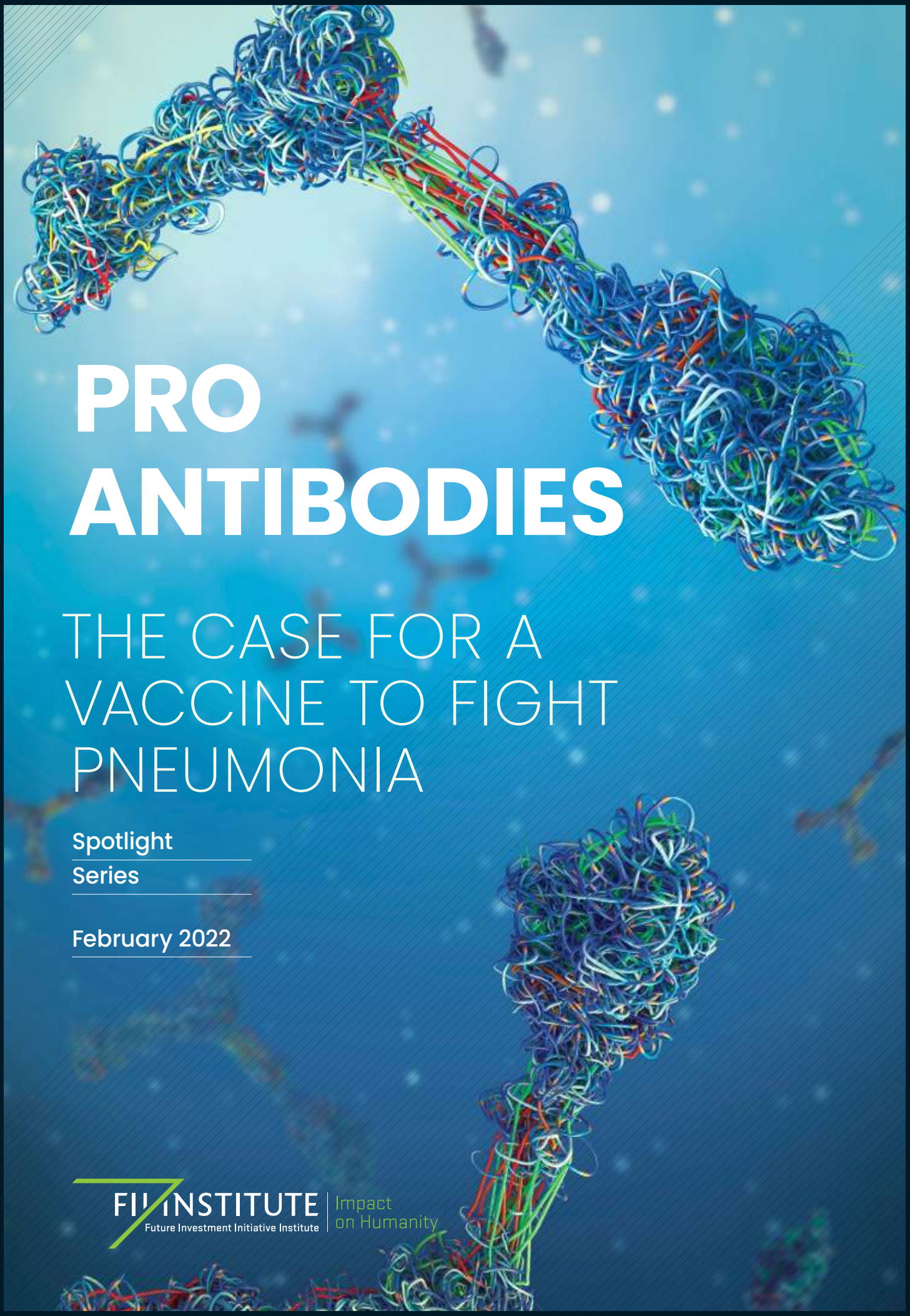

PRO ANTIBODIES

THE CASE FOR A VACCINE TO FIGHT PNEUMONIA

Spotlight Series

February 2022

FII INSTITUTE
Future Investment Initiative Institute
Impact on Humanity

PRO ANTIBODIES

THE CASE FOR A VACCINE TO FIGHT PNEUMONIA

Pneumonia is, in most cases, a curable or preventable disease. But it remains the leading infectious cause of death globally among children under the age of five, disproportionately affecting the most deprived and marginalized. An effective and affordable vaccine is the best way to tackle this global challenge.

