The Critical Role of Pneumonia-Fighting Vaccines in an Era of Respiratory Pandemics

Photo: International Federation on Ageing

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This report was prepared for the Every Breath Counts Coalition, a public-private partnership including United Nations and multilateral agencies, companies, foundations, NGOs, and academic institutions united in their efforts to support low- and middle-income countries to reduce deaths from pneumonia. Learn more at ***https://stoppneumonia.org****.*

Pneumonia is the leading infectious cause of death in the world. Prior to the pandemic, pneumonia killed an estimated 2.5 million people. Three-quarters of deaths were among two vulnerable populations - children under five years of age (672,000) and adults over 70 (1.2 million).(1)

This means that even before COVID-19 every country was dealing with a pneumonia burden. In high-income countries pneumonia deaths concentrated among the elderly; in low-income countries it was children who bore the greatest burden; and in many middle-income countries there was a double-burden of pneumonia among both children and the elderly.

COVID-19 has increased the total burden of pneumonia deaths from 2.5 million in 2019 to an estimated 6 million in 2021. And this is an underestimate as it only includes reported COVID-19 deaths.(2) No other infection causes anywhere near this burden of death.

In an era where more respiratory pandemics are likely, pneumonia-fighting vaccines have become even more critical. Protecting everyone, everywhere with pneumonia vaccines, and especially the most vulnerable children and older adults in our communities, has become a critical global health goal in the 21st century.

1. Why vaccines that prevent pneumonia are so important...

The estimated 2.5 million deaths from pneumonia would be even higher without the pneumonia-fighting vaccines that have been developed, principally pneumococcal vaccines and the Haemophilus influenzae type b vaccine (Hib), which target the leading bacterial causes of pneumonia.

Vaccines against pertussis and measles are also critical pneumonia-fighting vaccines as both infections can cause pneumonia. The pertussis vaccine is typically given with the diptheria and tetanus vaccines (DTP) and measles is given as a standalone vaccine (MCV) or with mumps and rubella (MMR).

The expansion of this "basket" of pneumonia-fighting vaccines has contributed to the dramatic 57% decline in childhood pneumonia deaths since 2000, from an estimated 1.6 million to 672,000. Low- and middle-income countries (LMICs) have recorded the steepest declines.(3)

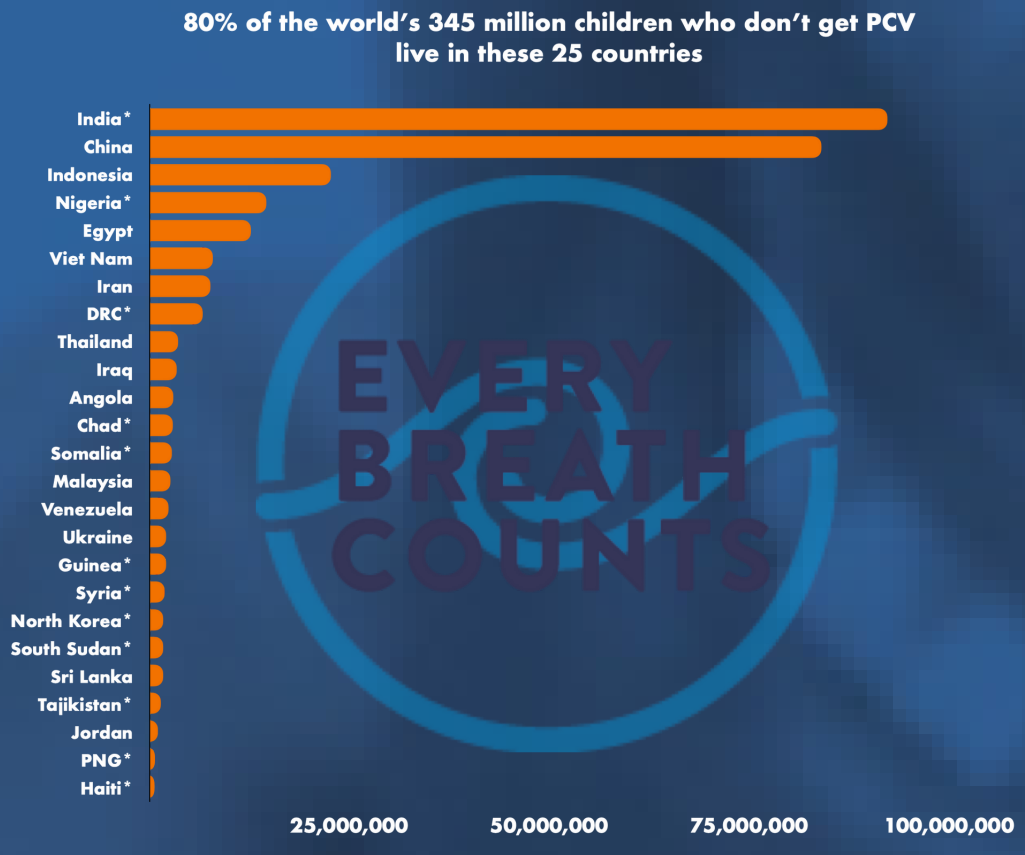
For example, after Kenya introduced the pneumococcal conjugate vaccine (PCV) in 2011, the annual incidence of severe pneumococcal disease dropped by 92% among children under five years, (4) and hospital admissions fell sharply.(5)

