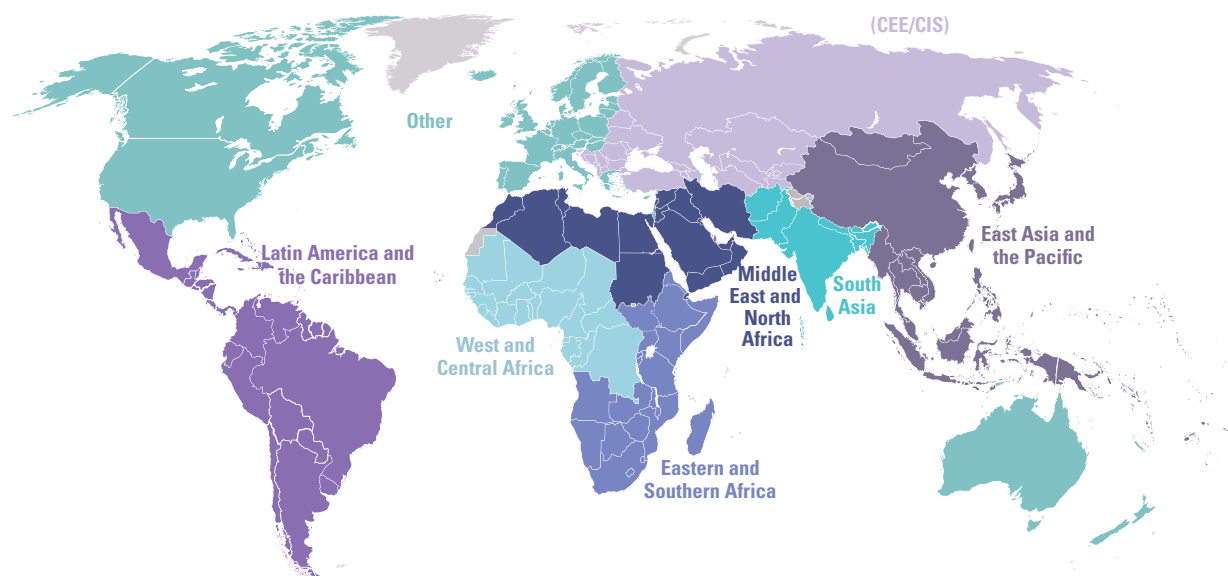
Prevalence estimates derived from household surveys can vary markedly by season and by timing of outbreaks (such as cholera). These estimates are also limited by caregiver recall of symptoms, and research indicates that caregivers with less education or living in poorer households may under-report diarrhoea symptoms in their children in household survey interviews.⁶ This pattern likely holds for other illness symptoms as well, such as fever and respiratory symptoms. Surveys do not measure the type of diarrhoea experienced by the child (including its length and severity). While these prevalence estimates are not presented in this report, they are used to derive the denominator for treatment coverage values.

Prevalence of symptoms of pneumonia refers to children with a combination of respiratory symptoms for which they should seek clinical assessment for pneumonia by an appropriate provider. These respiratory symptoms include ‘cough and fast or difficult breathing due to a chest-related problem’. Not all children with suspected pneumonia in the previous two weeks should receive antibiotic treatment, only those with pneumonia as classified by the Integrated Management of Child Illness guidelines (IMCI) (based on a rapid respiratory rate counted by a

health worker). It is not possible to measure such pneumonia prevalence among children under age 5 during a household survey interview or to ascertain underlying pneumonia illness for children with these respiratory symptoms.

Regional estimates and trends over time

Regional and global estimates are based on population-weighted averages, which are presented only if available data cover at least 50 per cent of the relevant population in the regional or global grouping. The map below presents the regional distribution of countries in UNICEF regions.



