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Pneumonia & Diarrhea Progress Report:

**Reaching Goals
Through Action
and Innovation**



JOHNS HOPKINS
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Foreword

The *2016 Pneumonia and Diarrhea Progress Report: Reaching Goals Through Action and Innovation* is our seventh annual Progress Report, but the first in the era of the Sustainable Development Goals (SDGs) which follow the Millennium Development Goals (MDGs) that ended in 2015. The 17 SDGs have been agreed upon within the global community, with SDG 3's (ensure healthy lives and promote well-being for all at all ages) second target (3.2) focused on child survival and eighth target (3.8) focused on access to essential medicines and vaccines for all. With these new and ever more ambitious targets set, it is time to evaluate the progress made to date—noting achievements, highlighting lessons learned, drawing attention to unfinished business, and planning how to accelerate progress to address the challenges we must now face.

Although unprecedented progress has been made in reducing maternal and child mortality, and in the fight against infectious diseases, many country MDG targets were not met. We can learn how to achieve more, by evaluating what went well, and learning from what did not. We are not making progress fast enough if we are serious about meeting the new SDG target on child health of reducing mortality to at least as low as 25 deaths per 1000 live births in children under the age of 5 years.

The rate of all-cause mortality in this age group has been cut by more than half worldwide since 1990, from 91 deaths per 1000 live births to 43 in 2015. Although this is an enormous achievement, pneumonia and diarrhea's contribution to under-5 deaths remains stubbornly high. In 2015, these two diseases together were responsible for nearly one of every four deaths that occurred in children under five.

There are simple proven interventions to prevent these deaths, including vaccines, antibiotics, exclusive breastfeeding, and access to treatment and care. We urgently need to find actionable approaches to accelerate the deployment of these life-saving solutions to ensure that there is continued positive progress in reducing preventable child deaths. But this may not be enough. As new targets are being set, we need to take stock and go beyond business as usual.

The 2016 Pneumonia and Diarrhea Progress Report focuses on action and innovation. These can be found in new technologies and approaches, but also in new ways of providing services, innovative thinking in reaching communities with existing tools and new or improved applications to help move the needle of progress and shrink existing inequities.

As we move forward and set even more ambitious targets, I call on all of us to address this unfinished agenda. Key to achieving this will be common efforts supported by national governments and development partners to find and commit to implementing innovative ways and actions to accelerate progress toward a healthier future for all children.

It's clear we must keep the promise to stop pneumonia and diarrhea now.



Kate O'Brien, MD, MPH
Executive Director
International Vaccine Access Center

A photograph of a woman in traditional attire, including a grey shawl and a colorful headscarf, feeding a baby. The baby is wrapped in a white cloth and is lying down. The woman is holding a spoon to the baby's mouth. The background is dark, and the lighting is soft, highlighting the woman's face and the baby. The text "Executive Summary" is overlaid on the image in white font.

Executive Summary

Executive Summary

Global Burden of Pneumonia and Diarrhea in Children

Together, pneumonia and diarrhea claimed the lives of nearly 1.5 million children under the age of five in 2015.



In 2015, 5.9 million children died before reaching their fifth birthday. Of these 5.9 million deaths, pneumonia was responsible for 16% and diarrhea was responsible for 9%, making these diseases two of the leading killers of children worldwide.^{1,2} Together these diseases claimed the lives of nearly 1.5 million children under the age of 5 in a single year. While pneumonia can swiftly take a young life, diarrheal diseases can compromise health more broadly by leading to a vicious cycle of malnutrition, stunted growth, cognitive impairment, and poor immune response.³ In addition, treatments for either illness can cause serious financial difficulties, contributing to the cycle of poverty.

Pneumonia and diarrhea mortality in young children continues to be disproportionately concentrated in a few countries, year after year. Seventy-two percent of the global burden of pneumonia and diarrhea child deaths occur in just 15 countries, even though they are home to only 55% of the world's under-5 population.

Integrated and mutually beneficial interventions that begin at birth can protect from, prevent, and treat pneumonia and diarrhea. These include clean air and water, vaccines, adequate nutrition and supplements, and exclusive breastfeeding in the first six months of life. It is critical to promote a set of health practices—no

one intervention is enough—to prevent pneumonia and diarrhea, especially for children without reliable access to health care and treatment.⁴ Treatments that are vital to the successful management of these childhood diseases can include appropriate use of antibiotics, oxygen, oral rehydration salts (ORS) and zinc supplements amongst others.

The collective will to tackle these common childhood illnesses is embodied by the SDGs. The goal to create a world with good health and well-being is intertwined with those to reduce inequality, provide clean water and sanitation, maintain affordable and clean energy, and eliminate poverty and hunger. Providing all families—rich or poor—with access to the tools they need to keep children healthy can help keep children in school and parents at work, leading to more productive households, communities, and countries. Tackling pneumonia and diarrhea is critical to living up to the promise of making the world a safer, healthier, and more equitable place. Integrated prevention, protection, and treatment, as outlined in the Global Action Plan for Pneumonia and Diarrhea (GAPPD),⁴ is proving to be an important strategy to tackle the goals outlined in the plan. However, to reach these goals by 2025, given the current pace of uptake of GAPPD interventions, further action and innovations are needed.



Seventy-two percent of the global burden of pneumonia and diarrhea child deaths occur in just 15 countries, even though they are home to only 55% of the world's under-5 population.

Evaluating Progress in the 15 Highest Burden Countries

This 2016 Pneumonia and Diarrhea Progress Report evaluates the annual progress implementing high impact interventions outlined in the GAPPD,⁴ among the 15 countries with the greatest number of under-5 pneumonia and diarrhea deaths. 2015 marked the end of the MDGs, prompting us to examine the substantial progress made in implementing GAPPD interventions since the year 2000. The analysis highlights the need to accelerate uptake of select interventions in order for countries to reach both the 2025 GAPPD goals⁴ and the 2030 SDGs.⁵ Innovations in pneumonia and diarrhea disease management that may accelerate the pace of progress are discussed.



The coverage targets for interventions included in this report are:



90% for vaccinations

Pertussis vaccine

Measles vaccine

Haemophilus influenzae type b (Hib) vaccine

Pneumococcal conjugate vaccine

Rotavirus vaccine



90% for pneumonia and diarrhea treatments

Treatment of children with suspected pneumonia by a health care provider

Antibiotic use in children with suspected pneumonia

Oral rehydration salts (ORS) for children with diarrhea

Zinc supplements for children with diarrhea



50% for exclusive breastfeeding

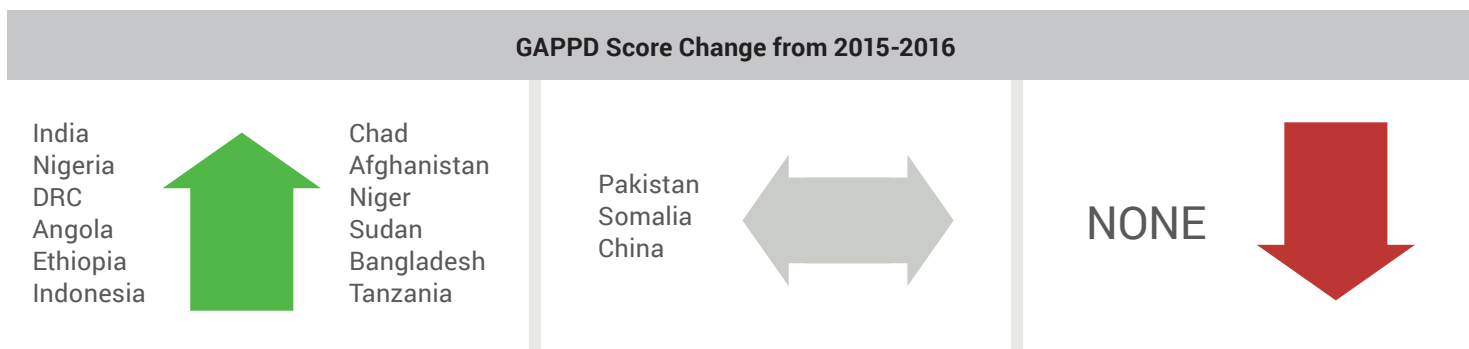
Exclusive breastfeeding for the first 6 months of life

Collectively, 10 interventions are evaluated and summarized into an overall GAPPD score, developed by the International Vaccine Access Center (IVAC) at the Johns Hopkins Bloomberg School of Public Health (JHSPH). GAPPD scores are used to assess and compare progress over time in the 15 countries with the greatest number of pneumonia and diarrhea deaths in children under the age of 5 years. GAPPD scores are a calculated average of national coverage levels for 10 GAPPD interventions, using the most recent data available.

Key Progress Updates

Between 2015 and 2016, 12 of the 15 countries with the greatest burden of child pneumonia and diarrhea deaths showed some improvements in their GAPPD scores. However, gains were minimal in some of the largest countries (Nigeria, Democratic Republic of the Congo (DRC), and Afghanistan) or remained unchanged, including in Pakistan and China. India increased its score by seven percentage points, although still remains with a score below 50.

Between 2015 and 2016, the ranking of the 15 countries accounting for the greatest number of pneumonia and diarrhea deaths remain unchanged. Progress in implementing GAPPD interventions in these countries over the past year has been mixed. **GAPPD scores improved for 12 countries: six countries realized an improvement of five or greater percentage points (India, Angola, Ethiopia, Indonesia, Niger, and Bangladesh), six countries had only a very modest change ranging from one to three percentage points (Nigeria, DRC, Afghanistan, Chad, Sudan, and Tanzania), three remained unchanged from 2015 (Pakistan, China, and Somalia).**



SDG 3 aims to ensure healthy lives and promote wellbeing for all ages. Target 3.2 addresses reducing deaths in children under 5 years of age to at least as low as 25 per 1000 live births.^{5,6}

Improved GAPPD scores were largely driven by new vaccine introductions and ongoing country rollouts. India, the country that leads the world in under-5 pneumonia and diarrhea deaths, increased their GAPPD score by seven percentage points by continuing to roll out Hib vaccine (pentavalent) and improving exclusive breastfeeding rates. India, however, still has a relatively low score, below 50 points. Small or no changes were observed in the GAPPD scores for Nigeria, the DRC and Pakistan, three countries that are consistently in the top four highest burden countries.

It is increasingly evident that without significant gains in GAPPD scores in countries with large birth cohorts, such as India, Nigeria, Pakistan, and DRC, reduction in global pneumonia and diarrhea mortality

in children will not be achieved. The pace of progress must be accelerated to make a difference in reducing global totals, which will occur through both the increased use of recommended interventions and treatment innovations.

The rate of uptake and scale-up of evidence-based interventions that protect against, prevent, and treat pneumonia and diarrhea must improve for countries to meet the GAPPD goal of ending preventable childhood deaths due to pneumonia and diarrhea by 2025, as well as the SDG 3 target of reducing under-5 mortality to at least as low as 25 per 1000 live births by 2030.^{5,6} Of the 15 countries profiled in this report, seven have mortality rates over 25 per 1000 live births due to pneumonia and diarrhea alone.

Low GAPPD scores in this report may result from a number of factors, including but not limited to a lack of implementation of GAPPD interventions (e.g., no introduction of the vaccines that can impact pneumonia and diarrhea mortality or lack of policies that enable usage of treatments), slow rollout of vaccines that have been introduced (which is often the case for phased introductions for large countries), or slow uptake of interventions such as ORS, zinc or antibiotics, and challenges in changing health behaviors, specifically with regard to adopting protective and treatment measures. For breastfeeding, although many more mothers breastfeed their newborns, some introduce complementary feeding during the first six months and are therefore not included in the coverage for this indicator. Additionally, data quality may be an issue, which can result in either overestimating or underestimating coverage.

Introduction



Pneumonia and Diarrhea – Major Threats to Child Health and Survival

Since 1990, the rate of mortality in children under the age of 5 years has been cut by more than half worldwide, from 91 deaths per 1000 live births to 43 deaths per live births in 2015.⁷ Nevertheless, reaching a fifth birthday is a milestone that many children will never reach, especially in the poorest areas of the world. In 2015, the number of childhood deaths exceeded 5.9 million.⁷ Despite significant gains in overall child health achieved across the globe, the world fell short of reaching the MDG of reducing 1990 under-5 mortality by two-thirds by 2015. Pneumonia and diarrhea's contribution to under-5 deaths remains stubbornly high. **In 2015, these two diseases together were responsible for nearly one in four deaths that occurred in children under 5 years of age.**^{1,2,7} The 15 countries profiled in this report are disproportionately responsible for the majority of global pneumonia and diarrhea deaths. Although these countries only account for 55% of the world's under-five population, 72% of childhood deaths due to pneumonia and diarrhea occur there.^{1,2} Of the 15 countries with the greatest number of pneumonia and diarrhea child deaths, six are among countries with the highest all-cause under-5 mortality rates:

Angola, Chad, Somalia, Nigeria, DRC, and Niger.⁴ To reduce global mortality, the 15 highest mortality countries must continue to focus on further reductions in pneumonia and diarrhea mortality, particularly among their most vulnerable populations.

Methodology: Measuring and Evaluating Country Progress

This report brings together the most up-to-date information on the implementation of high impact pneumonia and diarrhea interventions as recommended by the World Health Organization (WHO) and UNICEF in the GAPPD by the 15 countries with the greatest number of deaths from pneumonia and diarrhea in children under the age of 5. In addition, actual coverage levels for each intervention are compared to coverage targets set forth in GAPPD to assess how close or far countries are from meeting global standards for pneumonia and diarrhea prevention and treatment. GAPPD provides an integrated strategy for ending preventable pneumonia and diarrhea deaths through the use of proven measures that **protect** child health, **prevent** children from becoming ill with pneumonia and diarrhea, and **treat** affected children.

In 2015, these two diseases together were responsible for nearly one in four deaths that occurred in children under 5 years of age.

**Protect.
Prevent.
Treat.**

GAPPD sets forth the following coverage targets for its recommended interventions, which countries should strive to achieve:



90%



coverage for each of the following vaccines: pertussis, measles, Haemophilus influenzae type b (Hib), pneumococcal conjugate, and rotavirus vaccines

90%



treatment coverage for children with suspected pneumonia, including care by an appropriate health care provider and antibiotics

90%



treatment coverage for children with diarrhea, including treatment with oral rehydration salts (ORS) and zinc supplements

50%



rate of exclusive breastfeeding for the child's first six months of life

GAPPD Intervention Scoring

GAPPD scores are composite scores calculated from the most recent coverage data for each country for 10 of the 19 GAPPD indicators.⁴ These 10 indicators were selected because they are discreet and measurable coverage targets with publicly available data. GAPPD scores are one method to estimate the relative progress of countries meeting global standards for pneumonia and diarrhea prevention and treatment. GAPPD scores represent a summary of coverage, and are expressed as a percentage. The protection indicator is exclusive

breastfeeding for the first six months of a child’s life and does not include mothers who introduce complementary feeding during this period. Prevention indicators include coverage rates for five vaccines: the third dose of pertussis as measured by DTP3; the first dose of measles-containing vaccine, MCV1; the third dose of Hib vaccine, Hib3; the third dose of pneumococcal conjugate vaccine (PCV), PCV3; and the last dose of rotavirus vaccine, RV. The treatment indicators include care by an appropriate health care provider and antibiotic treatment for

children with suspected pneumonia and treatment with ORS and zinc for children with diarrhea. The overall GAPPD scores provide an overview of progress made in providing children with high-impact interventions for pneumonia, diarrhea, or both. For a closer look at the countries’ progress with respect to pneumonia and diarrhea interventions separately, GAPPD-Pneumonia and GAPPD-Diarrhea scores, which respectively take into account only pneumonia-specific and diarrhea-specific interventions, are also reported.

The coverage indicators that are included in each score are outlined below:

Score	DTP3	MCV1	Hib3	PCV3	RV (last dose)	Pneumonia Treatments		Diarrhea Treatments		Exclusive breastfeeding in first 6 months
						Care by an appropriate health care provider	Antibiotics	ORS	Zinc supplements	
Overall GAPPD score	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
GAPPD-Pneumonia score	✓	✓	✓	✓		✓	✓			✓
GAPPD-Diarrhea score		✓			✓			✓	✓	✓

GAPPD scores reflect the progress of each country on 10 key GAPPD interventions for which coverage data are publicly available; they are not intended to represent the full portfolio of interventions that are effective in reducing pneumonia and diarrhea morbidity and mortality in children. Therefore, non-inclusion of interventions in the GAPPD score calculations does not imply their lack of importance in the prevention and treatment of childhood pneumonia and diarrhea.

