



**The power of
vaccines: still not
fully utilized**

Vaccines prevented at least 10 million deaths between 2010 and 2015, and many millions more lives were protected from illness. The global push to end polio has reached its final stages, with just 3 remaining countries still working to eradicate this debilitating disease. The ambitious Global Vaccine Action Plan to reach everyone with vaccines by 2020 started strong but is falling behind. WHO challenges all health leaders to make immunization one of the biggest success stories of modern medicine.

Vaccines have been one of the biggest success stories of modern medicine. WHO estimates that at least 10 million deaths were prevented between 2010 and 2015 thanks to vaccinations delivered around the world. Many millions more lives were protected from the suffering and disability associated with diseases such as pneumonia, diarrhoea, whooping cough, measles, and polio. Successful immunization programmes also enable national priorities, like education and economic development, to take hold.

Such success builds on a long history of research and innovation, with discovery science producing new product breakthroughs and delivery science carving out ways to reach universal vaccine coverage.

The Expanded Programme on Immunization was born out of success at a time of tremendous optimism about the game-changing potential of vaccines. The Programme was established in 1974 as the world moved closer to smallpox eradication. Confidence was high that, with international commitment and cooperation, other vaccine-preventable diseases could be conquered. **The 1979 certification of smallpox eradication was taken as proof of the power of vaccines to permanently improve the world.**

In the decades since, the Expanded Programme on Immunization has remained true to its privileged birthright. It numbers among the most successful of all public health programmes. Since its inception, the Programme has been a pathfinder for universal coverage. In 1974, only 5% of the world's children were protected from the six killer diseases targeted by the



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Programme. Today, that figure is 86%, with some developing countries reaching more than 95% immunization coverage.

In the era of sustainable development, immunization programmes have matured to the point that they can now serve as a model and a platform for delivering other priority public health interventions. This broadened role has been amply demonstrated by the global initiative to eradicate polio.

Polio eradication: from deep trouble to likely triumph

In 2007, the initiative to eradicate polio was in deep trouble. As stakeholders gathered in Geneva for an urgent meeting, they faced a situation characterized by the highest number of polio cases reported in more than six years. Though the virus was endemic in only four countries, Afghanistan, India, Nigeria, and Pakistan, travellers from Nigeria and India had seeded outbreaks in an additional nine countries.

A strategy was in place, with clear guidance for the rapid detection of circulating poliovirus, the conduct of large-scale rounds of immunization using a type-specific monovalent oral vaccine, and the maintenance of highly sensitive surveillance. Still, progress was too slow.

The eradication effort in Nigeria faced a host of complex operational challenges, including vaccine refusals, especially in some northern states. But India was considered the most formidable challenge, given the country's vast size, dense and mobile population, high birth cohort, and poor living conditions, all favouring high and efficient virus transmission. At the end of 2006, the country reported a 10-fold increase in new cases compared with the previous year. New evidence made some question whether eradication in India could ever succeed in the absence of dramatic improvements in sanitation and hygiene.

The spearheading partners and donors were tired. Staff, including tens of thousands of community volunteers, were demoralized. The initiative faced a funding shortfall of \$575 million for 2007–2008. As the WHO Director-General told the meeting, **"We have few opportunities to change the world for the better in a permanent way. If we don't meet this virus with an immediate surge of commitment, the virus may win."**

Stakeholders rallied behind that call. WHO, Rotary International, the US Centers for Disease Control and Prevention, UNICEF, and the Bill and Melinda Gates Foundation renewed their commitment. The money was found. The Director-General visited the heads of state in endemic countries to secure high-level political commitment. The initiative struggled on.

By 2009, however, the world's largest-ever global health initiative had clearly stalled. The strategies that had so effectively reduced polio incidence by more than 99% worldwide were not powerful enough to eradicate the disease in its last stubborn strongholds. New approaches would have to be found.

That same year, work began to develop a bivalent oral polio vaccine that could simultaneously target the two remaining serotypes in a single dose. The decision to do so was made at the start of the year. Evaluation, clinical trials, licensing, and production took place in record time. The new vaccine was introduced in Afghanistan in December, then rolled out programme-wide in early 2010.

Another important innovation came in 2010, when WHO established the Independent Monitoring Board of the Global Polio Eradication Initiative. The Board's hard-hitting, straight-talking reports, issued twice yearly, took management to task at every level of the initiative, from donors, to international partners, to country operations. Finger-pointing was the norm. If a national eradication programme was "riddled with dysfunction", the Board said so. It also demanded solutions, and harped when change came too slow. As the eradication machinery got better, the Board urged it to get great.