Eastern and Southern Africa

Angola; Botswana; Burundi; Comoros; Eritrea; Ethiopia; Kenya; Lesotho; Madagascar; Malawi; Mauritius; Mozambique; Namibia; Rwanda; Seychelles; Somalia; South Africa; South Sudan; Swaziland; Uganda; United Republic of Tanzania; Zambia; Zimbabwe

West and Central Africa

Benin; Burkina Faso; Cabo Verde; Cameroon; Central African Republic; Chad; Congo; Côte d'Ivoire; Democratic Republic of the Congo; Equatorial Guinea; Gabon; Gambia; Ghana; Guinea; Guinea-Bissau; Liberia; Mali; Mauritania; Niger; Nigeria; Sao Tome and Principe; Senegal; Sierra Leone; Togo

Middle East and North Africa

Algeria; Bahrain; Djibouti; Egypt; Iran (Islamic Republic of); Iraq; Jordan; Kuwait; Lebanon; Libya; Morocco; Oman; Qatar; Saudi Arabia; State of Palestine; Sudan; Syrian Arab Republic; Tunisia; United Arab Emirates; Yemen

South Asia

Afghanistan; Bangladesh; Bhutan; India; Maldives; Nepal; Pakistan; Sri Lanka

East Asia and the Pacific

Brunei Darussalam; Cambodia; China; Cook Islands; Democratic People's Republic of Korea; Fiji; Indonesia; Kiribati; Lao People's Democratic Republic; Malaysia; Marshall Islands; Micronesia (Federated States of); Mongolia; Myanmar; Nauru; Niue; Palau; Papua New Guinea; Philippines; Republic of Korea; Samoa; Singapore; Solomon Islands; Thailand; Timor-Leste; Tonga; Tuvalu; Vanuatu; Viet Nam

Latin America and the Caribbean

Antigua and Barbuda; Argentina; Bahamas; Barbados; Belize; Bolivia (Plurinational State of); Brazil; Chile; Colombia; Costa Rica; Cuba; Dominica; Dominican Republic; Ecuador; El Salvador; Grenada; Guatemala; Guyana; Haiti; Honduras; Jamaica; Mexico; Nicaragua; Panama; Paraguay; Peru; Saint Kitts and Nevis; Saint Lucia; Saint Vincent and the Grenadines; Suriname; Trinidad and Tobago; Uruguay; Venezuela (Bolivarian Republic of)

Central and Eastern Europe and the Commonwealth of Independent States (CEE/CIS)

Albania; Armenia; Azerbaijan; Belarus; Bosnia and Herzegovina; Bulgaria; Croatia; Georgia; Kazakhstan; Kyrgyzstan; Montenegro; Republic of Moldova; Romania; Russian Federation; Serbia; Tajikistan; the former Yugoslav Republic of Macedonia; Turkey; Turkmenistan; Ukraine; Uzbekistan

Other countries outside of these regions

Andorra; Australia; Austria; Belgium; Canada; Cyprus; Czech Republic; Denmark; Estonia; Finland; France; Germany; Greece; Holy See; Hungary; Iceland; Ireland; Israel; Italy; Japan; Latvia; Liechtenstein; Lithuania; Luxembourg; Malta; Monaco; Netherlands; New Zealand; Norway; Poland; Portugal; San Marino; Slovakia; Slovenia; Spain; Sweden; Switzerland; United Kingdom; United States

Annex 2

LIVES SAVED TOOL

Lives saved projections are derived from the Lives Saved Tool, a model developed by a consortium of academic and international organizations led by the Johns Hopkins University Bloomberg School of Public Health (see www.jhsph.edu/dept/ih/IIP/list/). The model estimates the potential number of deaths averted in children under age 5 by linking changes in coverage of maternal, newborn and child health interventions with empirical evidence of the effect of the interventions on child mortality. The model takes into account current demographic projections, nutritional status and country-specific cause of death

profiles for children under age 5. Cause of death estimates are for 2015*.

The model for the 75 high-mortality countries estimated for this report assumes an ambitious scenario in which key interventions related to childhood pneumonia and diarrhoea are scaled up to 90 percent. These interventions are divided into protective, preventive and treatment measures. For protective measures, the interventions included are: exclusive breastfeeding for babies 0-5 months, adequate complementary feeding and vitamin A supplementation. The preventive

measures included in the analysis are: DPT3, Hib3, PCV, Rotavirus and Measles vaccines, population with improved and piped water, population with improved sanitation facilities, hand washing with soap, safe disposal of stools, as well as population receiving ART and Co-trimoxazole treatment. Treatment measures include case management of neonatal sepsis/pneumonia, oral rehydration salts (ORS), antibiotics for dysentery, zinc for treatment and care seeking for pneumonia.