Considerations for Interpreting GAPPD Scores: Data for some GAPPD indicators over the last 10 years are not consistently available; where data are not available, they are excluded from the calculation of GAPPD scores. As a result, countries with several missing values, such as Angola and China, may have scores that either overestimate or underestimate the true progress being made in the country. Zinc supplementation for diarrhea treatment is the exception to the exclusion of an indicator in a GAPPD score when data is not available. When zinc coverage data is not available, we calculated the GAPPD score using zero for zinc, assuming that when this particular intervention is not measured, it is likely to be used at very low levels, if at all. Additionally, progress may appear stalled in countries where coverage estimates for GAPPD indicators are not updated annually, even if the country has made improvements in recent years. This underscores the importance of investing in generating high quality, annual data that then allows ongoing monitoring on key GAPPD interventions. This data feedback loop will not only enhance the quality of programs delivering these interventions, but also allows an accurate assessment of progress in these countries.

Immunization coverage rates calculated in the GAPPD scores are from the WHO/UNICEF Estimates of National Immunization Coverage (WUENIC). These estimates are updated for the most recent year, as well as all previous years, taking into account any new survey data that were made available since the prior year’s WUENIC release. Any changes in estimated coverage rates of previous years do not necessarily imply increases or decreases in actual coverage in that given year. These changes reflect an adjustment of coverage estimates based on the latest available survey data. Therefore, changes between the 2014 vaccine coverage rates reported in the 2015 Pneumonia and Diarrhea Progress Report and the 2015 rates reported in this year’s Progress Report can be either due to WHO/UNICEF’s adjustments of 2014 coverage rates or to a true increase or decrease in coverage levels between 2014 and 2015. In this 2016 Progress Report, when assessing trends in the years 2000, 2009 and 2015, coverage rates from the latest WUENIC data were used to recalculate GAPPD scores using the current GAPPD indicators.

Key Findings

GAPPD Package Coverage

Overall GAPPD scores in 2016 varied widely from a low of 20% (Somalia) to a high of 74% (Tanzania), with all 15 countries falling below the 86% target for the overall GAPPD score. Over the past year, some large countries, including Nigeria, DRC, Afghanistan, Pakistan, and China had little to no improvement in their GAPPD scores, while others, including India, Angola, Niger, and Bangladesh have made substantial gains.



Large countries with low coverage of lifesaving interventions that protect against, prevent, and treat pneumonia represent critical opportunities to make a meaningful impact on the fight against child mortality.

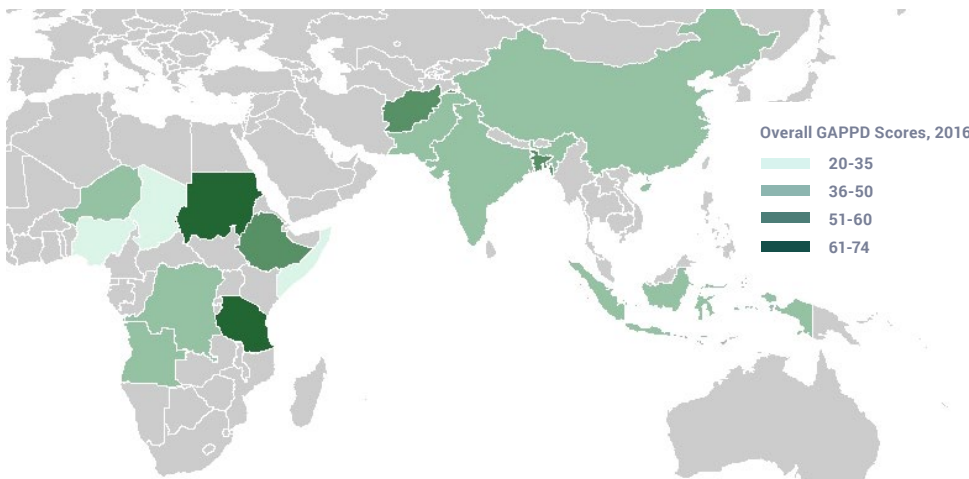
The top 15 countries contributing to the global burden of child pneumonia and diarrhea deaths were unchanged between 2015 and 2016. These 15 highest burden countries consist of (1) India, (2) Nigeria, (3) Pakistan, (4) DRC, (5) Angola, (6) Ethiopia, (7) Indonesia, (8) Chad, (9) Afghanistan, (10) Niger, (11) China, (12) Sudan, (13) Bangladesh, (14) Somalia, and (15) United Republic of Tanzania

(listed in decreasing order of pneumonia and diarrhea child deaths).^{1,2}

In 2016, overall GAPPD scores varied widely from a low of 20% (Somalia) to a high of 74% (Tanzania). Tanzania achieved the highest GAPPD score reached by any of the 15 highest-burden countries since we began evaluating both pneumonia and diarrhea interventions in 2013 (See Figs.1 and 2 and Table 1), prompting an in-depth analysis on this country (Page 26). The median score among the 15 countries was 48%. This represents a slight improvement over 2015 scores, which ranged from 20% (Somalia) to 72%

(Tanzania), with a median score of 47%. However, in 2016, only five of the 15 countries had overall GAPPD scores of at least 50% (Afghanistan, Sudan, Bangladesh, Ethiopia and Tanzania), and none met the 86% target for the overall GAPPD score, which would be achieved if a country met the minimal coverage targets for each of the 10 GAPPD interventions evaluated in this report. India achieved an improvement of seven percentage points, but still remained below the threshold of 50%.

Figure 1: Overall GAPPD scores for the 15 countries with the greatest absolute number of pneumonia and diarrhea deaths in children under 5 years of age, 2016



Large countries with low coverage of lifesaving interventions that protect against, prevent, and treat pneumonia represent critical opportunities to make a meaningful impact on the fight against child mortality.

Table 1: Current levels of coverage for pneumonia and diarrhea interventions in the 15 countries with the most absolute child pneumonia and diarrhea deaths

Global Mortality Rank in Pneumonia & Diarrhea Deaths in Children Under 5	Country	Pneumonia & Diarrhea Deaths in Children Under 5 Years 2016 ^{1,2}	Vaccine Coverage (%) ^{3,7,8}					% of Children Under 5 with Suspected Pneumonia ^{4,5}		% of Children Under 5 with Diarrhea ^{4,5}		% Exclusive Breastfeeding in first 6 months ^{4,5} (2006-2015)	2016 Overall GAPPD Intervention Score	2016 GAPPD-Pneumonia Intervention Score	2016 GAPPD-Diarrhea Intervention Score
			Pertussis (DTP3) 2015	Measles (MCV1) 2015	Hib3 2015 (Year Introduced) & Vaccine Use Status	PCV3 2015 (Year Introduced) & Vaccine Use Status	Rota 2015 (Year Introduced) & Vaccine Use Status	Taken to an appropriate health care provider (2006-2015)	Receiving Antibiotics (2006-2015)	Receiving ORS (2006-2015)	Receiving zinc supplements (2006-2015)				
1	India	296,279	87	87	45	0 Gavi approved Introduction planned 2016-Q4	0 Phased introduction March 2016 Rotavac (RV1)	77	12.5	34	0.3	65	41	53	37
2	Nigeria	210,219	56	54	56	13	0 Gavi approved Intro planned 2018	34.5	36.5	34	2.3	17	30	38	21
3	Pakistan	103,444	72	61	72	72	0 Gavi approved Intro planned 2017	64.4	41.5	38	1.5	38	46	60	28
4	DRC	78,273	81	79	81	73	0 Gavi application submitted	42	39.6	39	2.4	48	48	63	34
5	Angola	54,429	64	55	64	58	49	-	-	-	0	-	48	60	35
6	Ethiopia	46,962	86	78	86	85	83	27	6.8	26	0.0	52	53	60	48
7	Indonesia	33,551	81	69	81	0 Non-Gavi planning introduction 2018*	0 Non-Gavi planning introduction*	75.3	38.9	39	1.1	42	43	55	30
8	Chad	30,635	55	62	55	0 No decision	0 No decision	25.8	30	20	1.3	0	25	33	17
9	Afghanistan	30,394	78	68	78	66	0 Gavi plan to apply	62	63.9	46	10.0	43	51	66	33
10	Niger	28,163	65	73	65	74	70	53.1	10.7	44	10.3	23	49	52	44
11	China	27,113	99	99	Private Market Coverage	0 No decision	0 No decision	-	-	-	0	28	32	45	32
12	Sudan	25,087	93	87	93	93	84	48.3	59	20	15.2	55	65	76	52
13	Bangladesh	24,541	94	88	94	48	0 Gavi application submitted Intro planned 2018	42	34.2	77	48.6	55	58	65	54
14	Somalia	23,428	42	46	42	0 No decision	0 No decision	13	32.4	16	0	5	20	26	13
15	Tanzania	22,322	98	99	98	95	98	71	-	44	4.7	59	74	87	59

*Not profiled in the 2014 Pneumonia & Diarrhea Progress Report; was not among the top 15 countries with the highest number of child pneumonia and diarrhea deaths in the previous year.

Sources:

¹ Liu, L., Oza, S., Hogan, D., Chu, Y., Perin, J., Zhu, J., Lawn, J., Cousens, S., Mathers, C., Black, R. E. (2015). National, regional and global causes of child mortality in 2000-2015 – reflecting on the MDG 4 and embarking on the SDG 3.2. Under preparation.

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⁸ VIEW-hub. Retrieved October 2016 from <http://view-hub.org/>



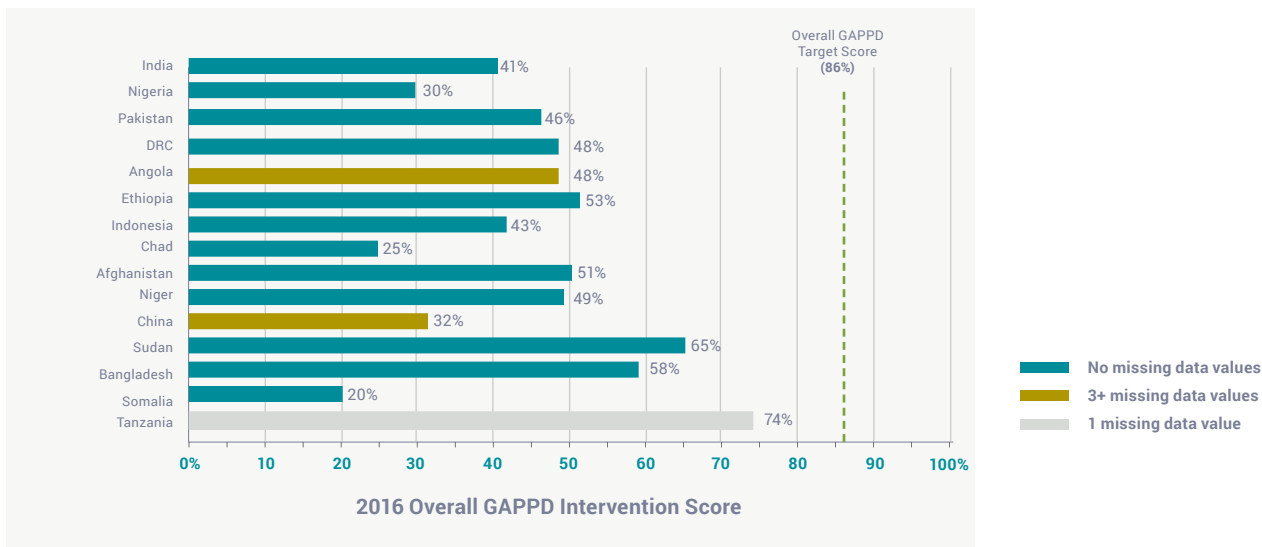
Compared to 2015 scores, 12 of the 15 countries had some improvements in their 2016 scores (Fig. 3), with the largest increases seen in Niger (+11), Bangladesh (+8), India (+7), Angola (+6), Ethiopia (+5), and Indonesia (+5). Moderate increases were seen in Nigeria (+3), Chad (+3), Afghanistan, Sudan, and Tanzania each increased their GAPPD scores by two, DRC increased by one. The scores for Pakistan, China, and Somalia were unchanged.

Of the 15 countries profiled in this report, the two countries with the highest GAPPD scores (Tanzania and Sudan) are using all five vaccines protective against pneumonia and diarrhea (pertussis, measles, Hib, PCV, and rotavirus vaccines) and are achieving relatively

high coverage with each vaccine. In contrast, where PCV and rotavirus vaccine had not been introduced into the national immunization schedule of countries with large populations of children under-5 as of December 2015, including India, Indonesia, and China, the overall GAPPD scores stagnated. Indeed, India has the highest burden of under-5 pneumonia and diarrhea deaths in the world, and has the lowest GAPPD score among the Asian countries evaluated in this report. Progress in immunization coverage is now being made in India with rotavirus vaccine introduced in four states in 2016 with further expansion planned in 2017; PCV is expected to begin to be introduced in early 2017.

Progress in immunization coverage is now being made in India with rotavirus vaccine introduced in four states in 2016 with further expansion planned in 2017; PCV is expected to begin to be introduced in early 2017.

Figure 2: 2016 Overall GAPPD intervention scores (countries shown in decreasing order of child pneumonia and diarrhea deaths)



Source: World Health Organization (WHO). (2015). WHO vaccine-preventable diseases: monitoring system. 2016 global summary. Last updated 8 Sep 2016. Retrieved from http://apps.who.int/immunization_monitoring/globalsummary/indicators



The pattern noted in previous editions of the Progress Report persists in 2016: countries with the greatest absolute burden of child deaths from pneumonia and diarrhea have among the lowest GAPPD scores. In Figure 4, those countries with the largest number of under-5 pneumonia and diarrhea disease deaths, represented by the largest bubbles, are India, Nigeria, Pakistan, and the DRC. All of these countries have overall GAPPD scores below 50%. It is important to recognize that the absolute burden of pneumonia and diarrhea deaths in children under-5 does not necessarily

tell the complete story for a country. The death rate for pneumonia and diarrhea per 1000 live births provides a different representation of the child health environment than the absolute burden of disease. In countries with large birth cohorts, even relatively low pneumonia and diarrhea mortality rates can result in a high number of deaths. For example, India has a pneumonia mortality rate of 7 and diarrhea mortality rate of 5 per 1000 live births, lower than 11 of the top 15 countries (Table 2). However, since India's under-5 population is the largest in the world, at 121.3 million, the absolute burden of pneumonia and diarrhea deaths is still very high and gains will be great if the problem can be addressed.