In contrast, pneumonia deaths among adults over 70 years have risen sharply in the last decade - from 794,000 to 1.2 million. This is despite the fact that some countries recommend pneumococcal vaccination for the elderly and that childhood PCV vaccination should also protect adult populations over time.(6)

The fact that pneumonia deaths among the elderly have risen so sharply is another indication that improved coverage with the pneumonia-fighting vaccines is urgently needed.

This is particularly true for pneumococcal vaccines which, despite recent progress,(7) still only reach 49% of the world's children and a tiny minority of the elderly.(8) The unvaccinated 51% or 345 million children under five who are still waiting for the PCV are concentrated in 25 countries (see chart below). (9)

17 of these governments do not yet offer PCV (China, Egypt, Viet Nam, Iran, Thailand, Chad, Somalia, Malaysia, Venezuela, Ukraine, Guinea, Syria, North Korea, South Sudan, Sri Lanka, Tajikistan, and Jordan), while the remaining eight have coverage rates below 60%.(10)



*eligible for Gavi support | Sources: UN World Population Prospects 2019, WHO/UNICEF 2020

Importantly, 12 of these no- and low-coverage PCV countries are eligible for support from Gavi, the Vaccine Alliance (Gavi) including India, Nigeria, Democratic Republic of Congo, Chad, Somalia, Guinea, North Korea, Syria, South Sudan, Tajikistan, Papua New Guinea, and Haiti.(11)

Many of these no- and low-coverage PCV countries also have very low coverage of diphtheria, tetanus, and pertussis (DTP), Hib, and measles vaccines, which also offer protection against pneumonia.

The very low rates of full coverage (two doses) of the measles vaccine in so many countries underscore the urgency of increasing and sustaining high coverage of this highly effective vaccine.

The decline of measles deaths is one of the greatest public health achievements. Between 1990 and 2019, measles deaths among children fell by 90% from an estimated 700,000 to 70,000, according to the Global Burden of Disease (GBD), largely as a result of high and sustained measles vaccine coverage.(12)