THE ISSUE AT STAKE

GLOBALLY, SOME 450 MILLION CASES of pneumonia are caused every year by more than 100 different viruses and bacteria. The most common and most dangerous pathogen is *Streptococcus pneumoniae*, the bacterium responsible for pneumococcal disease. Worldwide, an estimated 14.5 million episodes of serious pneumococcal disease occur annually among children under five years of age.[2] Estimates of the number of children under five dying of pneumonia range from 300,000 (WHO)[3] to 800,000 deaths per year (UNICEF).[4] Most of these deaths occur in low- and middle-income countries, about half of them in just five: Nigeria, India, Pakistan, Democratic Republic of Congo and Ethiopia.[5]

Pneumococcal disease is curable: antibiotics are first-line treatments, while oxygen therapy can help treat pneumonia but is often not available for children in low- and middle-income countries for a number of reasons, including logistics management and health system priorities, as well as cost. A recent study of hospitals in Nigeria, for example, found that just one in ten children that were treated for pneumonia received the oxygen they needed.[6]

Pneumococcal disease is also preventable: vaccines are the best preventive measure. Breastfeeding, good nutrition, hand washing, and abating indoor air pollution are other ways to prevent the disease.[7]

Nevertheless, pneumonia remains responsible for the deaths of hundreds of thousands of children each year. It is therefore not only a dangerous disease, but also a symbol of global inequities, affecting disproportionately the most deprived and marginalized children. Just one example: The number of pneumonia deaths for children under five years in Bangladesh has fallen from 17 deaths per 1,000 live births in 2000 to 4 deaths per 1,000 live births in 2018. But in Western Europe, the mortality rate is still 50 times lower.[8]

REDUCING THE BURDEN

In 2013, the WHO and UNICEF launched the Integrated Global Action Plan for Pneumonia and Diarrhea (GAPPD) to reduce the massive burden of pneumonia and diarrhea deaths among children. The GAPPD was the first global framework to set national pneumonia and diarrhea mortality targets. By 2025, all countries were to have reduced child pneumonia deaths to less than three for every 1,000 babies born and diarrhea deaths to less than two for every 1,000 babies born.

Since the GAPPD was launched, child pneumonia and diarrhea deaths have fallen by 27 percent.[9] But despite this progress, some of the low- and middle-income countries with the highest numbers of child pneumonia deaths are unlikely to meet the GAPPD pneumonia mortality target.

The era of respiratory diseases

According to FII Institute's Global Infectious Disease Index, respiratory infections are the family of infectious diseases with the heaviest impact on human life.[10] They cause the highest number of annual deaths and the highest loss of disability-adjusted life years (DALYs). Respiratory diseases are also the most likely diseases to cause a pandemic. Due to the increase in globalization and connectivity, the contagion with a virus that causes a respiratory disease can spread from one side of the world to another in mere hours.[11] Learn more: https://www.globalinfectiousdiseaseindex.org/