Figure 3: Change in overall GAPPD scores between 2015 and 2016 shown from top to bottom in decreasing order of child pneumonia and diarrhea mortality

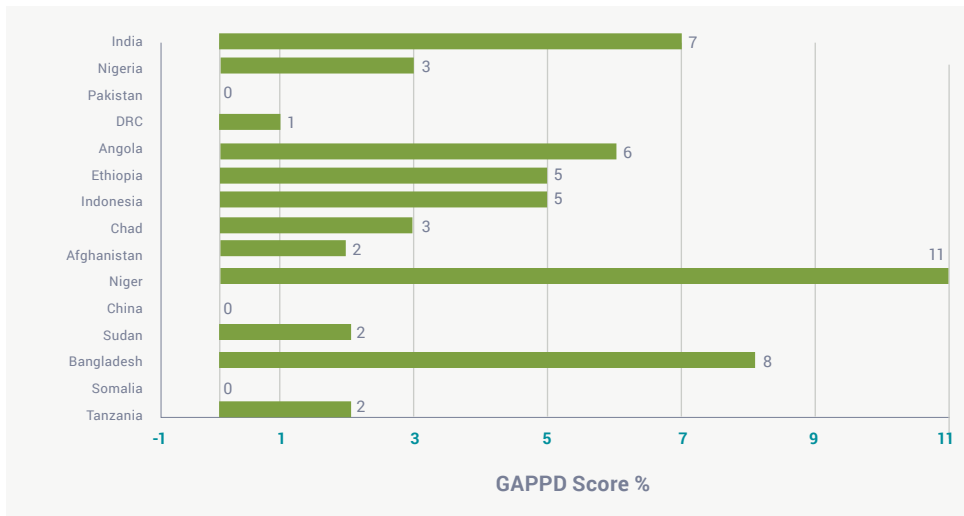
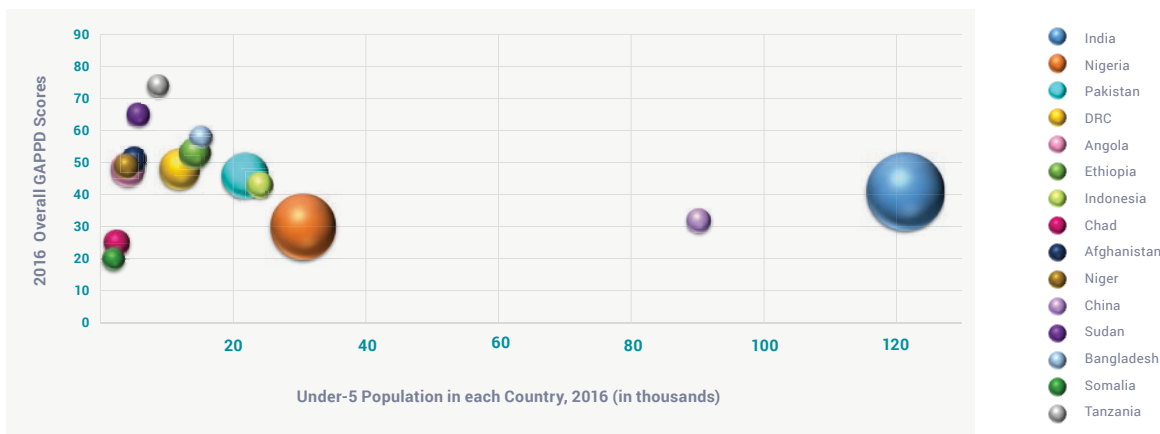


Figure 4: Absolute number of pneumonia and diarrhea deaths in under-five children and overall GAPPD scores in the 15 highest burden countries, relative to their under-five population size



Note: The size of each bubble represents the absolute number of under-five child deaths from pneumonia and diarrhea in each country.

India has a pneumonia mortality rate of 7 and diarrhea mortality rate of 5 per 1000 live births, lower than 11 of the top 15 countries.

Table 2: Pneumonia and diarrhea deaths in children under 5 years of age in the 15 highest burden countries

Country	Pneumonia & diarrhea deaths in children under 5 years (2015) ^{1,2}	Pneumonia & diarrhea deaths per 1,000 live births (2015) ^{1,2}
India	296,279	12
Nigeria	210,219	30
Pakistan	103,444	19
DRC	78,273	25
Angola	54,429	50
Ethiopia	46,962	15
Indonesia	33,551	7
Chad	30,635	51
Afghanistan	30,394	29
Niger	28,163	29
China	27,113	1
Sudan	25,087	19
Bangladesh	24,541	8
Somalia	23,428	53
Tanzania	22,322	11

¹ UNICEF, Estimates of child cause of death, acute respiratory infection, 2015. Data as of December 2015. Retrieved from <https://data.unicef.org/child-health/pneumonia.html>

² UNICEF, Estimates of child cause of death, diarrhea. Data as of December 2015. Retrieved from <https://data.unicef.org/child-health/diarrhoeal-disease.html>

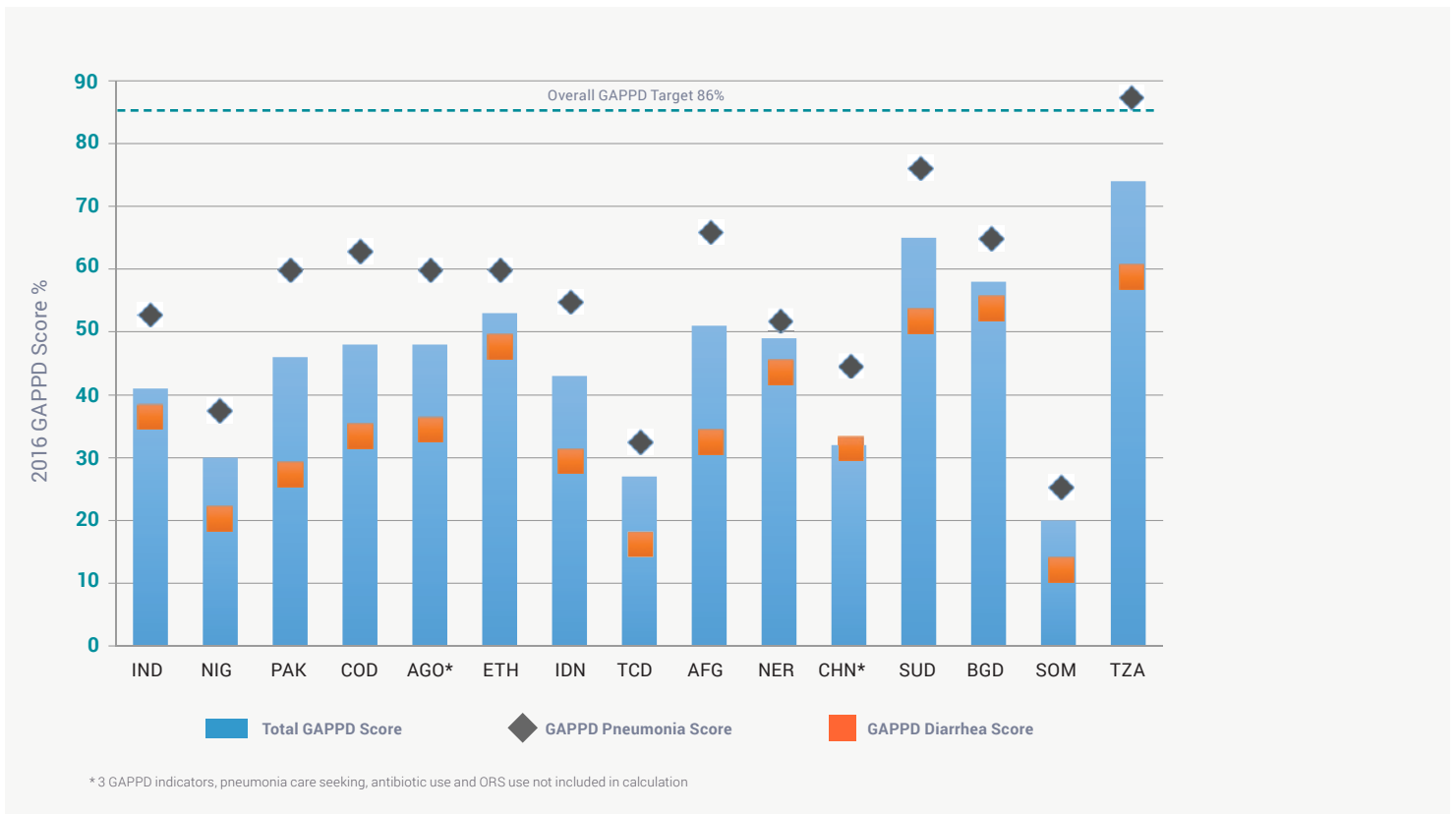
Opportunity for reducing this burden of mortality begins with closing the access gap and providing equitable access to GAPPD interventions for all children. Prevention through immunization alone is not enough. Access to appropriate treatment in adequate health facilities staffed by well-trained health care workers is critical to saving lives. Identifying children who should be referred to the next level of care will also save lives. Pneumonia severity of illness scores are being developed to identify and prioritize severely ill children for the appropriate enhanced treatment needed for survival.⁸

We need to ramp up the coverage of GAPPD interventions to reach identified targets. Innovation through new technologies, as well as new ways to use existing tools, must also be put into practice to reduce preventable child deaths.

Progress in reducing the burden of childhood pneumonia and diarrhea mortality should include the introduction of PCV and rotavirus vaccines in those countries that have not yet done so. Of the 15 countries profiled in this report, five have not yet introduced PCV and nine have not yet introduced rotavirus vaccine. Once the decision to introduce a vaccine is made, that introduction must include rapid, equitable rollout to ensure maximum impact. Too often the areas of the country in most need of the vaccines are the last to receive them. An intentional effort to introduce interventions in the highest burden areas in parallel with system strengthening is needed to achieve the greatest impact.

Countries consistently scored higher on their GAPPD-Pneumonia scores than their GAPPD-Diarrhea scores. Tanzania was again the only country of the 15 highest burden countries to meet the GAPPD-Pneumonia target score of 84%, while no country achieved the GAPPD-Diarrhea target score of 82%.

Figure 5: 2016 GAPPD-Pneumonia and GAPPD-Diarrhea intervention scores for countries (shown from left to right in decreasing order of total child pneumonia and diarrhea deaths)





When evaluating pneumonia and diarrhea interventions separately, GAPPD-Pneumonia scores were consistently higher than GAPPD-Diarrhea scores across all 15 countries, ranging from 26-87% and 13-59%, respectively (Fig.5). India, DRC, Ethiopia, Chad, Afghanistan, Niger, Sudan, and Bangladesh made improvement to both their GAPPD-Pneumonia and their GAPPD-Diarrhea scores. In other countries, progress was mixed, with some countries making gains on pneumonia interventions, while losing ground on diarrhea interventions. For example, Indonesia increased its GAPPD-Pneumonia score by six percentage points, but lost two percentage points in its GAPPD-Diarrhea score. Two countries (Pakistan and China) experienced virtually no change in either their GAPPD-Pneumonia or GAPPD-Diarrhea score. Somalia had an unchanged GAPPD-Pneumonia score combined with a one-point decrease in its GAPPD-Diarrhea score. It is encouraging to note that none of the 15 countries profiled had a decrease in both scores.

These results show that advances and barriers to progress vary by country and should be addressed on the individual country level. It is important to recognize these potential differences across geographic areas and between various interventions to devise country-tailored solutions to successfully reduce childhood pneumonia and diarrhea mortality.

Although none of the 15 countries met the 86% target for an overall GAPPD score, Tanzania again exceeded the 84% GAPPD-Pneumonia target as it had in 2015. No country came close

to reaching the 82% GAPPD-Diarrhea target (the minimum score achieved if a country were to meet the minimum standards for all the diarrhea-specific GAPPD interventions). Only six of the 15 countries met at least one of the 10 GAPPD intervention coverage targets. As in 2015, Tanzania hit targets for the most indicators (six), followed by Sudan, who met four coverage targets in 2016. In total, nine of the 15 countries failed to reach even a single one of the 10 GAPPD intervention coverage targets.

Reductions in Pneumonia and Diarrhea Mortality due to GAPPD Interventions: Overview of Progress, 2000-2016

GAPPD Improvements during the MDG era and beyond

The MDGs were in effect between the years 2000 and 2015.⁷ During this period, there was a substantial decline in total deaths in children younger than

5 years old, from about 10 million in 2000 to 5.9 million in 2015.⁴ Pneumonia and diarrhea deaths in children under 5 also declined from 2.9 million in 2000 to 1.4 million in 2015. In addition to a reduction in mortality, the proportion of under-5 deaths due to pneumonia or diarrhea also fell from 30% in 2000 to 24% in 2015. As we transition to the era of SDGs, IVAC is taking the opportunity in this report to reflect on progress in the pneumonia and diarrhea arena between the year 2000 and the most up-to-date coverage information available.

In total, nine of the 15 countries failed to reach even a single one of the 10 GAPPD intervention coverage targets.

Figure 6: 2000, 2009, 2016 GAPPD intervention scores for 15 highest burden countries



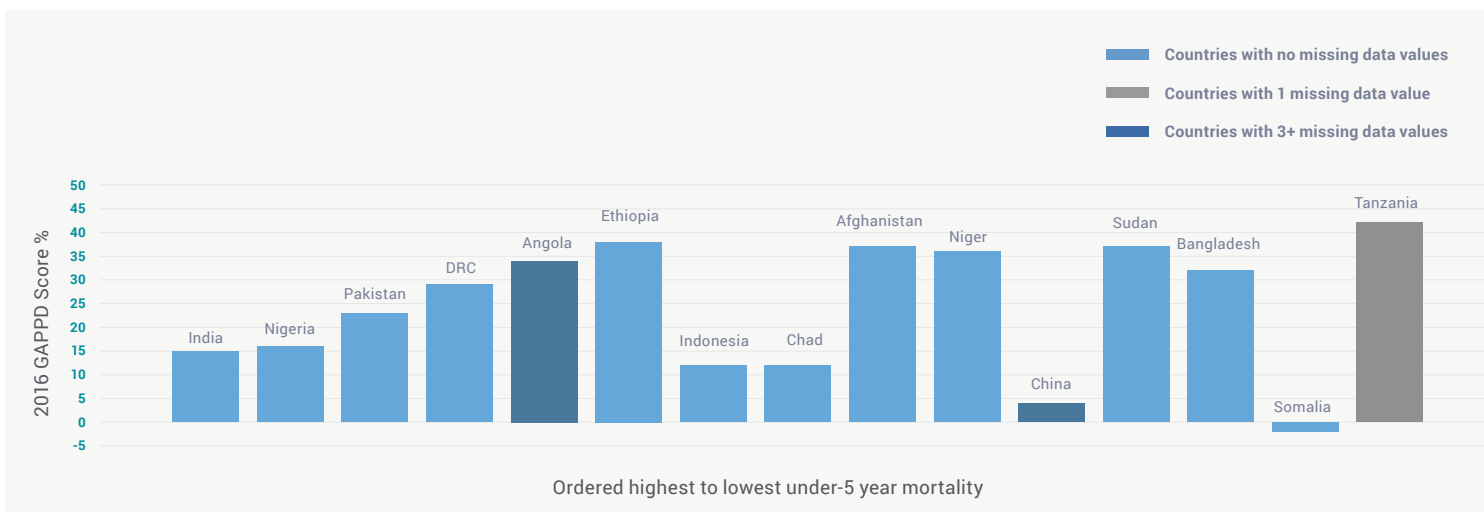
In an effort to assess the historical progress towards reducing under-5 mortalities, we compared the 2016 GAPPD scores to scores from two other key years—2000, the start of MDGs; and, 2009, the first year of GAPP. Using WUENIC vaccine coverage numbers and collecting breastfeeding and treatment coverage data from the Demographic and Health Survey and Multiple Indicator Cluster Surveys country report closest to, but not exceeding each date, we calculated the overall GAPPD scores for years 2000 and 2009. Note that when a vaccine had not yet been introduced, the value of that indicator was calculated as a zero because the children of that country are known not to be receiving the vaccine, and the zero is added to the GAPPD score total. However, when data is not available, as was often the case for antibiotic treatment, the level of access to these treatments is unknown, then the indicator cannot be included in the score calculation. The exception to the exclusion of an indicator in these GAPPD scores when data was not available is zinc supplementation for diarrhea treatment. When zinc coverage data is not available, we calculated the GAPPD scores using zero for zinc, under the assumption that for this particular intervention, if it is not measured, it is likely to be used at very low levels, if at all.

In 2000, none of the 15 countries had introduced the Hib vaccine, PCV or rotavirus vaccine. No data was available for any country on antibiotic use for suspected pneumonia or zinc supplements. By 2009, most countries had introduced the Hib vaccine, although none had yet introduced PCV or the rotavirus vaccine. Many countries reported coverage on antibiotic use for suspected pneumonia or zinc supplements. Overall GAPPD scores ranged from 13 to 32 percentages in 2000; from 16 to 48 percentage points in 2009; and from 20 to 74 percentage points in this year’s report. Although some countries are moving closer to the target, many remain with only modest increases versus 2009. Somalia, China, Nigeria, and Chad remain in the bottom tier of performance in GAPPD scoring and although some progress has been made in the latter two since 2000, the rate of improvement is insufficient to meet goals if the pace of adoption and uptake of new interventions does not change substantially.