*WHO and Maternal and Child Epidemiology Estimation Group (MCEE) estimates 2015

Annex 3

FINANCING ANALYSIS - OFFICIAL DEVELOPMENT ASSISTANCE SUPPORTING EFFECTIVE INTERVENTIONS TO REDUCE PNEUMONIA AND DIARRHOEA

Mortality in children under 5 is still led by infectious diseases, mainly pneumonia and diarrhoea, and most of these deaths occur in lower-income countries. There are a number of interventions that are proven to be effective in reducing morbidity and mortality related to these two conditions.¹ An analysis of global funding over time provides insight into the resources available for reducing the burden of these conditions. Furthermore, estimates of the funding disbursed to effective interventions can improve resource allocation. Tracking financial aid has become an important tool to improve donor accountability.²

The results of this analysis contribute to resource tracking initiatives,³ providing estimates of financial assistance disbursed for effective interventions in reducing morbidity and

mortality due to diarrhoea and pneumonia. This analysis builds on previous analyses done by the Countdown to 2015 Financing Group,^{2, 4, 5} by using similar methods, and part of this analysis relies on the coded dataset used in their estimations. This analysis provides estimates of total disbursements at national level and trends over time for the different interventions. This is a first attempt to provide estimates at this level of disaggregation for pneumonia and diarrhoea.

Methods

The analysis began by compiling a list of interventions that are effective in reducing morbidity and mortality from diarrhoea and pneumonia. These interventions were compiled based on the 2012 UNICEF report on pneumonia

and diarrhoea⁶ and the paper from Bhutta et al.¹ included in *The Lancet Series on Childhood Pneumonia and Diarrhoea*. The interventions were classified as diarrhoea-specific, pneumonia-specific, or benefitting both conditions (Table 1). Each category was further divided into interventions for prevention and treatment.

For this analysis, preventative interventions for diarrhoea included vaccination (rotavirus, cholera, and typhoid), hand washing, safe water and improved sanitation. Preventative interventions for pneumonia included vaccination (pneumococcus, Haemophilus influenzae type b, and pertussis in the form of DPT) and reduction of household air pollution. Preventative interventions that benefit both conditions included measles vaccination, adequate nutrition for mothers and children,

Table 1: Effective interventions for diarrhoea and pneumonia

Diarrhoea	Both diarrhoea and pneumonia	Pneumonia
<ul style="list-style-type: none"> • Rotavirus, cholera and typhoid vaccination • Safe water and improved sanitation 	<ul style="list-style-type: none"> • Measles vaccination • Adequate nutrition for mothers and children • Breastfeeding promotion and support • Micronutrient supplementation (zinc, vitamin A, iron) • Hand washing with soap 	<ul style="list-style-type: none"> • Pneumococcal conjugate virus (PCV) vaccination • Haemophilus influenzae type b (Hib) vaccination • Diphtheria, pertussis and tetanus (DPT) vaccination • Household air pollution
<ul style="list-style-type: none"> • Delivery of health services for diarrhoea 		<ul style="list-style-type: none"> • Delivery of health services for pneumonia

breastfeeding, and micronutrient supplementation (including zinc, vitamin A, and iron).

For treatment interventions a 'delivery of services' category for diarrhoea and for pneumonia was created. This was a helpful analytical approach because the descriptions used to produce the estimates, which come directly from data reported by donors, are often not specific in describing the activities being funded. For example, a record might describe its purpose as *primary care* or *basic health care*. This analysis assumed that these broad descriptions included one or more of the treatment interventions described in the literature,^{1,6} such as low-osmolarity ORS, antibiotics for dysentery or pneumonia, oxygen therapy, improved care-seeking behaviour, or improved case management at community and health-facility levels. It was assumed that because pneumonia and diarrhoea are responsible for 24 per cent of child deaths, funding for health services provision will very likely target these interventions.