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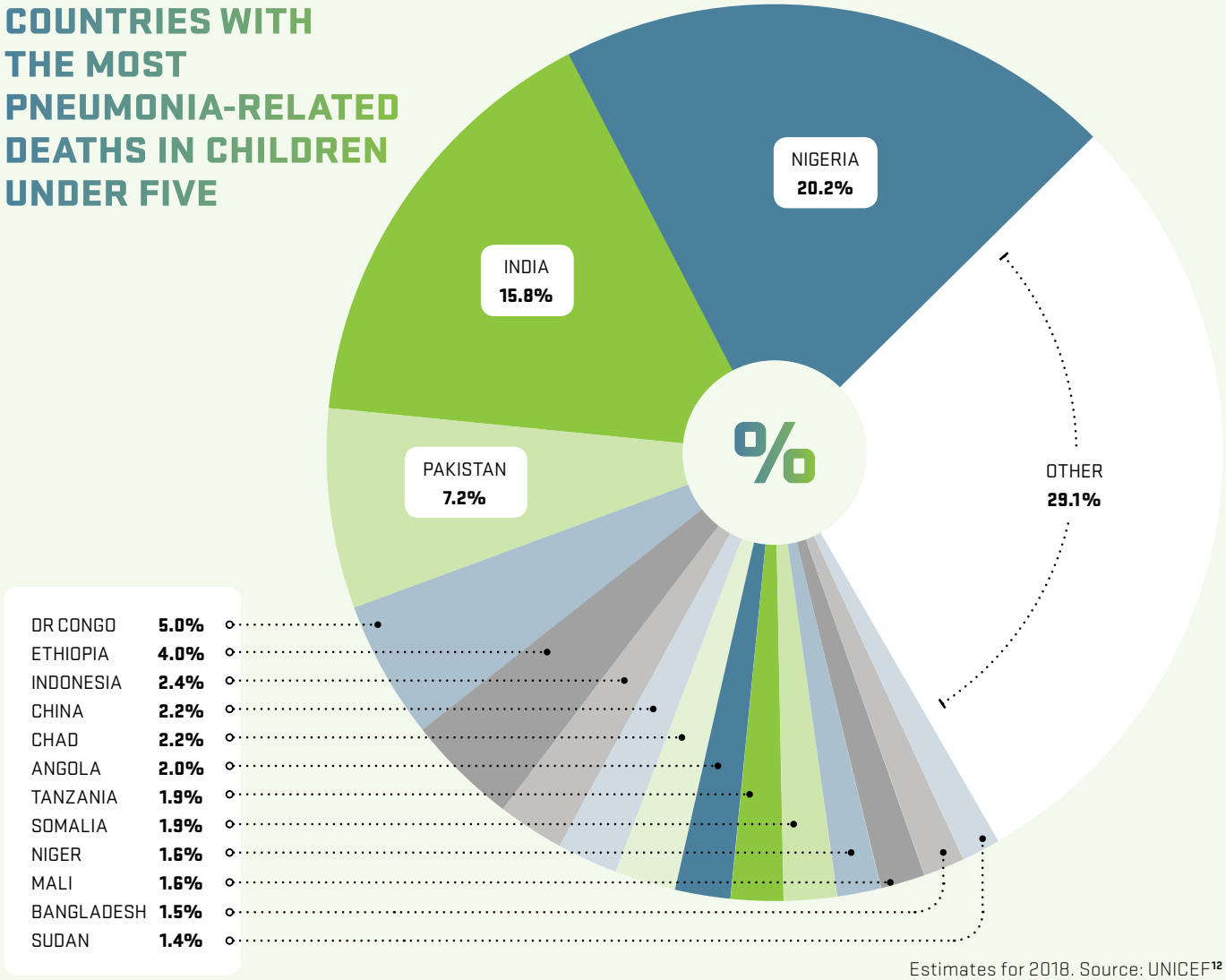
COUNTRIES WITH THE MOST PNEUMONIA-RELATED DEATHS IN CHILDREN UNDER FIVE



Estimates for 2018. Source: UNICEF[12]

VACCINES – THE SOLUTION SO HARD TO IMPLEMENT

Vaccines can be a highly efficient tool to prevent infections. They are especially valuable in cases where no treatment exists – as is often the case with viral infections.

Most diseases caused by bacteria can be treated with antibiotics. But often they go untreated. Globally, 32 percent of children with suspected pneumonia are not taken to a health facility. The reasons vary, from distance to the facility to cultural attitudes and beliefs. The care-seeking rate is substantially lower for children in low- and middle-income countries. Just 60 percent of children under five years with symptoms of pneumonia are taken to an appropriate healthcare provider. In the countries with the highest burden, care-seeking rates are as low as 31 percent in Ethiopia, 34 percent in the Democratic Republic of Congo, and 46 percent in Bangladesh.[13]

Prevention via immunization can help to reduce the number of cases, as well as the severity and the lethality of diseases.

At full coverage among children under five years, the pneumonia-fighting vaccines could prevent more than one-half of all child pneumonia deaths and also reduce deaths among adults, especially the elderly. Studies have shown that when children are fully vaccinated against the leading causes of pneumonia, deaths among adults and especially among the elderly also fall.[14] →

PHOTO: GETTY IMAGES / JASMIN MERDAN

THE CHALLENGE OF TACKLING MANY VARIETIES

The vaccine mechanism is the same for both viruses and bacteria: a part of the pathogen, or a debilitated version of it, is injected into the body, where it stimulates the immune system to produce antibodies.