The average improvement in GAPPD score calculated from data for the years 2000 and 2015 is 24.3 percentage points. Although some countries made large gains, not every country made progress (Fig. 7). Eight countries (DRC, Angola, Ethiopia, Afghanistan, Niger,

Sudan, Bangladesh, and Tanzania) improved their overall GAPPD score at a greater than average level, led by Tanzania, Ethiopia, and Sudan. These three countries achieved an increase of over 35 percentage points over that period. The four countries making moderate progress in overall GAPPD score improvement include the two highest burden countries of India and Nigeria. Indonesia’s score improved by less than 15 percentage points over this period. China’s score increased by only four percentage points, with the qualification that it is difficult to generate a representative GAPPD score for China because treatment data has never been available for this country. Only one country, Somalia, has a GAPPD score that has fallen over the period of 2000 to 2016. Not only has the score fallen for this country, but Somalia is also the country with the lowest GAPPD score among the 15 highest burden countries, falling by two percentage points, from 22% in 2000 to 20% in 2016. Somalia also has the highest combined pneumonia and diarrhea death rate of the 15 countries profiled in this report, 53 per 1000 live births (Table 2). Notwithstanding the dire situation in Somalia, in general, implementation of pneumonia and diarrhea interventions has improved steadily, on average, since the year 2000 in these 15 countries.

Figure 7: Change in GAPPD scores 2000 to 2016 in 15 highest mortality countries





Key Findings: Prevent

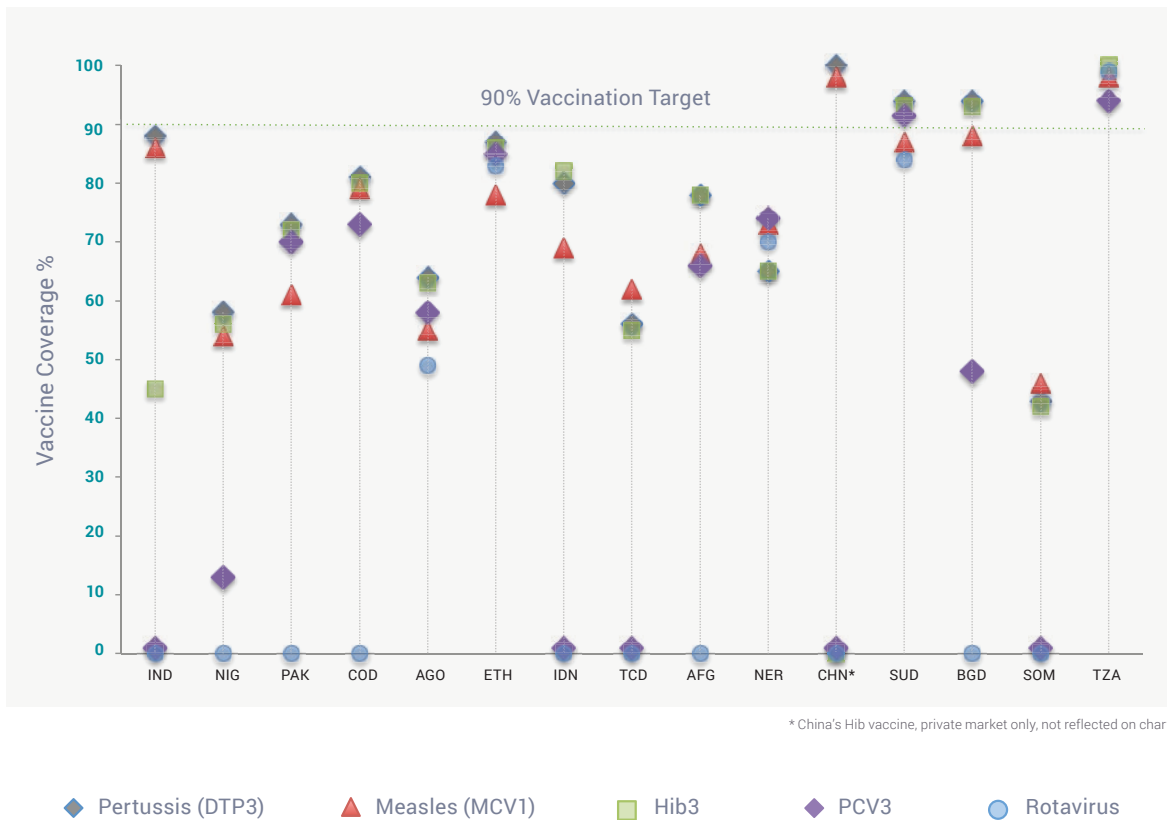
**Immunization Coverage for DTP3, Measles,
Hib, PCV, and Rotavirus Vaccines**

Vaccines have long been recognized as a cornerstone to child health and survival. There are several vaccines that are safe and effective in preventing pneumonia and diarrhea, including pertussis, measles, Hib, pneumococcal conjugate, and rotavirus vaccines.



The target coverage rate for vaccines is 90%. In the 15 highest burden countries, vaccine coverage rates vary widely in 2015 driven by a number of factors including introduction dates, infrastructure, and political will (Fig. 8).

Figure 8: Vaccination Coverage Rates 2015



DTP3 Vaccine Coverage

DTP3: According to the latest WUENIC report released in 2016, in 2015 six of the 15 countries have DTP3 coverage levels over 85%, with four surpassing the 90% coverage target. DTP3 coverage is viewed as a general indicator of the functionality of the country’s immunization program. It is encouraging to see that multiple countries with high pneumonia and diarrhea disease burdens do have well performing immunization systems that reach virtually all children in that country. In six countries DTP3 coverage increased between 2014 and 2015. DTP3 coverage rates decreased in four countries and remained the same in five. DTP3 coverage levels were remarkably low (below 50%) in only one country, Somalia, indicating serious issues with delivering routine immunizations. Somalia is experiencing political conflict, requiring enhanced efforts to strengthen immunization systems in the face of national, international or subnational disruptions, as more and more children become displaced and even harder to reach for preventative services.

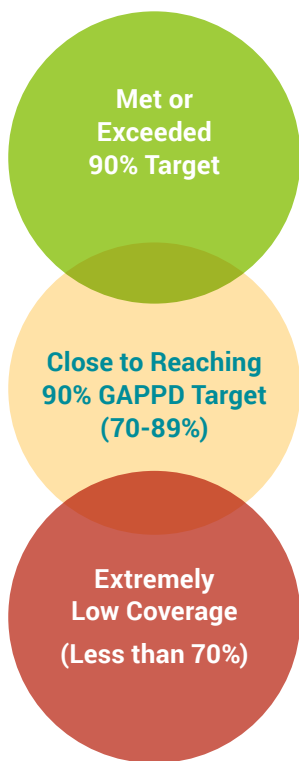
Measles Vaccine Coverage

Measles: For measles vaccine, coverage rates increased in eight countries, decreased in four (Pakistan, Angola, Indonesia and Bangladesh) and remained unchanged in three countries. Eight of the 15 countries had measles vaccine coverage at or above 70%, with two, China and Tanzania, reaching nearly universal coverage at 99% and Tanzania is considered on target to achieve elimination goals.⁹

The declining coverage of measles vaccine, in some countries, poses a real and substantial threat to the sustainability of previous successes achieved in measles prevention. The strategy to achieve measles elimination must anchor on achieving and maintaining strong routine immunization coverage with supplemental activities used as an adjunct, but not the core strategy. Pakistan and Bangladesh decreased coverage by two and one percentage point, respectively.

Hib Vaccine Coverage

Hib: Hib vaccine is another vital vaccine for the prevention of pneumonia and is widely used in every country except for China and Thailand. Hib vaccine is delivered to children in China through the private market, but coverage levels in China’s private sector are not well documented. The transition to pentavalent vaccine, which contains the diphtheria, tetanus, pertussis and hepatitis B vaccines in addition to Hib, occurred in all 73 Gavi countries in 2014.¹⁰ Thirteen of the 15 countries (not India and China) have identical DTP and Hib coverage rates because they now use the pentavalent vaccine. Currently, three of the 15 countries (Sudan, Bangladesh, and Tanzania) have exceeded the 90% GAPPD coverage target for Hib vaccination, and eight countries have coverage rates over 70%. Indonesia and India have made great progress in Hib coverage, increasing by 51 and 25 percentage points, respectively, over the past year as they completed the roll out of pentavalent vaccine across the country. In large countries such as India and Indonesia, a high coverage for this indicator is both a function of phased introduction and coverage rates. Ethiopia and Chad both increased Hib coverage by 11%. Somalia has the lowest coverage at 42%, reflecting a very weak immunization system requiring urgent and focused efforts to restore basic program services in the face of serious local conflicts.



Pertussis (DTP3)	Measles (MCV1)	Hib3	PCV3	Rotavirus
China Sudan Bangladesh Tanzania	China Sudan Bangladesh Tanzania	Sudan Bangladesh Tanzania	Sudan Tanzania	Tanzania
India Pakistan DRC Ethiopia Indonesia Afghanistan	India DRC Ethiopia Niger Sudan Bangladesh	Pakistan DRC Ethiopia Indonesia Afghanistan	Pakistan DRC Ethiopia Niger	Ethiopia Sudan Niger
Nigeria Angola Chad Niger Somalia	Nigeria Pakistan Angola Indonesia Chad Afghanistan Somalia	India Nigeria Angola Chad Niger Somalia	India Nigeria Angola Indonesia Chad Afghanistan China Bangladesh Somalia	All remaining countries

PCV Vaccine Coverage

The pace of introduction of PCV and rotavirus vaccines in the highest burden countries has been remarkably slow, especially in large countries that have the potential to make the greatest impact. Fifteen years after PCV's first introduction globally in 2000 (the United States was first to implement the vaccine), five of the highest pneumonia burden countries (India, Indonesia, Chad, China, and Somalia) are still not using the vaccine in their routine immunization programs. Progress is anticipated since India and Indonesia are planning PCV introduction, with India expected to begin subnational use in selected states in early 2017. Indonesia is expected to introduce PCV in a small number of districts as soon as 2017; with plans for a gradual introduction into their Expanded Program on Immunization over the next few years. Many countries had impressive PCV coverage gains over the past year, led by a 61% increase in coverage in Niger (to 74%) and a 26% increase in Afghanistan. Bangladesh introduced PCV in March of 2015, and achieved 48% coverage in 2015. Two countries, Sudan and Tanzania, exceeded the 90% GAPPD coverage target for PCV. Among the 10 countries that have introduced PCV, coverage varied from 13% in Nigeria, which continued to roll out the vaccine in 2016 to 95% in Tanzania. In eight of these countries, PCV coverage mirrors DTP3 coverage, an expected result

because DTP3 (usually given in the form of the pentavalent vaccine) and PCV are administered at the same time.

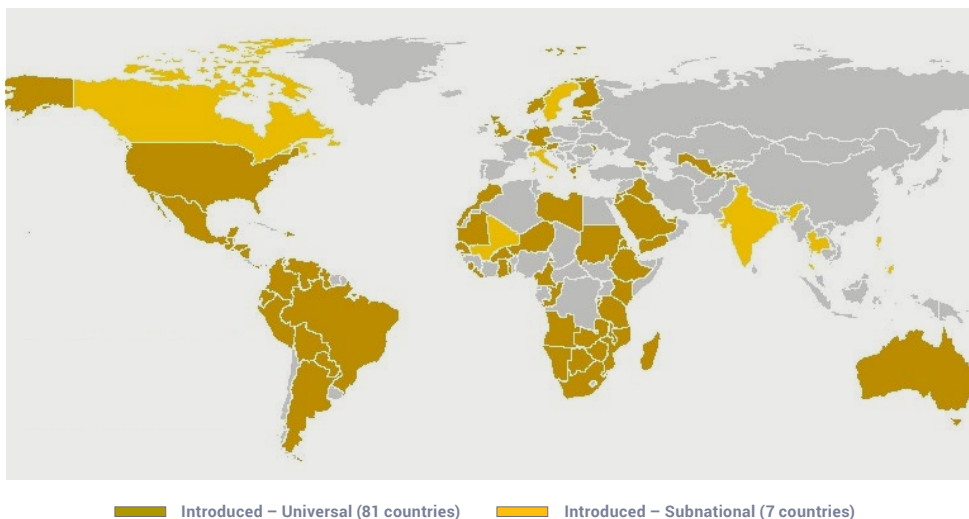
Rotavirus Vaccine Coverage

Compared to PCV, rollout of rotavirus vaccine in these 15 countries has been even more limited. Ten years after the introduction of rotavirus vaccine on the global market, only five of the 15 highest burden countries for childhood pneumonia and diarrhea deaths were using the vaccine in 2015 (Angola, Ethiopia, Niger, Sudan, and Tanzania). On the global scale, uptake of rotavirus vaccine is especially delayed in South and Southeast Asia, falling substantially behind the pace of introductions in Africa. In 2016, India delivered on its plan to introduce the vaccine in four states, and is discussing plans for further roll out. China has licensed a monovalent rotavirus vaccine that has achieved limited coverage in the country, available on the private market since 2000.¹¹ For the five countries profiled in this report that are using rotavirus vaccine, coverage ranged from 49% in Angola to 98% in Tanzania. As noted last year, Nigeria, Pakistan, Indonesia, Afghanistan, and Bangladesh are actively planning to introduce rotavirus vaccine.¹² DRC, Chad, and Somalia have not yet made decisions regarding rotavirus vaccine introduction into their national immunization program.¹²

As in previous years, momentum in rotavirus vaccine introduction in South Asia continues to lag behind other regions. The slow trend in adoption continues the trend of needless deaths and/or hospitalizations for a preventable burden from rotavirus disease. A single hospitalization for rotavirus diarrhea can be financially catastrophic for some families close to the poverty line. In India, for example, a hospitalization can cost the equivalent of more than three weeks' salary.¹³ Some of the reasons we do not see growing momentum for introduction of rotavirus vaccine in Asia are related to competing priorities for small resources; limited political will to address such a chronic and common disease; a lack of knowledge about the true local burden of rotavirus disease;¹⁴ a misperception that traditional hygiene measures that prevent transmission of other diarrheal pathogens are sufficient to prevent rotavirus disease;¹⁵ lack of appreciation for the severe effects rotavirus disease can have on the vicious cycle of malnutrition; and, the logistical difficulties of adding new vaccines to the routine immunization system in a developing country.

Partners and countries are making progress, but gaps remain despite these efforts. To compliment ongoing efforts and address those gaps, a new project focused on South Asia is now underway. This project, the Rotavirus Accelerated Vaccine Introduction Network, is a partnership of IVAC at the Johns Hopkins Bloomberg School of Public Health, the U.S. Centers for Disease Control (CDC) and Prevention and JSI Research & Training Institute, Inc. (JSI). The project is providing targeted technical assistance supplementing WHO, UNICEF and other partner support through all steps of a country's decision to apply to Gavi for rotavirus vaccine support including the pre-application decision process; advocacy support for in-country champions to build political will and address challenges such as financing or perceptions of competing priorities; application; and, post-application introduction and implementation based on country need and interest. The goal is to help countries make sustainable evidence based decisions and for countries who decide to apply, to accelerate high-quality, streamlined applications and introductions of rotavirus vaccine.

Figure 9: Global rotavirus vaccine introductions



Striving to Achieve and Maintain High, Equitable Vaccine Coverage

Beyond the political will needed to introduce these vaccines, achieving high levels of equitable coverage among children within countries that are using these vaccines remains a major challenge. It is encouraging to report that between 2014 and 2015, most of the countries profiled in this report either improved immunization coverage levels, or stayed close to 2014 coverage levels, although equity remains a concern in most countries. As we found in last year's report, 12 vaccines in four countries (China, Sudan, Bangladesh, and Tanzania) exceeded the 90% GAPPD coverage target. Notable coverage increases, mostly due to the completion of rollout, that have occurred over the past year include increases of 25% in India and 51% in Indonesia of the Hib vaccine; increases of 26% in Afghanistan, 48% in Bangladesh, and 61% in Niger of PCV; and, increases of 20% in Ethiopia, 31% in Angola, and 51% in Niger for rotavirus vaccine.

Of the 15 countries profiled in this report, Tanzania and Sudan have the best immunization coverage levels for all five vaccines measured, as well as the top GAPPD scores. The in-depth country reports for these two countries (Tanzania, page 26; Sudan, page 28) reviews their progress in reducing child mortality, lessons learned that may apply to the other countries profiled in this report, and challenges that still remain.