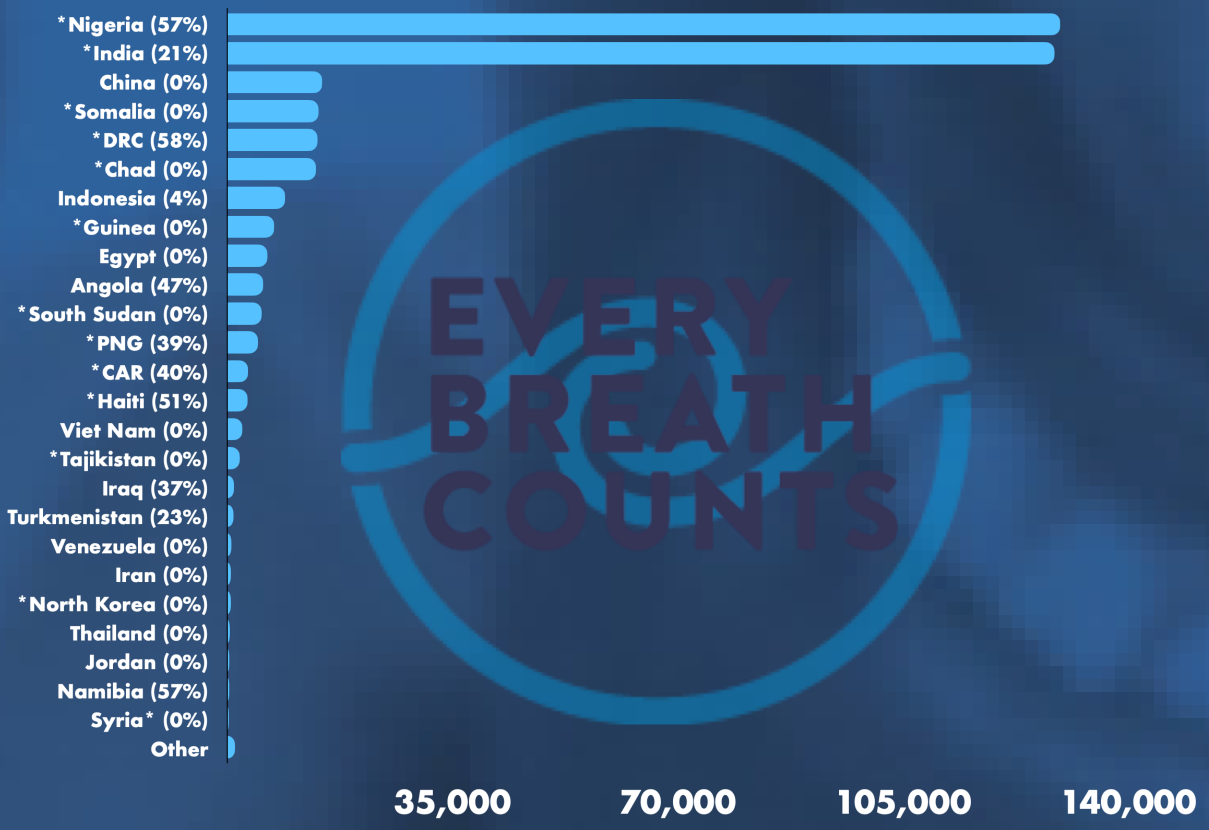
The outbreaks of measles in multiple countries are a major cause for concern. The US CDC reports that there have been measles outbreaks in Yemen, India, Tanzania, Somalia, Nigeria, Pakistan, Burundi, Democratic Republic of Congo, Brazil, and China. And 40 countries have delayed their measles campaigns due to the COVID-19 pandemic.(13)

The cost of such low coverage of the pneumonia-fighting vaccines is ultimately measured in lives lost to pneumonia. 370,000, or 55% of all child pneumonia deaths, occur in the countries where PCV coverage is below 60% (see chart).

The no- and low-coverage vaccine countries with the heaviest burdens of child pneumonia deaths include the clear outliers - Nigeria and India - as well as China, Somalia, Democratic Republic of Congo, and Chad. Alarmingly, child pneumonia deaths are actually rising in Chad and Somalia.

Further, most of the LMICs with the lowest coverage of the pneumonia-fighting vaccines are currently off-track to achieve the global pneumonia target of less than three child pneumonia deaths for every 1,000 children born by 2025.(14)

55% of child pneumonia deaths are in countries with <60% PCV coverage



*eligible for Gavi support | Sources: WHO/UNICEF 2020 and Global Burden of Disease 2019

2. Why new pneumonia-fighting vaccines are so urgently needed...

As powerful as the existing pneumonia-fighting vaccines are, they do not target all of the causes of pneumonia and especially the leading viral causes, such as respiratory syncytial virus (RSV), and influenza.

Prior to the pandemic, studies revealed that viruses were the leading causes of severe pneumonia in children in LMICs.

The seven-country Pneumonia Etiology Research for Child Health (PERCH) study showed that 61% of severe pneumonia cases in children are caused by viruses, especially RSV (31%), influenza (9.4%), rhinovirus (7.5%), and hMPV or human metapneumovirus (7.5%).(15)

It is extremely promising then, that an RSV vaccine and more effective influenza vaccines have been in development for some time and are expected to become available in the next five years.