The problem with *Streptococcus pneumoniae* is that it is a complex bacterium with more than 90 varieties (serotypes), which vary by contagiousness, lethality and region. The pneumococcal vaccines most commonly used for adults today simultaneously tackle 23 of these serotypes, which are responsible for up to 80 percent of all pneumococcal diseases. For children, there exist so-called pneumococcal conjugate vaccines (PCVs) against 10 or 13 serotypes, responsible for about 60 percent of pneumococcal disease cases.[15]

The WHO recommends the inclusion of PCV in childhood immunization worldwide. For infants, a three-dose schedule →

Shazam-like diagnostics

With pneumonia, early and accurate diagnosis is critical. Without it, the correct treatment is delayed, which can prolong illness, possibly leading to long-term disability. It can even be life-threatening and endanger the wider community by causing an outbreak of this highly infectious disease.

But help is at hand. Not all coughs are equal. Just as a song can be recognized through apps like Shazam, respiratory diseases also have their own acoustic "signature." By recording chest sounds and analyzing them with AI, the prototype of a so-called "Pneumoscope"[16] can diagnose pneumonia with a sensitivity of almost 100 percent, according to a preliminary case-control study on children under five. The Pneumoscope can also tease apart viral pneumonia from bacterial pneumonia almost 90 percent of the time.[17] Furthermore, it doesn't need a lot of technical training and it can be used in a wide range of conditions, meaning it is well-suited for low- and middle- income countries.

administered either as three primary doses or two primary doses plus a booster is recommended. Primary vaccination can be initiated as early as six weeks.[18]

INCREASING ACCESS

To increase the access to immunization in low-income countries, the public-private global health partnership Gavi launched an Advance Market Commitment (AMC) program in 2009. Under the terms of an AMC, donors make a legally binding guarantee that, if a vaccine is developed in the future against a particular disease, they will purchase a predetermined amount at an agreed-upon price.

The access to cheap pneumococcal vaccines has considerably increased the vaccination rates in low-income countries, with, for example, coverage of 97 percent in Bangladesh and 83 percent in Tanzania.

Globally, however, just 48 percent of children are protected with three doses of the PCV.[19] One main reason for this gap is the high vaccine prices for middle-income countries ineligible for the AMC program. Indonesia, for example, has a PCV rate of only 3 percent. According to Doctors Without Borders, in middle-income countries that do not qualify for Gavi support, the vaccine suppliers Pfizer and GSK charge as much as US$80 per child to be vaccinated – about nine times the price to be paid within the AMC program.[20] →

AMC

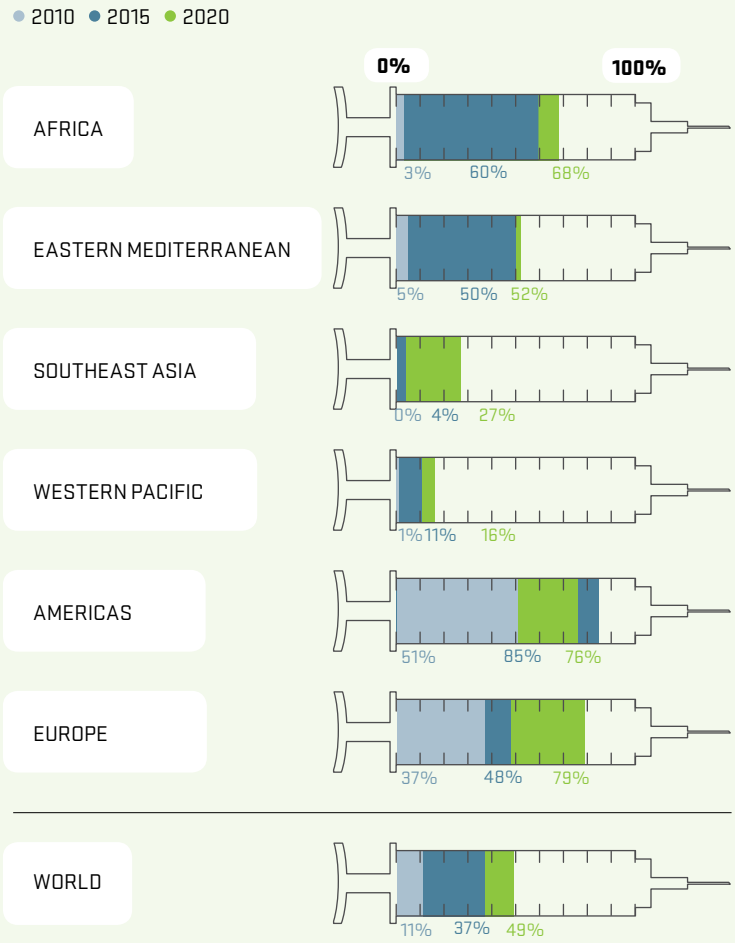
An Advance Market Commitment (AMC) for vaccines aims to encourage the development and production of affordable vaccines tailored to the needs of developing countries. In June 2009, the Governments of Italy, the United Kingdom, Canada, the Russian Federation and Norway, along with the Bill & Melinda Gates Foundation, collectively pledged a total of US$1.5 billion to fund a pilot AMC against pneumococcal disease.