Levers of Prevention

Immunization: The Most Effective Way to Lower Pneumonia Mortality

By Keith Klugman, MD, PhD,
Director for Pneumonia,
Bill & Melinda Gates Foundation

While there are a number of levers that can be used to prevent pneumonia, by far the largest is vaccines—more specifically, conjugate vaccines.

Over the last decade, we have seen a dramatic rollout of the pentavalent vaccine to infants, which includes the Hib conjugate vaccine and, more recently, pneumococcal conjugate vaccine. These two vaccines aim to prevent Hib and pneumococcal disease. The significant impact of these vaccines on residual pneumonia mortality has been proven, and researchers are working to evaluate the magnitude of that impact.

Other levers of prevention include promotion of breastfeeding and trying to reduce indoor and outdoor air pollution. However, there are still large questions about the extent to which one can impact indoor air pollution by altering the source of energy in the home. The Bill & Melinda Gates Foundation (Gates Foundation) is supporting a large National Institutes of Health study looking at the switch from wood-based energy to gas, and the impact that switch has on infant pneumonia. Looking into the future, we hope to see continued rollout of pneumococcal conjugate vaccine. Current discussions in India about introducing PCV into high-burden states is very exciting. However, despite the success of Gavi, there are large numbers of children in low-middle income countries that do not have access to the vaccine. In particular, Indonesia and China do not currently have plans for PCV rollout.

Innovation is needed in a number of areas. First, although vaccines are available, we need innovative solutions to make them more affordable. Another major issue for pneumococcal conjugate vaccines is vaccine serotype type replacement. Existing vaccines only cover 70-75% of the pneumococcal burden in developing countries. The combination of strains that are not covered, and some degree of replacement, means that as much as a third of the pneumococcal pneumonia burden still remains. We need innovation in either expanded conjugate vaccines, or approaches that are not type specific, to prevent the residual burden of pneumococcal disease.

Additionally, as post-neonatal mortality is reduced with scale-up of interventions, the fraction of infant mortality attributable to pneumonia among neonates is increasing. The major viral cause of pneumonia hospitalization in very young infants is respiratory syncytial virus (RSV). Since there's neither a vaccine nor a practical passive antibody approach that could be used on a routine basis, especially one that is affordable for low-resource countries, we are looking to support the development of vaccines that could protect against RSV mortality. Two potential ways forward are investigating if maternal immunization can reduce RSV in the very young; and the second, a single injection of long lasting antibody given to infants intramuscularly that could protect them for the entire RSV season.

Investing in efforts to improve immunization that prevents more bacterial and viral causes of pneumonia is a big task, yet a critical next step. Building upon existing knowledge with innovative approaches to improve vaccine effectiveness, access, and affordability will save more young lives around the world.

Read Dr. Klugman's perspective on pneumonia treatment on [Page 35](#).



Eliminating Tobacco Exposure in the Home is a Key to Tackling the Problem of Child Pneumonia

Interview with Professor Heather Zar, South Africa

Strengthening Smoking Cessation Programs in Low- and Middle-Income Countries Provides an Opportunity To Improve Maternal And Child Health

Ongoing research in South Africa, led by Professor Heather Zar of the University of Cape Town, is identifying the links between antenatal and post-natal tobacco smoke exposure on child pneumonia, giving us a window into the role maternal and household smoking has on children's respiratory health. The study is showing that children are prime targets for the adverse effects of tobacco use, whether exposed in utero (during pregnancy) or in early childhood. We have the evidence and can intervene and protect children by reducing maternal and household smoking.

Q: Can you tell us about your research and what you have found so far?

A: We are investigating the link between tobacco smoke exposure during pregnancy and in the first few months after birth, on the incidence and severity of childhood pneumonia in the outskirts of a peri-urban area in South Africa in a low socioeconomic population. We are looking at the potential interaction of tobacco smoke exposure with exposure to other forms of indoor air pollution, such as particulate matter (a mixture of solid particles and liquid droplets found in the air such as dust, dirt, or soot) or volatile organic compounds, as well as other risk factors for pneumonia such as poor nutrition, on childhood pneumonia. We measure antenatal and post-natal exposure to tobacco smoke and exposure to indoor air pollution in the home. Lastly, we are measuring the impact of environmental tobacco smoke and indoor air pollution on child lung health broadly by measuring lung function in children at six weeks and annually. We have found that exposure to environmental tobacco smoke before birth leads to impaired lung function by six weeks of age, which may predispose a child to pneumonia.

Q: How does exposure to tobacco smoke impact children's respiratory health?

A: Environmental tobacco smoke exposure has been shown to increase a child's risk for developing many respiratory conditions including pneumonia, wheezing illness, bronchiolitis, and asthma, and reduced lung function. Environmental tobacco smoke has been identified as a risk factor for RSV, bronchiolitis, and severe influenza disease. Further, it has been associated with increased severity of disease—development of more severe pneumonia requiring hospitalization, longer hospital stays, or intensive care unit admission—or more severe asthma attacks. Long-term studies show exposure in early life is linked to the development of chronic obstructive pulmonary disease (COPD) in adulthood. Tobacco smoke exposure in utero has been associated with low birth weight or prematurity, and these children also have a higher risk of lung disease such as bronchopulmonary dysplasia, a chronic lung disease that can affect newborns and infants.

Editorial Commentary: South Africa has led the charge with strong cigarette taxes and bans on public smoking, and they are not alone. But while we know how to cut tobacco use and reduce second-hand exposure to tobacco smoke, global and country-level commitment is needed to implement those policies. Just one in five people worldwide is protected by national smoke-free laws, and about one in seven has access to national, fully or partially covered tobacco cessation services.¹⁷ Even fewer live in countries with tobacco taxes amounting to more than 75% of the retail price. The burden of smoking-related illness and death is disproportionately heavy in LMIC, home to 80% of smokers worldwide, yet a quarter of low-income countries have no cessation services. By rallying together to promote and enact common-sense policies and programs to reduce tobacco smoke exposure at every age in every country—especially LMIC, where these interventions are needed most—the global community can protect children from pneumonia and the other debilitating and deadly respiratory effects of tobacco smoke exposure.

Q: Is the effect pathogen-specific? Do you see a stronger link for viral or bacterial respiratory infections?

A: An association has been shown for lower respiratory tract infection from RSV and for influenza, as well as for severe disease from these pathogens in children who have environmental tobacco smoke exposure.

Q: Is there a link between changes in the quantity or severity of environmental tobacco smoke exposure and the change in pneumonia risk? Have you seen any difference in the effect of maternal smoking versus paternal smoking?

A: Maternal smoking during pregnancy seems to be a very important risk factor for pneumonia, wheezing, or development of asthma in children. In terms of pneumonia, there seems to be an additive effect if a child is exposed to maternal smoking and to smoking of another household member. **A 2011 systematic review reported if either parent smoked, the child's risk for pneumonia was substantially increased (the odds ratio for developing pneumonia was 1.22, or a child was 22% more likely to contract pneumonia if they lived in a household where one parent smoked);** this increased to 62% greater risk if both parents smoked, and 54% if an additional household member smoked.¹⁶ In the Drakenstein Child Health Study, maternal smoking during pregnancy was associated with a two-fold risk of developing pneumonia in those infants.

Q: What are some of the long-term effects of exposure to smoking at such a young age?

A: In the long term, a key risk is the development of COPD in adulthood. We are also finding that early life pneumonia further reduces lung function; by predisposing a child to pneumonia, environmental tobacco smoke exposure is also predisposing them to further impairment of lung health.

Q: Where do we go from here? Are there opportunities to apply what we are learning about smoking and child pneumonia in a policy setting?

A: There is an important opportunity to strengthen smoking cessation programs and to focus on women of reproductive age for these strategies. Smoking cessation does not receive a lot of attention in low- and middle-income countries (LMIC). This is a key area that can be strengthened to improve maternal and child health.

HEATHER ZAR, MD, PhD, is the Professor and Chair of the Department of Paediatrics and Child Health, and Director of the MRC Unit on Child & Adolescent Health at the Red Cross War Memorial Children's Hospital at the University of Cape Town, South Africa. Zar is also the current president of the Pan African Thoracic Society and serves on the Forum of International Respiratory Societies. In 2014, she was the first pediatrician to receive the World Lung Health award.



80%

Smokers worldwide are in Low and Middle-Income Countries



1 in 5 people protected by national smoke-free laws



1 in 7 have access to tobacco cessation services

Country Highlights: **Tanzania**



Tanzania

Global rank in number of pneumonia & diarrhea child deaths: **15**

2015 GAPPD score: **74**

Over the past 15 years Tanzania has been very successful in reducing child mortality. These efforts resulted in the country going beyond its MDG 4 target with 49 deaths per 1000 live births recorded for 2015.* At this rate, Tanzania might be on track to attain even more ambitious targets, such as the 2030 goal of 14 deaths per 1000 live births under A Promise Renewed, an effort that brings together governments, civil society, the private sector and individual citizens to stop women and children from dying of causes that are easily avoidable. However, over the past couple of years progress has slowed.

The biggest gains in terms of child survival occurred between 2000 and 2012. These successes can be attributed to several factors including: political commitment to child survival and political leadership focused on the primary care level and more recently on further strengthening accountability.¹⁸

Immunization also strongly contributed to the increases in child survival. Tanzania introduced several new vaccines into its routine immunization programme (PCV, rotavirus vaccine, HPV, measles second dose/measles rubella) and it remained a consistently high performer, with coverage for all antigens remaining above 90%.[‡] In December 2012, Tanzania jointly introduced PCV and rotavirus vaccines and within three years, coverage for both vaccines increased rapidly, with PCV3 at 95% and Rota2 at 98% in 2015. Reported geographic equity of vaccine coverage is also high with 92% of districts reporting over 80% DTP3 coverage.¹⁹

Tanzania's track record with other life-saving GAPPD interventions is also commendable.

PROGRESS:

- Successfully reached MDG4 target by reducing under-five child mortality to 49/1000 live births; one out of 12 low-income countries to have reached the target.
- Completed joint PCV and rotavirus vaccine introduction in December 2012; and, high coverage achieved within three years of introduction (PCV3 -95%; rotavirus - 98%).
- There is strong political commitment to immunisation and child health.

CHALLENGES:

- Under-5 child mortality from pneumonia and diarrhea remains significant and there have been no recent improvements.
- Data quality on vaccine coverage is poor in some areas of the country.
- Inequities in coverage and access to interventions remain.

INNOVATIONS:

- A new vaccine information management system (VIMS) is being rolled out.
- Development of Tanzanian reproductive, maternal, neonatal, and child health (RMNCH) Scorecard.

The country is among top performers in exclusive breastfeeding (50% of infants exclusively breastfed for the first six months of life). The data show that almost 71% of children with suspected pneumonia are taken to an appropriate healthcare provider and 44% of children under-5 with diarrhea receive ORS. Few children receive zinc supplements (4.7%) and unfortunately no data was found on antibiotic provision for those with suspected pneumonia. Given all these indicators, Tanzania's overall GAPPD score is at 74 (the highest among the target 15 countries). Tanzania has a large population and due to its size, even with achievements towards controlling pneumonia and diarrhea, it still accounts for 2% of the global burden of child mortality from these diseases.

Making further progress will be more challenging, but not impossible. Many children have been reached with vaccines, yet there remain inequities in access that result in over 22,000 preventable deaths from pneumonia and diarrhea every year. The children yet to be reached are different from those who have been reached already. Many of them live in hard to reach areas, face socio-economic barriers, or security challenges. Tanzania's southern regions show lower coverage than their northern neighbors. The influx of Burundi refugees results in increasing unplanned demands especially for immunization services.

Additionally, the quality of data available does not allow for accurate evaluation of the situation making it difficult to address gaps in coverage and access. Tanzania identified data visibility on stock status as one of its primary challenges and

prioritized its improvement. In 2013, it launched its new eHealth strategy. The strategy includes a national electronic logistics management information system (eLMIS) to ensure adequate quality and quantities of health commodities are always available at all levels. To strengthen Tanzania's immunization supply chain, which has particular needs, the country's Immunization and Vaccine Development Program has created an integrated VIMS that works with the existing eLMIS. JSI with support from the Gates Foundation, Clinton Health Access Initiative (CHAI), PATH, and VillageReach are working closely with the project to develop the VIMS.²⁰

While its progress has been very impressive, Tanzania must still step up efforts to exit from inclusion on the list of top 15 countries with the highest child mortality from pneumonia and diarrhea.

Development of RMNCH scorecards can help track progress and keep the issues front and center so improvements can continually be made. Additionally, improved data can also help in monitoring inequities, an objective that Tanzania will need to focus on in order to achieve ambitious goals and ensure progress continues. While political commitment remains strong, national ownership and government accountability can be strengthened further and partners will continue to work with Tanzania towards this goal.^{§,21}

* Meanwhile the target of reducing child mortality by two thirds was at 55 deaths per 1000 live births

+ President Jakaya Kikwete co-chaired the WHO Commission on information and accountability for women's and children's health with Canadian Prime Minister Stephen Harper. Every Woman Every Child (WHO). Commission on information and accountability for women's and children's health. Keeping promises, measuring results. Geneva: World Health Organization, 2011. Kikwete also launched the RMNCH scorecard in 2014.

‡ The exception is measles second dose which faces coverage challenges due to falling in the second year of life (whereas all other vaccines are in the first year of life).

§ President Kikwete launched the Tanzanian RMNCH Scorecard in May 2014. The scorecard was developed to track progress and foster an environment of accountability at all levels.

Country Highlights: **Sudan**



Sudan

Global rank in number of pneumonia & diarrhea child deaths: **12**

2015 GAPPD score: **65**

One might imagine a dire situation when thinking about a country in conflict like Sudan. The country, however, is doing a lot to improve the under-5 mortality rate. The story lies in the difficulties a country like Sudan can have in making improvements. The number of deaths in children under-5 increased slightly (by 184 children) while the under-5 mortality rate decreased by 2%, from 72/1000 live births (2014) to 70/1000 live births (2015).²²

In 2011, Sudan became the first low-income country in Africa to introduce rotavirus vaccine with Gavi support. It has also introduced PCV and has become the first country to introduce Meningitis A vaccine in its routine immunization program. This illustrates the country's commitment to addressing child mortality. Introducing new vaccines requires a commitment to improve the health system including improvements in cold chain, updating immunization cards and registries and training health workers, including mobile teams to reach the hard to reach populations.

There has been remarkable progress for children in Sudan since the signing of the Comprehensive Peace Agreement in 2005 as the country was striving to achieve the MDG 4 and MDG 5 targets.²² But when looking more closely, the GAPPD score, an indicator of the country's progress in combatting child mortality, the results were mixed. The total GAPPD score only increased by 2 percentage points from 63 (2015 Report) to 65 (2016 Report). Sudan's GAPPD-Pneumonia score increased (two points), but they had a greater increase in the GAPPD-Diarrhea score (five points). Concurrently, there was a drop in Sudan's reported vaccine coverage from the previous year. DTP3 dropped one point (93%), PCV3 decreased by four points to 93%, and rotavirus vaccine dropped by two points (84%).²³ Further evidence that the immunization system was under stress was the fact that the country faced numerous measles outbreaks, an indicator that there are at least pockets of low vaccine coverage and heterogeneity in the access to vaccines.

PROGRESS:

- The first low-income country in Africa to introduce a rotavirus vaccine with Gavi support (2011).
- Decreased under-5 mortality rate despite serious systems challenges.
- Maintains high coverage rates for introduced vaccines.

CHALLENGES:

- Children living in areas of conflict (North Darfur, South Kordofan, and Blue Nile Region) are often not reached by immunization and water, sanitation, and hygiene services. There is an influx of internally displaced persons (IDPs) and refugees due to conflict in neighboring areas.
- Insufficient domestic resources for the payment of routine traditional vaccines.
- There are managerial and technical capacity issues due to conflict and administrative splitting.

INNOVATIONS:

- A Community-based Management of Acute Malnutrition programme is being implemented in West Darfur for severely malnourished children in IDP camps.