All national governments should support the development of these vaccines and prepare for their introduction, as they will have a significant impact not just on child survival but on population health more broadly, as both RSV and influenza also cause large burdens of sickness and death among adults.(16)

Of course, the emergence of COVID-19 and its aggressive spread throughout the world underscores the urgent need for full coverage of COVID-19 vaccines. The virus has so far infected more than 490 million people and has officially caused more than 6 million deaths, as reported to the WHO.(17)

As pneumonia is a major cause of death from COVID-19, the new vaccines will substantially strengthen the basket of "pneumonia-fighting" vaccines and make a major contribution to reducing all-cause respiratory infection deaths.

Many LMIC governments have called for a major overhaul in the global vaccine market, with LMIC manufacturing key to increasing vaccine "self-reliance" and reducing dependence on global supply chains and other mechanisms which have not delivered results.(18) The new mRNA Technology Transfer Hub in South Africa is a promising development which will seed vaccine production in Egypt, Kenya, Nigeria, Senegal, and Tunisia. But much more is needed.

The potential for vaccination to significantly reduce pneumonia's massive burden of sickness and death is far from exhausted and increasingly necessary in the context of demographic shifts, urbanization, air pollution, and the likelihood that other novel respiratory pathogens will emerge.

New COVID-19 vaccines must be universally available and affordable to people in every country, with the most vulnerable a priority for early protection - including the elderly, those with co-morbidities and weakened immune systems, and healthcare workers.

Universal access to COVID-19 vaccines will be especially critical in the LMICs already struggling with heavy burdens of pneumonia deaths from other causes as their health systems have been stretched to breaking point by the pandemic.

For example in 2021, 61 no- and low-coverage PCV countries, already dealing with 370,000 child pneumonia deaths, reported 356,000 COVID-19 deaths to WHO.

With the exception of Turkmenistan, North Korea and four Pacific Islands (Cook, Nauru, and Tuvelu), all of the zero- and low-coverage PCV countries have confirmed COVID-19 deaths.(20) The countries with the largest numbers of reported COVID-19 deaths include India, Indonesia, Iran, Ukraine, and Viet Nam.

Of particular concern are the high numbers of both COVID-19 deaths and child pneumonia deaths in India, Indonesia, and Egypt.

These, and other countries, are now dealing with "double-burdens" of pneumonia from COVID-19 and other causes, most of which are vaccine-preventable.

But currently just 18 of the 61 countries have been able to vaccinate more than 60% of their populations with the initial doses of a COVID-19 vaccine (not including boosters).(19)

3. Why routine vaccination with the pneumonia-fighting vaccines is critical during COVID-19

COVID-19 will increase the total burden of respiratory infection deaths from 2.5 million to at least 6 million in 2021.(20) And recent estimates put the real COVID-19 death toll at three times higher.(21). No other infection causes anywhere near this burden of death.

During a global pandemic of respiratory infection it is vital that all countries are protecting their populations, and especially their most vulnerable, with every tool available to prevent pneumonia from any cause.

Although there is no evidence that pneumococcal vaccination among children or adults offers protection against COVID-19 infection, ensuring that all children and the elderly are protected with PCV and the other pneumonia-fighting vaccines (DTP, Hib, measles, and flu) during the pandemic will relieve additional pressure on hospitals and reduce the likelihood of co-infections of bacterial pneumonia and COVID-19.

There is evidence that the heavy death toll from the 1918 influenza outbreak was due to subsequent bacterial infection, particularly with streptococcus pneumoniae, and that poor outcomes in the 2009 H1N1 influenza pandemic were also associated with bacterial co-infections. There is no evidence yet that bacterial co-infection is contributing to COVID-19 deaths.(22)

Early modeled estimates of the indirect effects of COVID-19 on child mortality in LMICs underscore the importance of maintaining routine vaccination with the existing pneumonia-fighting vaccines.

These estimates suggest that thousands of children's lives are at risk every month from disruptions to routine vaccination, especially with the DTP, Hib, PCV, and measles vaccines.(23)

For example, if vaccination with these four vaccines was reduced by 27% (scenario 2), the study estimates that 4,470 additional child deaths would occur each month - 1,540 from measles, 1,410 from DTP, 830 from Hib, and 690 from PCV vaccine reductions.(24)

There is evidence that vaccine services have been disrupted during the pandemic. In 2020, UNICEF, Gavi, and the Sabin Vaccine Institute announced substantial vaccine suspensions in at least 68 countries affecting approximately 80 million children.

COVID-19 has demonstrated just how vulnerable every nation is to a pandemic of respiratory infection and underscores the absolutely critical role of vaccination in reducing the risks of severe illness and death.