As of December 2020, 63 of the 73 AMC-eligible countries had been approved to receive Gavi support for PCV introduction. US$540 million was spent on vaccine doses produced by GSK (Belgium), US$697.5 million on doses produced by Pfizer (USA) and US$75 million on doses produced by the Serum Institute of India. US$187.5 million is still available for PCV contracts.

PHOTO: GETTYIMAGES / HUGH SITTON

Pneumonia vaccination

Coverage of PCV vaccination (final dose in % of population)



Source: (WUENIC)[21]

HOW TO PROTECT ALL VULNERABLE POPULATIONS FROM PNEUMONIA

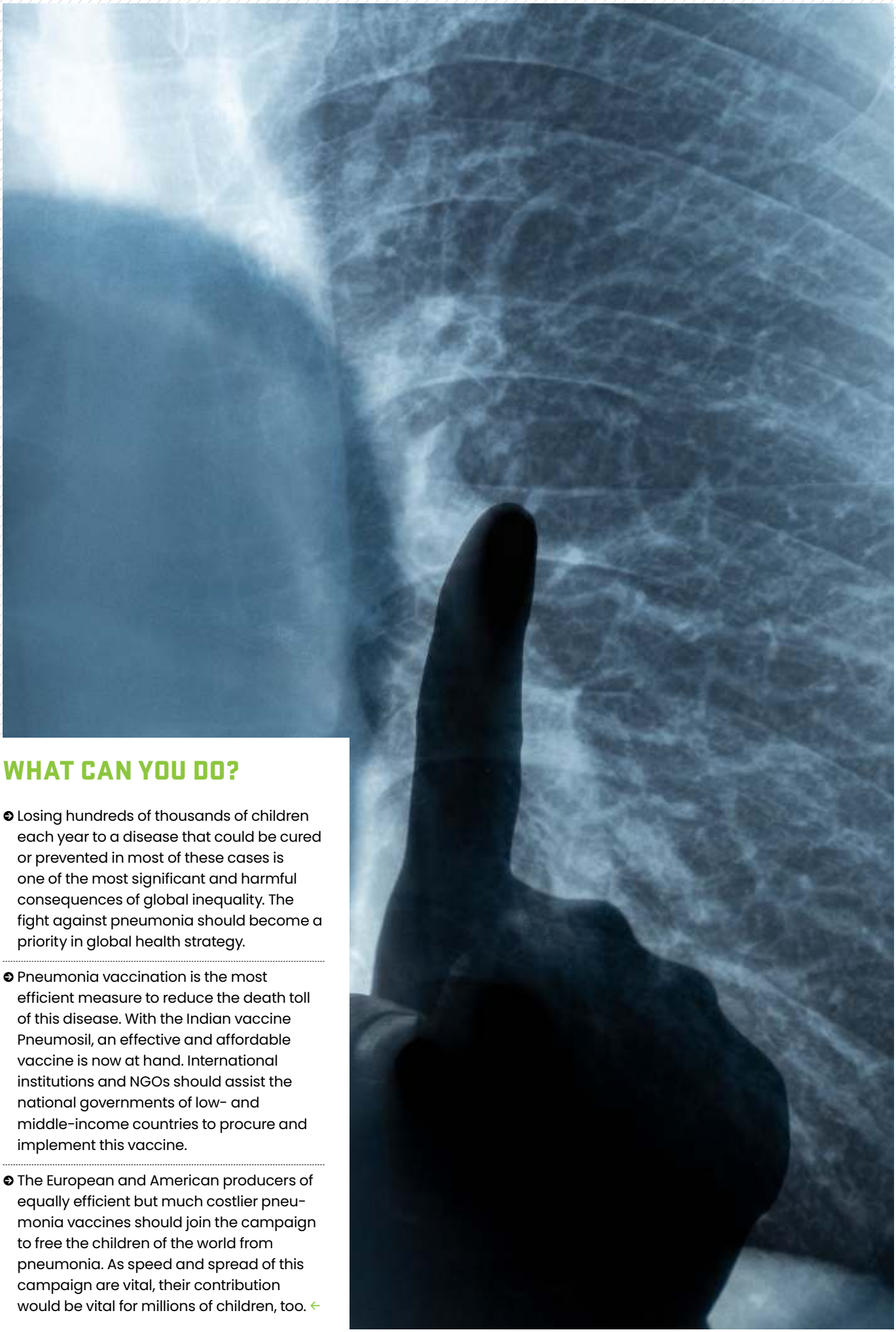
Full vaccination of vulnerable populations with pneumonia-fighting vaccines is essential but not sufficient to achieve pneumonia control. Even at full coverage, hundreds of millions of children and adults will still contract pneumonia each year, their survival dependent on timely access to accurate diagnosis and effective treatment.[22]