The provision of immunization services in Sudan is plagued with many challenges including trying to access difficult to reach areas, rural-urban migration, natural disasters, the longstanding civil war, and limited resources. As a consequence, there are wide variations within the country in delivery of services, vaccination coverage, and disease incidence. It is estimated that over 140,000 children under 5 years who are not reached by immunization services and lack access to clean water and sanitation are in three areas of conflict in North Darfur, South Kordofan, and Blue Nile Region.^{24,25,26} In addition to the hard to reach population and conflict areas, conflict in some states and neighbouring countries has led to an influx of IDPs and refugees. The country is struggling to deliver services to those most in need.

Data quality improvement, especially regarding vaccine coverage and disease surveillance, needs to be a priority in Sudan so evidence-based solutions to address the challenges can be developed. Determining both the total number of children (denominator) and the number of those who have not been reached is critical, yet the last national census was conducted in 2008. The country is getting on the right track with a weekly case-based vaccine preventable diseases surveillance system that includes polio, diphtheria, pertussis, neonatal tetanus, rotavirus, bacterial meningitis, and measles. The country also introduced reporting on adverse events following immunization and on intussusception. But, many components of the surveillance system are weak, for example the community based disease surveillance among IDPs and refugees.

Additionally, Sudan has undergone significant administrative change, including changes in the number of districts from 88 in 2005 to 135 in 2008, and 157 in 2010. Such splitting of districts affected both capacity and resources

at the local levels. These rapid changes put an additional strain on the already weak cold chain capacity. Many localities still have cold chain functionality of less than 80% and large proportions of the currently functioning refrigerators are aging and need replacement. Sudan is working with multiple donors to strengthen their health system capacity and specifically the cold chain for vaccines. Political commitment to reducing child mortality must go beyond introduction of new donor-funded interventions. The federal government has not yet established a national budget line to procure core vaccines or to support operational costs of routine immunization. Despite the significant increase in the governmental support to the primary health care universal coverage plan there remains a funding gap, resulting in insufficient domestic resources for the payment of routine traditional vaccines. The international sanctions, financial crisis, and the high inflation rate have also negatively impacted the routine immunization program.

Over the past 15 years, significant improvement has been achieved, yet serious challenges remain as the country continues to be affected by lack of infrastructure, limited capacity, funding, and the ongoing conflicts. The result is often huge inequities in access to health services for the populations. These symptoms are familiar to many countries that find themselves in protracted conflict situations. The government has been working with partners and donors to improve the situation. The introduction and focus on new vaccines provides opportunities to strengthen both primary health care and equity. Both pediatricians and the Federal Ministry of Health have advocated for needed changes, but much more remains to be done. We applaud Sudan's efforts and encourage the country and partners to further increase the focus on primary healthcare and equitable access, particularly for children living in conflict.



Key Findings: **Protect**

Breastfeeding is an important and inexpensive strategy for protecting children from pneumonia and diarrhea, particularly exclusive breastfeeding for a child's first six months of life. Despite indisputable evidence on the benefits of breastfeeding, only 40% of children worldwide are exclusively breastfed during their first six months.²⁷

Global rates of exclusive breastfeeding during the first six months of life remain low. Currently, five of the 15 countries with the most child pneumonia and diarrhea deaths have exclusive breastfeeding rates that exceed the 50% GAPPD target for this protective intervention.

GAPPD set a 50% coverage target for exclusive breastfeeding for the first six months of an infant's life.⁴ Nevertheless, in most countries with a large burden of disease from childhood pneumonia and diarrhea, coverage levels for exclusive breastfeeding for the first six months fall short of the GAPPD target (Fig. 10).

Exclusive Breastfeeding

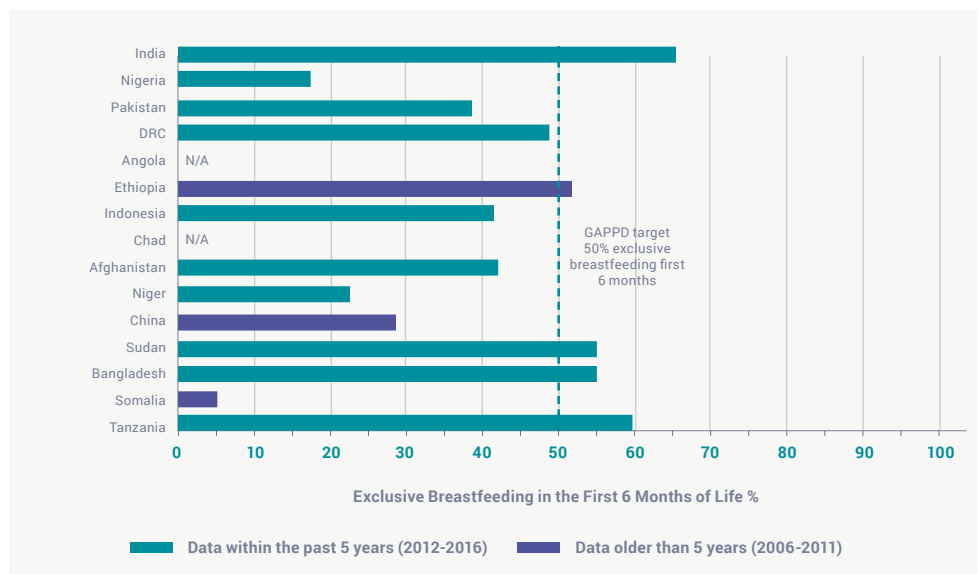
Exclusive breastfeeding data for 11 of the 15 countries profiled in here is drawn from reports dating from 2012 or later. Exclusive breastfeeding coverage for Ethiopia, China, and Somalia is derived from older reports, dated between 2008-11.²⁷ Angola has not reported exclusive breastfeeding rates within the past 10 years. First six months exclusive breastfeeding rates varied widely, from a high of 65% in India to lows reported to be 0% in Chad and 5% in Somalia. Mothers often breastfeed their children, but in many countries they may provide complimentary feeding leading to very low reported exclusive breastfeeding rates. Five countries, India, Ethiopia, Sudan, Bangladesh, and Tanzania, have exclusive breastfeeding rates that exceed the GAPPD target, an increase of two countries over 2015. Additionally, three countries (DRC, Indonesia, and Afghanistan) have rates over 40%. In the remaining six countries, Nigeria, Pakistan, Chad, Niger, China, and Somalia, the rates are reported as ranging between 0% and 38% (Fig. 10).

and Somalia, the rates are reported as ranging between 0% and 38% (Fig. 10).

Universal, exclusive breastfeeding for the first six months of life could annually avert the deaths of an estimated 823,000 children younger than 5 years and 20,000 maternal deaths from breast cancer.²⁸ Breastfeeding has been shown to have protective effect against breast cancer.²⁸ There is strong evidence, most of it from studies performed in LMIC, demonstrating that about

half of all diarrhea episodes and about a third of respiratory infections could be averted by breastfeeding.²⁸ Breastfeeding has the potential to be one of the top interventions for reducing under-5 mortality; increasing exclusive breastfeeding should be a top priority in global health.²⁸ The protection, promotion, and support of breastfeeding is essential to reducing overall under-5 mortality in general, and the global burden of pneumonia and diarrhea deaths in children under 5.

Figure 10: Levels of exclusive breastfeeding of infants in their first 6 months of life in the 15 countries with the greatest burden of child pneumonia and diarrhea deaths, 2006-2015



Source: UNICEF. Infant and Young Child Feeding (IYCF) (Data File). Last updated July 2016. Retrieved from <http://www.data.unicef.org/nutrition/iycf.html>



Key Findings: **Treat**

As important as protection and prevention are for tackling pneumonia and diarrhea mortality in children, access to appropriate treatment for children who do become sick is crucial for reducing mortality and the health, economic, and social burden of hospitalization.

Of the 10 GAPPD interventions evaluated in this report, pneumonia and diarrhea treatment tend to have the lowest coverage rates, with some countries not reporting any data at all, creating substantial blind spots on progress and program performance.

Although, optimal implementation of strategies for protection and prevention of pneumonia and diarrhea mortality in children is important, access to appropriate treatment for children who do become sick with these illnesses is crucial in reducing mortality and the health, economic and social burden caused by these diseases. Of the 10 GAPPD interventions evaluated in this report, pneumonia treatment (e.g. antibiotics, oxygen therapy) and diarrhea treatment (ORS, zinc) generally have the lowest coverage rates. Functional Health systems with skilled and motivated health care workers with

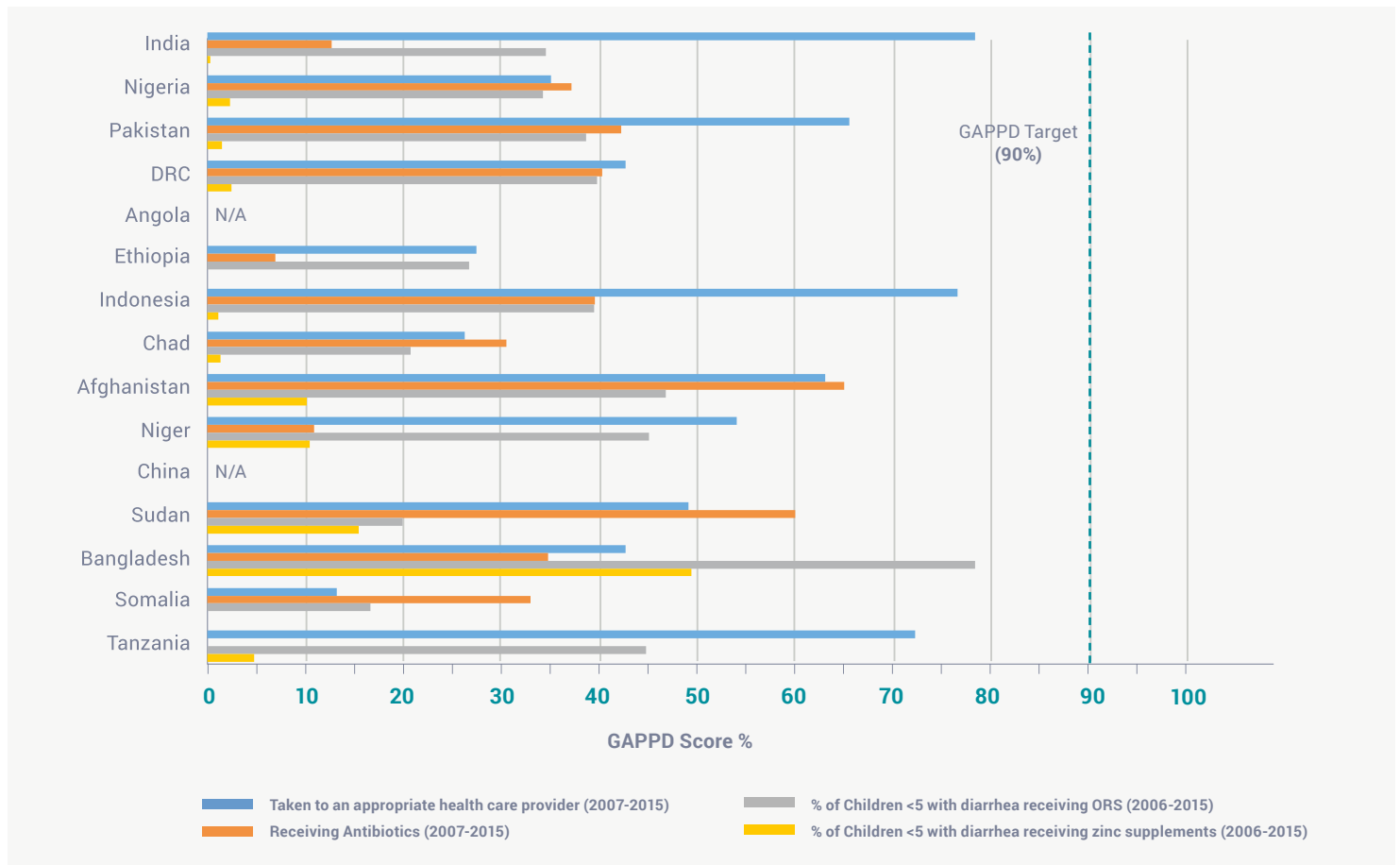
necessary infrastructure, drugs, and equipment, as well as equitable access to care for all children are essential elements that are necessary to provide optimal treatment with high coverage. For some countries, data is over 10 years old or not available, creating substantial blind spots on progress and program performance. Angola and China do not have national data available for any of the four pneumonia and diarrhea treatments included in the GAPPD scores. Tanzania does not report figures for antibiotic use in children with suspected pneumonia. Most of the treatment coverage data is derived

from country reports dated 2010 or later, with the exception of Somalia (2006) and India (2007-8), where data for the country as a whole is limited.

Pneumonia Treatment: Care by Appropriate Health Care Provider and Antibiotics

Proper care for children with suspected pneumonia includes two interventions—assessment by an appropriate health care provider (with appropriate and early

Figure 11: Proportion of children under 5 with suspected pneumonia and diarrhea who receive appropriate treatment*



* Year of data collected varies by country ranging from 2006-2015.

diagnosis) and antibiotic treatment for those suspected of having pneumonia. Based on the most recently available data (between 2006 and 2015), rates of treatment by an appropriate health care provider for children with suspected pneumonia did not exceed 77% for any of the 15 highest burden countries and were as low as 13%. The leading countries for appropriate care seeking for pneumonia are India, Indonesia, and Tanzania, all of which have coverage rates exceeding 70%. In contrast, in Somalia, Chad, and Ethiopia, less than 30% of children with suspected pneumonia were taken to an appropriate health care provider. Antibiotic use in children with suspected pneumonia was highest in Afghanistan (64%) and Sudan (59%), with most countries clustered between 30 to 40% coverage. Three countries had exceptionally low reported antibiotic coverage rates, with India, Ethiopia, and Niger all falling below 15%. Many of you will note the apparent contradiction in coverage of the two indicators for pneumonia treatment from India. With high reported appropriate care seeking practices (77%), but low reported rates of antibiotic treatment (12.5%), it is unclear whether this reflects data quality issues, or reflects issues with treatment practice quality by healthcare providers. Moreover, it is well recognized and documented that antibiotic overuse is prevalent in many parts of India, threatening the future effectiveness of first line antibiotics for pneumonia management. In spite of these data issues, which make it difficult to have a clear understanding of the state of pneumonia treatment in India, it remains clear that particularly in areas where the disease burden is greatest, children often do not receive the appropriate antibiotic. Antibiotic use data for India is 10 years old; we expect antibiotic use and misuse in India has changed substantially since collection of this data in 2006. For both of the pneumonia treatment indicators, the 90% GAPPD coverage

target was missed in all 15 countries (Fig. 11). In India, Pakistan, Ethiopia, Indonesia, and Niger, rates of treatment by an appropriate health care provider were notably higher than were rates of antibiotic treatment for children who were suspected of having pneumonia, possibly indicating that antibiotics may not be accessible or that WHO pneumonia treatment guidelines are not followed in these countries.

Additionally, sources of data available for the antibiotic treatment indicator may not always provide a reliable picture of usage.²⁹ The majority of countries for which data was available had about equal coverage rates for pneumonia care-seeking and antibiotic use for suspected pneumonia. This group includes Nigeria, DRC, Chad, Afghanistan, Bangladesh, and Sudan.

Even though effective treatments against pneumonia are available, diagnosis of pneumonia in low-resource settings is often reliant on non-specific clinical guidelines for diagnosis, which can result in incorrect diagnosis, inappropriate disease management (leading to over use or under use of antibiotics), and suboptimal outcomes. In the absence of adequate health infrastructures or technologies that enable proper assessments of the child's condition, health workers in weak, understaffed health systems in developing countries may miss some cases and over diagnose others. Strengthening district and community level training and supervision of health workers, and the development of patient centered and guideline compliant diagnostic decision support tools will improve pneumonia diagnosis and treatment.³⁰

It is also critical that caregivers of ill children recognize the signs and symptoms of a possible pneumonia infection, and are knowledgeable about

For both of the pneumonia treatment indicators, the 90% GAPPD coverage target was missed in all 15 countries (Fig. 11).

the proper course of action, namely, to seek care from an appropriate healthcare provider. Demand for care can be improved by community education on pneumonia prevention and symptom recognition.³⁰ Improving access to care in a timely manner will accelerate the reduction in pneumonia mortality in children under-5. Other factors that play a role in care-seeking behavior when a child is suspected to have pneumonia include differential access to care due to wealth disparities and isolated geographic location and availability of transportation. Therefore all efforts to make appropriate care widely accessible with little to no cost to the family is an essential strategy for assuring that treatment is received by all children who need it.