More recent surveys from the WHO, UNICEF, the World Bank, and the Global Financing Facility for Women, Children, and Adolescents (GFF) all report that childhood vaccination is among the most disrupted services during COVID-19.

WHO and UNICEF "pulse" surveys and World Bank phone surveys all reported vaccine disruptions during the pandemic. GFF data from 63,000 facilities in 10 countries found that childhood vaccination was the most disrupted service with significant drops in the number of children fully vaccinated in Liberia (-35%), Nigeria (-13%), and Afghanistan (-11%).(25)

A Lancet study estimated that in 2020, 30 million children missed doses of DTP and 27 million missed measles vaccines, reducing global coverage rates for both vaccines by 8%.(26)

In response, WHO has advised countries to maintain essential services during the pandemic, and provided guidance on when and how to resume mass vaccination campaigns, noting that countries will need to make specific risk assessments based on local COVID-19 transmission, health system capacity, and public health benefit.(27)

It would be a tragedy if disruptions in routine pneumonia vaccinations among children led to increased child pneumonia deaths at the same time as COVID-19 is increasing adult pneumonia deaths.

4. What must be done to protect all vulnerable populations from pneumonia

To protect vulnerable populations from pneumonia beyond the pandemic, national governments and global health and development agencies should adopt a "life-course" approach to pneumonia vaccination and develop policies and programs that prioritize full coverage of the pneumonia-fighting vaccines - existing and emerging - to children and the elderly, and to other vulnerable populations.

This will be a highly effective public health strategy in all countries, but especially those struggling with double-burdens of pneumonia among children and adults. COVID-19 has placed many more countries in this situation.

Ultimately, the provision of a stronger basket of pneumonia-fighting vaccines should be part of national Pneumonia Control Strategies which guarantee access to pneumonia prevention (e.g., vaccines, child nutrition, clean air, etc.), diagnosis (e.g., pulse oximetry), and treatment services (e.g., oxygen therapies and WHO-recommended antibiotics) for all vulnerable populations.

This is a key part of the Declaration that governments and global health and development agencies endorsed at the inaugural Global Forum on Childhood Pneumonia in January 2020.(28)

Wide coverage of all of the pneumonia-fighting vaccines over the next five years will help all countries reduce child pneumonia deaths and accelerate achievement of two global targets - the child pneumonia target, which requires every country to reduce child pneumonia deaths to at least three per 1,000 live births, and the SDG child survival target, which requires that every country reduce child deaths to at least 25 for every 1,000 babies born by 2030. (29)

The United Nations Secretary-General expressed concern at the low levels of PCV coverage in the 2020 SDG Progress Report, underscoring how important high PCV coverage is to national achievement of the child survival SDG.(30)

And with several next generation pneumococcal vaccines offering protection against many more pneumococcal strains becoming available - Pfizer (20-valent), Merck (15-valent), and Inventprise (25-valent) - there is an opportunity to provide even higher levels of protection.

Respiratory infections are such a major cause of sickness and death in every country that vaccines to prevent them are essential tools to improve population health and reduce mortality in the context of achieving the SDGs.

Global Forum on Childhood Pneumonia, Barcelona, 2020

1.

National governments and global health and development agencies should adopt a "life-course" approach to the pneumonia-fighting vaccines - ensuring that vulnerable populations, especially children and the elderly, are fully protected - and routinely measure and publish estimates of pneumonia vaccine coverage across all age groups.

Full coverage of the pneumonia-fighting vaccines - including for COVID - builds a strong foundation for every nation to deliver on the grand promise of the Sustainable Development Goals: healthy lives and wellbeing for all at all ages.

2.

By 2025, national governments should protect more than 90% (>80% in each district) of children under five years with all of the WHO-recommended pneumonia-fighting vaccines, including three doses of the pneumococcal conjugate vaccine (PCV), the Haemophilus influenzae type B vaccine (Hib), and the diphtheria, tetanus, and pertussis vaccine (DTP), and with two doses of the measles vaccine (MCV), as required by the Global Action Plan for Pneumonia and Diarrhea (GAPPD). In addition, 90% of adults over 70 years of age should be protected with the pneumococcal and influenza vaccines, and all adults and children with COVID-19 vaccines, by 2025.

3.