For these reasons, health institutions and NGOs like PATH and Every Breath Counts are supporting a combination of interventions that can prevent infection or reduce the chance of developing severe disease. These interventions include recommendations for individual behavior like handwashing with soap and exclusive breastfeeding, and basic needs like clean water, good nutrition, basic sanitation, and clean cookstoves to reduce indoor and outdoor air pollution.[23] They also include investments in medical infrastructure and equipment, like rapid diagnostic tests for pneumonia, stocking of the recommended pneumonia antibiotics (e.g., amoxicillin dispersible tablets) and access to pulse oximetry and oxygen as critical tools to prevent child pneumonia deaths.[24]

Of course, they also support vaccination. And not only by subsidizing vaccine doses or donating syringes: PATH in particular leverages decades of hands-on experience developing, introducing and improving vaccines and immunization technologies in multisector partnerships with manufacturers and resource-limited countries.[25] The organization also played a decisive role in the development of a new cheaper pneumococcal vaccine. Its cooperation with Serum Institute of India, with funding from the Bill & Melinda Gates Foundation, began in 2008. By 2020, they had developed a vaccine that not only provides the protection that is needed but also breaks down price barriers. With a target price per vaccinated child of US$6 (Gavi-subsidized) and US$11 (regular price), the new vaccine Pneumosil drastically increases the affordability and, with it, the reach of pneumococcal vaccination.[26] The vaccine was launched in India in December 2020.[27] →

Number of pneumonia deaths per 100,000 population

Source: Just Actions [28]



WHAT CAN YOU DO?

- Losing hundreds of thousands of children each year to a disease that could be cured or prevented in most of these cases is one of the most significant and harmful consequences of global inequality. The fight against pneumonia should become a priority in global health strategy.
- Pneumonia vaccination is the most efficient measure to reduce the death toll of this disease. With the Indian vaccine Pneumosil, an effective and affordable vaccine is now at hand. International institutions and NGOs should assist the national governments of low- and middle-income countries to procure and implement this vaccine.
- The European and American producers of equally efficient but much costlier pneumonia vaccines should join the campaign to free the children of the world from pneumonia. As speed and spread of this campaign are vital, their contribution would be vital for millions of children, too. ←

PHOTO: GETTYIMAGES / VIROJT CHANGYEMCHAM

ABOUT FII INSTITUTE

THE FUTURE INVESTMENT INITIATIVE (FII) INSTITUTE is a global new generation non-profit foundation built on ESG principles and strong pillars – THINK, XCHANGE, ACT – with a mission to positively impact humanity through five focus areas: Sustainability, Healthcare, Education, AI and Robotics. With an ambitious vision to empower the brightest minds to shape a better future for ALL and with ALL, the FII Institute will bring together global leaders and experts to collectively curate and enable concrete ideas that can solve today's most pressing societal issues.

This paper is part of our Respiratory Diseases Series, where the Institute's approach to addressing issues within this field emanates from our focus on Healthcare. The first paper of this series made the case for financing a global tuberculosis vaccine (*Preventing the Next Global Pandemic*, co-written with the International Vaccine Institute, December 2020). Future series will explore other families of infectious disease.

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