Emergency operations centres were established. Vaccination coverage increased as did the accuracy of monitoring and reporting. National programmes shifted from counting the number of children covered to counting those that were missed.

The introduction of health camps – outreach services that provide basic health care, including simple diagnostics and medicines – helped allay suspicions that a singular and intense focus on polio must serve some sinister purpose. The co-delivery of free check-ups and medicines expanded the initiative's contribution to include the treatment of common community ailments, like worm infections, scabies, anaemia, vitamin deficiencies, gastric pain, fevers, and diarrhoeal disease and malaria. Pakistan alone set up nearly 2000 health camps dotting underserved areas in remote and destitute districts. The initiative's call to "reach every child" now meant reaching entire communities with basic health care.

In 2012, polio eradication was put on an emergency footing. The Independent Monitoring Board had requested consideration of a resolution to "declare the persistence of polio a global health emergency". The World Health Assembly acted on that request and adopted a resolution that declared the completion of poliovirus eradication "a programmatic emergency for global public health". The resolution also urged countries with ongoing transmission to declare such transmission "a national public health emergency". On its part, WHO was asked to rapidly develop a comprehensive polio eradication and endgame strategy. This was done in a plan covering the period 2013–2018.

The breakthroughs began. **On 11 February 2014, India proved that there is no such thing as impossible.** That date marked three years since the country's last case of wild poliovirus. WHO declared that the territory of one of the world's most densely populated countries was now free of a virus that had killed and crippled children for centuries. Many thought that day would never come: the virus was too firmly entrenched in India and the barriers to eradication were too great. The country's dedicated leadership and determined vaccination teams proved them wrong.

In July 2014, Nigeria – a country that had, over the years, re-infected 26 polio-free countries – reached what looked like its last case. The euphoria of finding no new cases continued for two years, but then dissipated in the second half of 2016, when four new cases were confirmed in Borno State, an area rendered virtually inaccessible by insurgency and a devastating humanitarian

crisis. Genetic analysis indicated that the poliovirus had been circulating undetected for several years. Though the setback caused dismay, it redoubled the country's determination to rid itself of poliovirus once and for all.

To secure the impressive gains, WHO convened in 2014 the first of several Emergency Committees, set up under the International Health Regulations, to look at ways to prevent the international spread of wild poliovirus. The Committee declared that doing so was a Public Health Emergency of International Concern, and recommended vaccination, prior to international travel, of all residents and long-term visitors in countries that were exporting wild poliovirus.

The global eradication of wild poliovirus type 2 was declared in September 2015. The Polio eradication and endgame strategic plan 2013–2018 called on countries to introduce at least one dose of inactivated polio vaccine into routine immunization schedules, strengthen routine immunization, and withdraw oral polio vaccine in a phased manner. In line with this plan, another major step forward occurred during the spring of 2016. During a short two-week period in April, 155 countries successfully switched from trivalent to bivalent oral polio vaccine, marking the largest coordinated vaccine withdrawal in history.

The primary purpose of introducing inactivated polio vaccine was to ensure that new birth cohorts had some protection against the type 2 poliovirus, either wild or vaccine-derived, hence mitigating the potential consequences of any re-emergence of type 2 poliovirus following the switch. Introducing at least one dose of inactivated polio vaccine would also boost immunity against poliovirus types 1 and 3, likely hastening their eradication.

In 2017, the eradication programme found itself in the extraordinary position of being closer to its goal than at any time in history. By early April, Afghanistan had reported three cases of wild poliovirus and Pakistan had reported two. Nigeria had not yet detected a case. To safeguard achievements, more than 190 000 polio vaccinators in 13 countries across West and Central Africa began a week-long campaign in late March 2017 to immunize more than 116 million children. The synchronized coast-to-coast vaccination campaign, one of the largest of its kind ever implemented in Africa, is part of urgent measures to permanently stop polio on the continent.

But being on the brink of triumph is not enough. The job will be done only when the entire world has been certified polio-free. The magnitude of that victory will no doubt boost world confidence in the power of public health – and vaccines – to build a better world.

The vast infrastructure and finely-tuned machinery needed to take the world this far are another asset that will continue to bring benefits as part of the initiative's legacy. This capacity was best demonstrated in July 2014, when a traveller from Liberia brought the Ebola virus to the sprawling city of Lagos, Nigeria. At that time, the country had put together one of the world's most innovative eradication campaigns, using cutting-edge technologies to ensure that no child was missed.