Gavi should support eligible countries to accelerate introduction and to fully protect all children under five years with the existing pneumonia-fighting vaccines, with a special focus on increasing vaccine coverage in the Gavi-eligible countries with the largest numbers of child pneumonia deaths, including Nigeria, India, Somalia, Democratic Republic of Congo, Chad, Guinea, South Sudan, Papua New Guinea, Central African Republic, Haiti, Tajikistan, North Korea, and Syria.

4.

International donors and global health and development agencies should continue to support existing and new vaccine manufacturers to ensure supply of affordable, quality pneumonia-fighting vaccines, especially PCV, for both Gavi-eligible and non-eligible countries. Special efforts are needed to support non-Gavi countries with the largest numbers of child pneumonia deaths to increase coverage of the pneumonia-fighting vaccines, especially China, Indonesia, Egypt, Angola, Viet Nam, Iraq, Turkmenistan, Venezuela, Iran, Thailand, and Jordan.

5.

Full coverage of the pneumonia-fighting vaccines in both Gavi-eligible and non-eligible countries should be part of national pneumonia control strategies that aim to reduce pneumonia prevalence, incidence, and deaths among all vulnerable populations by improving nutrition and air quality, as well as access to diagnosis and treatment with pulse oximetry, medical oxygen therapies, and WHO-recommended antibiotics as part of the overall national effort to achieve universal health coverage and the Sustainable Development Goals (SDGs).

6.

National governments should make plans to introduce emerging pneumonia-fighting vaccines as they become available, including higher valent pneumococcal vaccines, COVID-19 vaccines, respiratory syncytial virus (RSV), and improved influenza vaccines, prioritizing access to the most vulnerable populations (e.g., children, the elderly, healthcare workers, etc.), as appropriate for each vaccine and in each country setting.

7.

As countries emerge from the COVID-19 pandemic, national governments must make every effort, with support from international donors and global health and development agencies where necessary, to get back on track by vaccinating children and adults with the pneumonia-fighting vaccines, integrating COVID-19 vaccination with routine vaccination, and protecting populations from future respiratory pandemics by strengthening the vaccine delivery system.

Endnotes

(1) Institute for Health Metrics and Evaluation (IHME). Global Burden of Disease (GBD) Compare. Available at: http://vizhub.healthdata.org/gbd-compare.

(2) See World Health Organization (WHO) Coronavirus (COVID-19) Dashboard, Available at: https://covid19.who.int/COVID-19.

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(4) Hammitt, L.L. et al., 2019. Effect of ten-valent pneumococcal conjugate vaccine on invasive pneumococcal disease and nasopharyngeal carriage in Kenya: a longitudinal surveillance study. The Lancet, 393(10186), pp.2146–2154. Available at: http://dx.doi.org/10.1016/s0140-6736(18)33005-8.

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(6) Shiri, T. et al., 2017. Indirect effects of childhood pneumococcal conjugate vaccination on invasive pneumococcal disease: a systematic review and meta-analysis. The Lancet Global Health, 5(1), pp.e51–e59. Available at: http://dx.doi.org/10.1016/s2214-109x(16)30306-0.

(7) Gavi's Advanced Market Commitment (AMC) has underwritten PCV expansion in most Gavi-eligible countries and prevented an estimated 700,000 deaths. See AMC Secretariat (Gavi), World Bank, and UNICEF, Pneumococcal AMC Annual Report, 2019. Available at: https://www.gavi.org/news/document-library/2019-pneumococcal-amc-annual-report.

(8) Van Buynder, P. & Booy, R., 2018. Pneumococcal vaccination in older persons: where are we today? Pneumonia, 10(1). Available at: http://dx.doi.org/10.1186/s41479-017-0045-y.

(9) WHO, UNICEF Estimates of National Immunisation Coverage (WUENIC), June 2020. Available at: https://www.who.int/immunization/monitoring_surveillance/data/en/.

(10) India (21%), Indonesia (4%), Nigeria (57%), Democratic Republic of Congo (58%), Angola (47%), Iraq (37%), PNG (39%), and Haiti (51%). Note Iraq's PCV coverage is reported to have dropped from 37% to 0% in 2020.