These assumptions were used to estimate 'official development assistance' and private grants (ODA+) disbursed to provide financial support to interventions effective in reducing morbidity and mortality from diarrhoea and pneumonia. Disbursement data was obtained from the dataset produced by the Countdown to 2015 Financing group.⁷ The Countdown to

2015 Financing group has coded for relevance to supporting child health, maternal and newborn health, and reproductive and sexual health all the disbursement records contained in the Creditor Reporting System (CRS) from the Organization for Economic Cooperation and Development (OECD) from 2003 to 2013. The analysis involved searching for disbursements that targeted at least one of the effective interventions within the Countdown to 2015 codes relevant to pneumonia and diarrhoea. Detailed descriptions of this dataset and its coding can be found elsewhere.^{2,7} All disbursements are in constant 2013 USD.

The Countdown to 2015 dataset contains some categories that directly map to effective interventions, such as nutrition for mothers and children. Other categories required further disaggregation to identify disbursements for diarrhoea and pneumonia, as described in Table 2.

The Countdown to 2015 dataset estimates disbursements of ODA+ for health service delivery that benefit child health. The value of disbursements that benefit diarrhoea and pneumonia reduction were estimated by multiplying the value disbursed to child health, provided in the Countdown to 2015 dataset, by the percentage each of these conditions represents in the burden of disease among children under 5 in every year between 2003 and 2013 for every country:

$$D_{ij} = H_{ij} * Bd_{ij}$$

$$Dp_{ij} = H_{ij} * Bp_{ij}$$

D is the amount disbursed for country j at time i . H is the disbursement estimated by Countdown to 2015 for health services, and Bd and Bp are the percentages estimated of the burden of disease for diarrhoea and pneumonia for country j at time i .

Burden of disease estimates from WHO were used to estimate Bd and Bp .⁸ These estimates are available for years 2000 and 2012. The value for every year between 2003 and 2013 was estimated by fitting an exponential function using estimated values for 2000 and 2012 by replacing twice in the following equation:

$$y_{ij} = a_j(b_j)^i$$

where y_{ij} is the percentage of the burden of disease from diarrhoea or pneumonia of the country j at time i , and a and b are estimated parameters specific to each country j .

The Countdown to 2015 dataset does not include disbursements for safe water, sanitation, hand washing or air pollution in its estimates. To obtain estimates for water and sanitation this analysis used the methodology of the Partnership for

Table 2:

Category in Countdown ODA+ Dataset	Disaggregation to estimate disbursements for diarrhoea and pneumonia	Method used
Non-polio immunization	Seven different vaccination categories: <ul style="list-style-type: none"> • rotavirus, cholera, and typhoid for diarrhoea; • Hib, PCV and DPT for pneumonia; • measles for both conditions. 	<ul style="list-style-type: none"> • Manual coding of all records in the Countdown ODA+ dataset according to the available descriptions into one of the seven vaccination categories. • For records that had unspecific descriptions (e.g. improving immunization coverage), we estimated the proportion allocated to each of the seven categories. Every recipient was assumed to have had a basic immunization schedule consisting of DPT-Hib-HepB (3 doses) + MMR (2 doses) + BCG (1 dose) + Polio (4 doses). Pneumococcus (3 doses) and rotavirus (2 doses) vaccines were included into each recipient's schedule according to the year of introduction reported to the WHO. If the recipient was a region the schedule included pneumococcus and rotavirus vaccines from 2007 onwards, as it is the first year that GAVI reported disbursements for these vaccines. The cost of the full scheme was then estimated for each year using the prices reported on the UNICEF vaccine price data. Then calculated the percentage of the cost each vaccine represented within the full scheme. The amount disbursed for each vaccine type was estimated by multiplying the disbursement by the percentage each vaccine represented within the full scheme of each category.
Nutrition for mothers and children, and child-specific nutrition	Breastfeeding, micronutrient supplementation, and mother-child nutrition (all benefitting both conditions)	<ul style="list-style-type: none"> • All nutrition records were searched for those targeting breastfeeding and assigned their value to breastfeeding. • All records for vitamin A, zinc, iron and unspecified micronutrients were searched and assigned their value to micronutrients. • Remaining records in the nutrition categories of the dataset were assigned to mother-child nutrition.

Maternal, Newborn and Child Health (PMNCH) with regard to water and sanitation.⁹ This included 15% of disbursements for basic drinking water supply and sanitation (purpose codes 14030, 14031, and 14032 of the CRS database). For household air pollution and handwashing, records were identified using key-term searches on the whole CRS dataset.

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