Pneumonia: Closing the Treatment Gap

Interview with Dr. Keith Klugman,
Gates Foundation

Addressing Access to Appropriate Antibiotics
and Correcting Underlying Malnutrition

As Director for Pneumonia at the Bill & Melinda Gates Foundation, Keith Klugman, MD, PhD, leads efforts to improve the development and delivery of pneumonia vaccines and expand the use of diagnostic tools and antibiotic treatments. In addition, Klugman is a leading expert on antimicrobial resistance (AMR) in pneumonia pathogens. His work has contributed to the development of pneumococcal conjugate vaccines that are now part of the routine immunization schedule for children in countries around the world.

Q: How are we doing in the fight against pneumonia?

A: Pneumonia is a major contributor to mortality in children, particularly in parts of the world with high infant mortality rates. The fraction of infant mortality that is attributable to pneumonia increases with increasing child mortality. For instance, in parts of the world like the United States where infant mortality is low, pneumonia is a very small part of that low mortality. Whereas in parts of rural Africa and Asia where infant mortality is high, pneumonia is still a very large cause of infant mortality. The good news: infant mortality has been reduced by 50% over the last 15 years and there has been an even greater reduction in pneumonia mortality. Certain countries, for example China, Bangladesh, and Ethiopia, have seen dramatic reductions in both infant mortality and pneumonia mortality. However, we have to be cautious. There are some countries, such as Nigeria and Angola, where there has been little change in these areas. The scorecard is mixed.

Q: What are the major hurdles in treating child pneumonia? How have these changed over the last decade?

A: There are at least two aspects to immediately highlight: the drug that is chosen, and access to the drug, which is largely an economic issue. The drug of choice for treating pneumonia was changed by WHO over a decade ago, from cotrimoxazole, to which there is broad resistance, to amoxicillin. In some countries, this switch has not been made yet. There has been progress over the last decade, but one of the challenges is ensuring that amoxicillin dispersible tablets (amoxicillin DT), which dissolve in water, is widely available in all countries.

Access to antibiotics is a key issue; it has been a strong predictor of reduction in pneumonia mortality and may have influenced the reduction in pneumonia mortality in places including China and India.

But in many of the poorest parts of the world, the key hurdle may be access to antibiotics by the poorest of the poor women. I believe this is where countries like Nigeria are failing. Even if antibiotics are available at remote sites, there remains an economic barrier for the very poor to travel there and pay for them.

If we believe that getting mothers access to cash is a critical determinant of infant mortality, then an approach focused on financial services for the poor may be an important lever to reducing pneumonia mortality. We have a group at the Gates Foundation that focuses on this; their innovation is direct transfer of funds from governments to the poorest women in the community, with the idea that mothers may be able to protect their infants from pneumonia mortality if they received small amounts of money to pay for care.

Q: Antimicrobial Resistance (AMR) is a high-profile public health issue, which intersects with child pneumonia treatment. Are you observing an increase in resistance in low-income settings?

A: Here we have good news. The resistance that we have observed to amoxicillin so far in low-resource settings is a low or intermediate resistance, which can be overcome by the existing recommended treatment guidelines for amoxicillin dosage. High dose oral amoxicillin DT therapy remains the drug of choice to treat outpatient community-acquired pneumonia.

So far, our observations are that the high-level amoxicillin-resistant strains, against which amoxicillin would not be expected to work, are rare. It is possible that the organism plays a biologic price for high-level resistance; they seem to be less virulent. Although there is increasing concern about AMR in Gram negative pathogens, which are a major cause of neonatal sepsis, they are not—we believe at the moment—a major cause of pneumonia in older infants.

Q: What role does innovation play in fighting pneumonia?

A: There is always scope for innovation in the fight against this major killer of children. Here we have significant resource problems. The resources which are available for innovation in the pneumonia space are far less than for other major infectious killers such as HIV, TB, and malaria.

On the treatment side, we need to examine the major risk factor of pneumonia mortality: under-nutrition. The outcome of malnourished children treated for pneumonia is much worse than for well-nourished children. We need more insight into how to improve the outcomes of malnourished kids with pneumonia.

A further area that needs innovation is the provision of oxygen. Oxygen can be lifesaving, but there are major barriers to provision of oxygen, largely around a constant source of electricity. Without a reliable electricity source, you cannot get a reliable supply of oxygen. There are innovations in batteries or ideas for oxygen storage that could transform the availability of oxygen for kids with pneumonia.

Q: How will efforts to combat pneumonia evolve over the next decade?

A: One thing which I find quite exciting on the horizon for pneumonia advocacy is the recent statement by the World Bank about the importance of child health to development. There is a great opportunity for advocacy to frame reducing the burden of disease in children as a strategy for development.

In pneumonia treatment, we see an evolution to concentrate on mortality at the extremes of the access to care. In remote rural areas we are looking forward to innovative ideas being implemented around antibiotic access, including financial services for the poorest.

While we anticipate many more children getting access to care, hospital care remains very poor in many countries. So at the other extreme of the provision of care, we hope to see (1) greatly improved treatment of at-risk malnourished children in health facilities, (2) strategies to measure the need for oxygen in at-risk children, and (3) innovative ways to provide that oxygen.

We still have a long way to go, but I think there is ground for optimism in the fight against pneumonia.

Keith Klugman, MD, PhD has chaired or served on numerous expert committees for WHO and the CDC, among other U.S. and international organizations, and has published more than 550 scientific papers on the subjects of pneumonia, meningitis, antimicrobial resistance, and vaccines for bacterial pathogens, which have been cited more than 25,000 times to date.

Amoxicillin Dispersible Tablets: Addressing Local Barriers to Scale-up



Amoxicillin is a highly effective antibiotic that has been shown to reduce deaths from pneumonia by 70% when provided with appropriate case management.³¹ Amoxicillin, a formulation of amoxicillin that dissolves in as little as a tablespoon of water, is half the cost of oral suspension and is easier to transport and store, making it easier to use by caregivers and community health workers.³² Amoxicillin DT is recommended by WHO as first-line treatment for pneumonia in children under the age of five.³³

Many countries have updated national pneumonia treatment guidelines to reflect the WHO's recommendation. Strong coordination between the government and key stakeholders—including professional associations, regulatory agencies, local non-governmental organizations, and clinicians—on the rationale for and importance of the treatment guideline changes often expedited the process. Of 10 high-burden countries that account for 60% of global pneumonia deaths, nine have included amoxicillin DT as first-line treatment in their national guidelines and in National Essential Medicines Lists.**

Still, too few children with suspected pneumonia receive an antibiotic in developing countries. Although securing favorable policy changes at the national level is critical, it is not enough to ensure widespread access to the essential medicine. Policy makers in many

countries share concerns about the risk of antimicrobial resistance. Many mothers fail to recognize the symptoms of pneumonia and seek prompt care—just three in five children with symptoms of acute respiratory infection are taken to an appropriate provider.³⁴ Many countries do not have the appropriate policies and guidelines that allow community health workers to manage pneumonia. Furthermore, these providers are often unaware of the benefits of amoxicillin DT because they have not been trained on the latest WHO guidelines and instead continue to prescribe less effective antibiotics. Providers on the frontline also lack simple, easy-to-use diagnostic tools needed to quickly diagnose and treat simple cases, or to refer more severe cases to higher-level facilities. The availability of amoxicillin DT is also low due to limited investments in marketing and distribution from local manufacturers and inadequate procurement and forecasting in the public sector.

Achieving significant increases in access to and use of amoxicillin DT requires greater attention to tackling these local barriers. Adopting simple innovations can further accelerate this progress. Amoxicillin DT itself, represents an edge over suboptimal alternatives. It is superior in efficacy to cotrimoxazole and diminishes the risk of antibiotic resistance due to better adherence to simplified treatment.³⁵

Current activities to increase access to and use of amoxicillin DT have focused on addressing global-level barriers. Amoxicillin DT is now available from six quality-assured manufacturers (approved by WHO's Expert Review Panel). Global partners have also introduced new resources to facilitate country efforts. PATH, Management Sciences for Health, UNICEF, and Anthrologica are generating evidence from several countries in Asia and sub-Saharan Africa on new job aids and user-friendly product presentations that can potentially help improve adherence to amoxicillin DT among providers and mothers. State-of-the-art communication tools designed by partner organizations help educate providers about the benefits of amoxicillin DT and give mothers the information they need to ensure their children receive appropriate care. Tools are free of charge and are customizable into different languages.

However, more investments are needed to drive large-scale increases to amoxicillin DT and should focus on addressing the local barriers to access and convincing policy makers and other key stakeholders about the life-saving benefits of amoxicillin DT. "Amoxicillin dispersible tablet is a critical part of an integrated package of interventions. We must do more to make this life-saving solution widely accessible and available where and when needed," Mark Young, Senior Health Specialist, Programme Division, UNICEF New York.

** The nine countries include Bangladesh, India, Pakistan, DRC, Ethiopia, Kenya, Niger, Nigeria, and Tanzania. Based on latest available data as of September 2016 from WHO, UNICEF, and the Diarrhea & Pneumonia Working Group.

Innovations: Pulse Oximetry and Oxygen Therapy

Children die from pneumonia commonly because their lungs are unable to perform their main job—delivering enough oxygen to the other organs of their body. Without a way to test children for the amount of oxygen in their blood, health care workers do not know which children need treatment with oxygen and, even if they did, oxygen is often not available.

Pulse oximeters are noninvasive devices that a trained health worker uses to measure the oxygen level in the blood. The measurements are made without

drawing blood from the child. Instead a probe is placed on a child's finger or toe, or in some small babies on the ear lobe. Normal pulse oximeter levels should be 96% or higher. A reading below 90% indicates hypoxemia—a condition in which there is a deficiency of oxygen in the blood associated with severe pneumonia. Administering oxygen can bring the level up to normal ranges and help to stabilize the infant, as antibiotics and other supportive treatment are administered.



Improving Pneumonia Management and Pulse Oximetry

Interview with Dr. Kim Mulholland, London, UK and Melbourne, AU

Successful Use of Pulse Oximetry Can Lead to Providing Lifesaving Therapies, Like Oxygen.

Pulse oximeters, a small device that can measure the amount of oxygen in the blood without actually collecting any blood, have the potential to save many lives by identifying which children are seriously ill and in need of oxygen support. They aid in revealing hypoxemia, a crucial step in diagnosing severe pneumonia. But the technology is only useful if high-quality products are made available where most sick children seek care, and if health workers use them properly, explains pediatrician Kim Mulholland, MBBS, FRACP, MD, one of the original contributors to the development of the GAPPD. He has spent much of his distinguished career studying pneumonia management and prevention in low-income countries, particularly Sudan, Gambia, Fiji, Mongolia, and Vietnam.

Q: When it comes to pneumonia management, where is the gap?

A: My main concern is that in most developing countries, the district hospitals, where most children with pneumonia are managed, do not get the resources they need. They do not get adequate attention from the government resources, which tend to focus on supporting the teaching hospitals.

Q: How has the availability and quality of pulse oximetry changed over time?

A: In the last 10 years, pulse oximetry technology has improved and is more affordable. But the quality of pulse oximeters varies from brand to

brand. For example, when I first started a pneumonia program in East Asia, I held training groups with doctors and most of them had a pulse oximeter in their pocket. But many of those being used were cheap and not well functioning. When I visited a few sick kids with some of the doctors, I came to the conclusion that their instruments were not working accurately.

LifeBox® is a charity in the United Kingdom set up by the World Federation of Societies of Anesthesiologists. They are providing pulse oximeter sets for USD \$250/unit to low-resource settings. The product has been tested extensively and it's one of the most accurate. The LifeBox® also includes appropriate size probes for infants. This is a big step forward because it's emphasizing the need for quality.

Q: How can appropriate use of pulse oximeters be improved?

A: Thorough training for health workers is necessary. There are times when the health worker puts the probe on the child's finger when the child is screaming and wiggling. Maybe they get a bit of a signal on the monitor, 89% flashes a couple of times, and the health worker takes the probe off the child. Then they record the reading as 89%. Now that's an inaccurate reading.

Doing pulse oximetry on a very sick child is not trivial. It has to be done properly. You have to have a continuous signal, and you have to have a proper pulse picked up by the probe and appear on the monitor, before you can consider the pulse oximeter is providing an accurate reading of the oxygen in the blood.

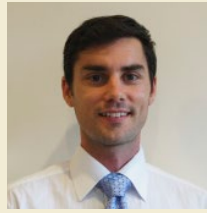
Q: How can these lessons learned be applied to other pneumonia strategies?

A: Many of the challenges with pulse oximetry are shared by other simple, lifesaving tools and interventions, like vaccines, which may be much harder to put into practice in low-income settings. Continued work on access, quality and training will bridge the gap between strategies that we know work and putting them in action.

KIM MULHOLLAND, MBBS, FRACP, MD, is a professor of child health and vaccinology at the London School of Hygiene and Tropical Medicine. Mulholland also holds professorial posts at Murdoch Children's Research Institute in Melbourne and the Menzies School of Health Research in Darwin. In 2016, he published the first edition of the textbook, Pneumonia in Children: Epidemiology, Prevention and Treatment.



Dr. Trevor Duke



Dr. Hamish Graham

Oxygen Therapy: Adapting Old Tools in New Ways

Interview with Drs. Trevor Duke and Hamish Graham, Melbourne, AU

Oxygen Therapy is Lifesaving, But Reaching Children in Low-Resource Settings Takes More than New Technology

For decades, tools have existed to diagnose and treat hypoxemia, the dangerously low blood oxygen levels that can occur with severe pneumonia. But what will it take for these technologies to fulfill their potential to save children's lives everywhere?

The answer: Context is everything, according to Trevor Duke, MD, and Hamish Graham, MBBS, MPH, from the Royal Children's Hospital in Melbourne, Australia. With funding from the Gates Foundation, they have been testing a strategy to improve the delivery and sustainability of pulse oximetry and oxygen therapy in high-burden, low-resource settings, namely Nigeria and Papua New Guinea (PNG). To them, not only is it about having the right technology, but it is also about strengthening the surrounding health system to optimize its use. Integration is where real innovation begins.

Q: How common is hypoxemia (low blood oxygen) and is oxygen readily available if detected?

A: Duke: On average, 13% of all children who present to a hospital with pneumonia have hypoxemia. But the rates vary from 5% up to 40% in some places.

Health workers find it hard sometimes to detect hypoxemia. Sometimes if a child is hypoxemic, they have blue lips or gums. This can be really hard to see in children with dark skin. A pulse oximeter, a simple monitor that can be placed on the child's toe or finger to measure oxygen levels in the blood through the skin, is a more accurate way of detecting hypoxemia. It is important to teach health workers how to use a pulse oximeter, and then without much effort, they can identify a potentially deadly situation.

Oxygen is not available everywhere. Where it does reach children, it has mostly been supplied in cylinders that are filled with gaseous oxygen. These cylinders can run out in just over two days for a child with severe pneumonia, and replacements are not always available. The cylinders are heavy and cost a lot of money to transport. If a child has very severe pneumonia, they may be hypoxemic for much longer than two days, making adequate access to oxygen a concern.

Q: How can we increase access to oxygen and improve treatment?

A: Duke: By using oxygen concentrators. Cylinders are an exhaustible source of oxygen, while oxygen concentrators are not. An oxygen concentrator makes oxygen by extracting it from atmospheric air, which

is 21% oxygen and 79% nitrogen. A concentrator removes the nitrogen and concentrates up the oxygen to around 90%. If there is adequate power and a concentrator is well maintained, it can just keep making oxygen out of the air.

Concentrators have been around for a long time. They have mostly been made for people who have chronic lung disease in western countries. We thought they would be useful for small hospitals in low-income countries where it is really hard to afford and deliver oxygen cylinders.

A: Graham: We are hoping to demonstrate what needs to be put in place for concentrators to work and be sustainable—and for health care workers to use it effectively. Some of this includes:

- An oxygen source: concentrator or cylinder. If it's a concentrator, a reliable power source.
- Tools to help health care workers recognize when a child needs oxygen, and administer it appropriately (e.g., pulse oximeters, clinical guidelines).
- Skilled health care workers who are motivated to use oxygen therapy effectively, and a work environment that makes it easy.
- Skilled technicians, with maintenance facilities, tools and structures to keep the equipment functioning well.
- Financing mechanisms, so that oxygen is affordable to patients and sustainable for the health system.