(11) Gavi-eligible countries 2020 (57 countries). Available at: https://www.gavi.org/types-support/sustainability/eligibility?gclid=Cj0KCQjw3duCBhCAARIsAJeFyPVEJTB-6JUbDLLET4saS__H7-XWtxsGo_RSs81wd_opZi3TMilfq88aAiFtEALw_wcB.

(12) Nigeria, Democratic Republic of Congo, Somalia, South Sudan, Chad, Guinea, Syria, Haiti, Papua New Guinea, and Central African Republic.

(13) US CDC measles data available at: https://www.cdc.gov/globalhealth/measles/data/global-measles-outbreaks.html.

(14) WHO and UNICEF, 2013. Integrated Global Action Plan for Pneumonia and Diarrhoea (GAPPD). Chan, M. & Lake, A., 2013. Integrated action for the prevention and control of pneumonia and diarrhoea. The Lancet, 381(9876), pp.1436–1437. Available at: http://dx.doi.org/10.1016/s0140-6736(13)60692-3.

(15) Pneumonia Etiology Research for Child Health (PERCH). Available at: http://perchresults.org/.

(16) Tin Tin Htar, M. et al., 2020. The burden of respiratory syncytial virus in adults: a systematic review and meta-analysis. Epidemiology and Infection, 148. Available at: http://dx.doi.org/10.1017/s0950268820000400.

(17) WHO Coronavirus (COVID-19) Dashboard, Available at: https://covid19.who.int/.

(18) See "African Union and Africa CDC launches Partnerships for African Vaccine Manufacturing (PAVM)", April 2021. Available at: https://africacdc.org/news-item/african-union-and-africa-cdc-launches-partnerships-for-african-vaccine-manufacturing-pavm-framework-to-achieve-it-and-signs-2-mous/.

(19) Our World in Data COVID-19 Vaccination. Available at: https://ourworldindata.org/vaccination.

(20) WHO COVID-19 Dashboard and the Global Burden of Disease. Note the GBD will categorize COVID-19 deaths as respiratory infections. Available at: https://covid19.who.int/ and https://vizhub.healthdata.org/gbd-compare/.

(21) Wang, Haidong, et al. "Estimating Excess Mortality due to the COVID-19 Pandemic: A Systematic Analysis of COVID-19-Related Mortality, 2020–21." The Lancet, Mar. 2022. Available at: https://doi.org/10.1016/S0140-6736(21)02796-3.

(22) Cox, M.J. et al., 2020. Co-infections: potentially lethal and unexplored in COVID-19. The Lancet Microbe, 1(1), p.e11. Available at: http://dx.doi.org/10.1016/s2666-5247(20)30009-4.

(23) Roberton, T. et al., 2020. Early estimates of the indirect effects of the COVID-19 pandemic on maternal and child mortality in low-income and middle-income countries: a modelling study. The Lancet Global Health, 8(7), pp.e901–e908. Available at: http://dx.doi.org/10.1016/s2214-109x(20)30229-1.

(24) Most of these deaths are from pertussis, which killed an estimated 107,800 children under five in 2019. In contrast tetanus killed an estimated 18,300 children under five and diphtheria 3,600, according to the Global Burden of Disease.

(25) A summary of survey results available at: https://www.cgdev.org/blog/what-do-we-really-know-about-covid-19s-impact-essential-health-services.

(26) Causey, K., et al., 2021. Estimating global and regional disruptions to routine childhood vaccine coverage during the COVID-19 pandemic in 2020: a modelling study. The Lancet, 398(10299), pp.522-534. Available at: https://doi.org/10.1016/S0140-6736(21)01337-4.

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(28) Global Forum on Childhood Pneumonia Declaration, January 2020. Available at: https://stoppneumonia.org/latest/global-forum/.

(29) See Bassat, Q. et al., 2020. The first Global Pneumonia Forum: recommendations in the time of coronavirus. The Lancet Global Health, 8(6), pp.e762–e763. Available at: http://dx.doi.org/10.1016/s2214-109x(20)30125-x.

(30) United Nations. Sustainable Development Goal Progress Report, May, 2020. Available at: https://www.un.org/sustainabledevelopment/progress-report/.

This report was written by Leith Greenslade, Coordinator of the Every Breath Counts Coalition. It relies heavily on the 2020 World Health Organization (WHO) and UNICEF Estimates of National Immunization Coverage (WUENIC), the Global Burden of Disease 2019, and UN World Population Prospects 2019 Revision.