Many of these things are also important not only for delivering oxygen, but also for many other aspects of care. We hope that by addressing the 'oxygen problem,' hospitals and health departments can begin to build stronger health care systems that impact health much more broadly.

Q: What does it take for oxygen concentrators to work well in low resource settings?

A: Graham: Since the 1990s, researchers and implementers have given increasing attention to the practical steps needed to improve oxygen systems and achieve real clinical benefits. So we have seen projects that have brought together technology with other aspects, like training and supervision, to actually to see how it is used and what effect it has on clinical outcomes.

The first study that showed the effectiveness of improving oxygen systems is one from PNG. This study ran from 2001 and 2007, and included more than 11,000 children. It showed a 35% reduction in the case fatality rate for hospitalized children under 5 years of age with pneumonia, following the introduction of oxygen concentrators and hospital system improvements.³⁶ This was in five hospitals where it was relatively easy to do it; for example, they had power.

Q: What is the main challenge with using oxygen concentrators in low resource settings?

A: Duke: You need power and many places have either irregular power, with surges that can damage equipment, or the health facility has no power at all. In such settings an alternative source of power is needed. Our current work across many hospitals in Nigeria and PNG is investigating how solar power can get oxygen into places that may have never had it before, and even improve the functioning of the rural health facilities.

Solar power is expensive to install, but solar panels have a life of up to 25 years, so it is a long-term investment for a health service. There are many low-income countries where solar power is being used for lots of industrial and domestic reasons. Because tropical environments usually have many hours of sunlight, it is possible to have sustainable solar power.

Using solar power should not just be about the provision of oxygen, but about improving health system functioning. We should look for the wider benefits such as powering a vaccine refrigerator, a light in the delivery room, a suction machine, and to charge the health workers mobile phone so they can call and refer patients on. Many of the essential day-to-day functions of a health system can benefit from that solar power.

Q: How do costs compare between cylinders and concentrators?

A: Duke: It has been shown many times that it is much cheaper to use concentrators than to use cylinders, and if maintained well they can be more reliable. You can get a good concentrator for USD \$600 that can last 5 years, if it is looked after well. So that is cheap. Solar panels are going to last longer than the concentrator, 20-25 years, but are expensive and may cost \$20,000. Batteries, accounting for about half of the cost of the system, are necessary when there is no sunlight and they do not last as long as the panels.

Q: Can this become affordable in low resource settings?

A: Graham: The cost was something we had clearly foreseen, as it is always a huge challenge for hospitals and health departments. In places like Nigeria, where it's a user-pay system, oxygen is also extremely expensive to patients. So one of the elements of our work in Nigeria is helping the hospitals develop financing mechanisms that will make it financially sustainable for hospitals to keep doing it—but also affordable for patients. Fortunately, concentrator-based systems are generally significantly less expensive than cylinder systems. So it really is feasible for hospitals to provide oxygen to patients affordably, typically less than \$3 USD per patient.

Q: What are next steps to scaling-up this intervention?

A: Graham: Oxygen therapy itself is a simple, lifesaving therapy. But actually making it available for children is a whole lot more complicated. We cannot say there is a five-step package that can be taken anywhere and applied. But hopefully the work in Nigeria and PNG will give us a much better understanding of how oxygen systems work in different contexts, and enable state governments and hospital boards to say, "Alright, this is what we need to do in our situation; in our context."

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Country in Action: **Ethiopia**



United for Oxygen: A First-of-its-Kind Partnership to Expand Access to Oxygen for Women and Children



In Ethiopia, where pneumonia is the leading cause of child mortality, a new public-private partnership has launched to scale-up access to pulse oximetry and oxygen therapy in health centers and hospitals across the country. United for Oxygen is a first-of-its-kind effort by a consortium of government, industry, foundation, and civil society organizations to tackle the issue of lack of access to oxygen. This initiative will support the Government of Ethiopia's Medical Oxygen and Pulse Oximetry Scale Up Road Map, with a special focus on reducing deaths among children under-5 and pregnant women.

Improved access to oxygen has the potential to reduce the estimated 30,000 children under-5 who die due to acute respiratory infection each year in Ethiopia.¹ Babies who are born preterm, or who develop sepsis or pneumonia early in life, are particularly vulnerable to death from these causes, as are women and children in remote communities with little or no access to health services.

The Ethiopian Government has described the oxygen access agenda as central to their 2015-2020 Health Sector Transformation Plan and to their 2015-2020 National Newborn and Child Survival Strategy. Increasing access to oxygen is also critical to the achievement of the new SDGs relating to health and to the implementation of the new Global Strategy for Women's, Children's, and Adolescents' Health.

There is much work ahead. A recent survey of 314 health centers and 110 hospitals in Ethiopia revealed that only 11% of health centers and 45% of hospital pediatric wards provide oxygen, with less than 14% of staff trained to operate the oxygen delivery technology.

The commitment will support the Government of Ethiopia's Medical Oxygen and Pulse Oximetry Scale Up Road Map by: (a) increasing the availability of pulse oximetry screening and oxygen therapy technologies in specific health centers and hospitals, (b) training local staff in the use of the new technologies,

(c) establishing sustainable financing solutions for the procurement, installation and maintenance of the new equipment, and (d) adding pulse oximetry and oxygen access in the policies and guidelines of the Ethiopian health authorities and of the major international development agencies. United for Oxygen partners will provide financial support to carry out these activities in Ethiopia.

Following the successful implementation of the Ethiopian Government's plan, post 2017, the United for Oxygen partners will promote and seek to extend this oxygen access model to other countries with high levels of maternal, newborn, and child deaths throughout South Asia and Sub-Saharan Africa.

More information on this initiative and partner organizations can be found at: <https://www.clintonfoundation.org/clinton-global-initiative/commitments/united-oxygen-oxygen-pulse-oximetry-ethiopia>



Diarrhea Treatment: ORS and Zinc

The WHO recommended treatment for children with diarrhea includes the use of ORS and zinc supplements. In this report, coverage rates for diarrhea treatment are measured by the percentage of under-5 children with diarrhea who are given ORS and the percentage of under-5 children who are given zinc supplements in addition to ORS for a 10 to 14 day period. The year of most recently available data reported for these two indicators are within the past 10 years, with most data from the recent past. Country reports range from 2011 to 2015, with the exception of Somalia (2006) and India (2007-8). In the absence of zinc coverage data for Angola, Ethiopia, China, and Somalia, we assumed that for this particular intervention, if it is not measured, it is likely to be used at very low levels, if at all. When zinc coverage data is not available, we calculated the GAPPD scores using a zero value for zinc.

Despite existing zinc policies in all 15 countries, of the 13 reporting countries, all failed to reach the 90% GAPPD coverage target for diarrhea treatment.

Bangladesh came closest to this target with 77% ORS coverage and 49% zinc coverage. Bangladesh is considered a country with sustained success in diarrhea treatment (see the following case study on Bangladesh). ORS coverage in countries other than Bangladesh ranged from 16% to 46%, with coverage in the three countries of Chad, Sudan, and Somalia reported to be 20% or less. One of the disparities by household wealth reported by UNICEF is

the ORS treatment coverage ratio of the richest 20% of households to the poorest 20% of households. A ratio of 1.0 indicates no disparity across wealth strata in the proportion using the intervention. It is encouraging to note that equitable access to ORS, independent of income level, has been reported in seven of the 13 countries described in this report; Pakistan, DRC, Indonesia, Afghanistan, Sudan, Bangladesh, and Tanzania. The remaining six countries do have disparity in access to ORS treatment, with ratios ranging from a high of 4.8 in Somalia and 4.7 in Nigeria, to 2.3 in Niger and India.³⁷⁻⁴⁰

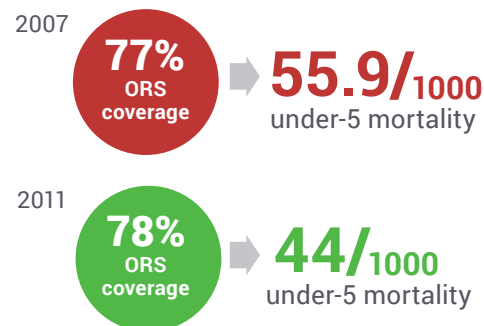
Zinc coverage rates in countries other than Bangladesh is very low, ranging from 15.2% to 0.3%, with most countries reporting single digit coverage. ORS and zinc supplements are low cost and highly effective, life-saving interventions. Zinc, used in combination with ORS, has been shown to reduce the severity and duration of diarrhea.⁴¹ Despite its proven effectiveness and a cost of pennies per dose, achieving high zinc coverage appears to be an almost universal challenge for countries with a high burden of pneumonia and diarrhea mortality.

Bangladesh: Case Study of Innovation in Addressing the Treatment and Prevention of Diarrheal Disease

How is it possible for Bangladesh to substantially reduce diarrheal deaths without changing ORS coverage? ORS, an effective treatment that helps prevent most childhood deaths from diarrhea, has been called by a leading medical journal the “most important medical advance of the century.”^{42,43} On first glance at the national ORS coverage data in Bangladesh between 2007 to 2011, the change in population coverage appears stable, even stagnant. The casual observer, noting just a 1% increase in coverage from 77% to 78% over that period, might assume a shift away from the country’s initial disease treatment and prevention efforts. An observer who looks more deeply into the data will indeed notice a shift—but a shift of intensified, rather than diluted, effort. That 1% increase in

coverage occurred during a time period when the country was making precisely targeted investments in distributing ORS to the poorest communities, with the highest burden of diarrheal disease and the worst economic and health outcomes. UNICEF data for the period between 2008-2012 shows that the poorest 20% of children in Bangladesh had the same access to ORS treatment as the richest 20% of children (81.2 versus 82.3, for a ratio of 1.0).⁴⁴

In fact, Bangladesh made impressive decreases in under-5 death rate from 55.9 to 44.0 per 1000 live births over this period, meeting the MDG 4 target.^{45,46} International donor organizations and national officials of health and finance ministries have asked how they might replicate this effect.



The effect is not tied to one policy; most people attribute it to the country’s comprehensive, pro-poor strategy for the prevention of diarrheal deaths using both health and economic development approaches, such as those used by the Bangladesh Rural Advancement Committee, a global development and microfinance non-governmental organization working to empower poor communities with a focus on Bangladesh.⁴⁷ Innovation can be defined as doing the thing that was so simple or obvious that nobody thought to do it. This example illustrates an innovation in service delivery.

The success of this case example lies in the innovative incorporation of an equity approach into a comprehensive multi-sector disease prevention strategy. By following a strategy focused on providing coverage to the most vulnerable first, Bangladesh has held steady in ORS coverage and shown continued decreases in under-5 mortality rate, with the most recent rate at 37.6 deaths per 1000 live births, with 2 per 1000 live births attributed to diarrhea.^{2,45}

Future Perspectives on Achieving the GAPPD Goals

Children represent the future of every nation, and it is every nation's responsibility to ensure their health, growth, and development. We call on all countries to protect their children's health and well-being through action and innovation to accelerate progress in combatting pneumonia and diarrhea.

Although significant success has occurred in the last nearly two decades to reduce the number of young children who die each year of common preventable and treatable infectious diseases, the rate of progress has been decreasing. Over the past 16 years, the number of children with access to simple and inexpensive interventions has increased. Some countries, such as Tanzania and Sudan have made remarkable gains in adopting the interventions recommended by the GAPPD. Bangladesh and Ethiopia have put concerted efforts forward as well to make improvements in equity. Others, such as Somalia and Chad, have made little progress. Nigeria, a country plagued by inequity and political strife, has also struggled. Some of the largest countries, India and China, despite improvements in rates of childhood mortality, will need to accelerate the pace of intervention rollouts as well as improve coverage rates to move out of the middle of the pack where GAPPD scores hover around 40-50%, far below the 86% target. Progress is much too slow. As the global community continues to set ambitious goals, we need to make sure that efforts are increased to achieve the existing goals, as well as future targets set at the country and subnational levels. This is the only way that global targets will be met. *The 2016 Pneumonia and Diarrhea Progress Report: Reaching Goals Through Action and Innovation* shows that even when countries have officially introduced nearly every GAPPD intervention, they repeatedly miss the target coverage rates. The time taken to scale-up and reach all those who need these interventions is repeatedly taking years, if not decades.

Not only is it essential for each country to adopt new vaccines, increase immunization coverage, and improve access to treatments, each country needs to look for new ways to reach the targets outlined. Innovation does not always mean new technology but also includes successfully implementing exciting new approaches, including a dedicated emphasis on data to monitor programs, tailoring program modifications based on those data; mobile phone technologies to improve both reporting of supply status, coverage rates, and to build demand through reminders and messaging about the importance of vaccines; using drones to deliver products to places that could not be reached; and, the innovations presented in this report—use of pulse oximetry and oxygen in ways that enable use in low resource settings or doing something about the impact of smoking, a behavior typically thought of as solely an adult health issue.

However, innovation also means approaching old problems in new ways. Bangladesh is a great example of improving results by looking at the problem differently and focusing resources to address coverage in communities where it is needed most. Leveraging the resources of on-the-ground partners can make a difference and achieve results. As the SDGs focus on issues of poverty and equity, more deliberate investments, actions and use of quality data and monitoring are needed to ensure that issues of access are addressed in places where burden is highest, including areas of conflict.

Concerted efforts are needed to ensure there is sufficient supply of the appropriate treatments, including amoxicillin DT, in places where the need is greatest and that prevention remains a priority. Renewed focus on implementing policies for interventions that work is essential to ensure that these products are accessible and can be administered by trained local health workers.



One of the aims behind this Progress Report is to illustrate the power of the interventions in GAPPD while also spurring countries to identify specific actions that are required for progress. There is a clear need for figuring out exactly what 'something more' means, but there is no one perfect answer that will work in every country. The components of the answer are familiar to all. It is clear—keep implementing the existing programs, strengthen the existing health systems, and ramp up their scale and reach so that more children are receiving these highly protective, preventative, and treatment interventions. Key components to success include a focus on high quality data to drive corrective actions, as well as a commitment to innovation, greater political will, and collaboration among nations to significantly change the trajectory of progress in achieving child survival targets as agreed upon in the newly set SDGs.

As we enter into the SDG era, the global plan, supplemented by country ingenuity and will to implement, is critical. Some countries are on their way. Others will need to make a renewed effort to take a fresh approach and start achieving meaningful progress to impact the lives of children and the communities they live in.

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Acronyms & Abbreviations

Amoxicillin DT – Amoxicillin dispersible tablets
AMR – Antimicrobial resistance
CDC – Centers for Disease Control and Prevention
CHAI – Clinton Health Access Initiative
COPD – Chronic obstructive pulmonary disease
DRC – Democratic Republic of Congo
DTP3 – Diphtheria-tetanus-pertussis, 3rd dose
eLMIS – Electronic logistics management information system
GAPPD – Global Action Plan for the Prevention and Control of Pneumonia and Diarrhoea
Gates Foundation – The Bill & Melinda Gates Foundation
IDPs – Internally displaced persons
IVAC – International Vaccine Access Center
JHSPH – Johns Hopkins Bloomberg School of Public Health
JSI – JSI Research & Training Institute, Inc.
LMIC – Low- and middle-income countries
MDGs – Millennium Development Goals
ORS – Oral rehydration salts
PCV – Pneumococcal conjugate vaccine
PNG – Papua New Guinea
RMNCH – Reproductive, maternal, newborn and child health
RSV – Respiratory syncytial virus
SDGs – Sustainable Development Goals
VIMS – Vaccine information management system
WHO – World Health Organization
WUENIC – WHO/UNICEF Estimates of National Immunization Coverage

WHO Country Abbreviations

AFG – Afghanistan
AGO – Angola
BGD – Bangladesh
TCD – Chad
CHN – China
COD – Democratic Republic of Congo
ETH – Ethiopia
IND – India
IDN – Indonesia
NER – Niger
NIG – Nigeria
PAK – Pakistan
SOM – Somalia
SUD – Sudan
TZA – United Republic of Tanzania



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