Health officials immediately repurposed polio technologies and infrastructures to conduct real-time Ebola case-finding and contact-tracing. World-class epidemiological detective work eventually linked every single one of the country's 19 confirmed cases back to direct or indirect contact with the July air traveller from Liberia. By October 2014, WHO could declare the Ebola outbreak in Nigeria over.

The Decade of Vaccines and the Global Vaccine Action Plan

In 2001, Gavi, the Vaccine Alliance, supported by a large grant from the Bill and Melinda Gates Foundation, was launched to reinvigorate the drive to protect children from vaccine-preventable diseases. The Alliance was founded on the principle of fairness. Poverty, or the place where a child was born, should not determine access to life-saving vaccines, including the newer and more expensive ones. **Every child deserves the best that science can offer.** The Alliance was also a tribute to the power of innovation to move the human condition a big step forward. A world that could put a computer in every home could surely put vaccines in every child.

By 2007, Gavi and its partners, including WHO, had revitalized immunization as a strategy for averting millions of childhood deaths each year. The new rotavirus and pneumococcal vaccines raised hope that diarrhoea and respiratory infections – the two biggest childhood killers – could be more routinely prevented.

In 2010, the Decade of Vaccines was launched at the World Economic Forum as an effort, supported by multiple stakeholders, to extend the full benefits of immunization to all by 2020. To support this goal, the World Health Assembly approved the ambitious Global Vaccine Action Plan in 2012 as the framework for delivering universal access to vaccines.

The Vaccine Action Plan has been described as “one of the largest and most ambitious public health initiatives ever launched”. It set new targets for the decade, defined their indicators, proposed six strategic objectives and the actions needed to achieve them, and provided an initial estimate of resource requirements and return on investment.

As a contribution to measurement and accountability, WHO’s Strategic Advisory Group of Experts (SAGE) on immunization has issued annual progress reports on implementation of the plan. The 2016 report provides a careful analysis of progress and challenges at the midpoint in the decade. Despite some bright spots in global immunization efforts, the overall picture is sobering.

On the bright side, more children are being immunized worldwide than ever before, with the highest level of routine coverage in history. **Indigenous measles and rubella have been eliminated from the Americas, and maternal and neonatal tetanus has been eliminated in South-East Asia.**

Since 2010, 99 low- and middle-income countries have introduced one or more new or underutilized vaccines, exceeding the target set out in the action plan. While data are not yet available to quantify the associated impact on child health, the steep decline in morbidity and mortality from pneumonia and diarrheal disease recorded in some countries that introduced the pneumococcal and rotavirus vaccines suggests that the contribution will be substantial.

At the same time, sustainability is an issue of growing concern. Even very poor countries have used domestic resources to support free immunization services as a public good. As more countries progress to middle-income status, they lose their eligibility for financing from GAVI, raising questions about whether introduction of the newer and more expensive vaccines can be fully financed from domestic budgets.

The success of the polio eradication initiative raises additional long-term concerns. For example, the 2016 outbreaks of urban yellow fever in Angola and the Democratic Republic of Congo prompted the largest emergency vaccination campaign ever undertaken in Africa. A crisis was averted, partly because countries could draw on the experience, massive infrastructure, and human resources of polio programmes already in place.

On the R&D front, substantial progress was recorded in developing vaccines for HIV, malaria, dengue, and tuberculosis. However, that progress underscores the urgent need to expand clinical trial capacity and strengthen the procedures used by national regulatory authorities to evaluate and license vaccines and technologies in the developing world. These needs are being addressed by two WHO initiatives: the African vaccine regulatory forum and a network of vaccine regulators from developing countries.

New platform delivery technologies are also being developed to make vaccines easier to safely store, transport, deliver, and administer. These technologies, once tested, licensed, and deployed at scale, will have a powerful impact on health and well-being around the world. They will enable many countries to expand immunization to reach even the most remote and vulnerable populations.

Yet, as the SAGE assessment revealed, progress towards other key targets has been sluggish and is woefully inadequate to meet the soaring ambitions of the action plan. Halfway through the decade, global targets set for maternal and neonatal tetanus, measles, and rubella, all slated for elimination, were missed by a long shot. Although more infants than ever before are receiving the critical third dose of diphtheria-tetanus-pertussis vaccine, global coverage of these basic vaccines has increased by only 1% since 2010, putting one of the plan's most important targets seriously off track. In 2015, 68 countries fell short of the target to achieve at least 90% national coverage with the third dose. Some 26 countries reported no change in coverage levels and 25 countries reported a net decrease.

The SAGE experts commended the 16 countries that made good progress, especially in reaching vulnerable and marginalized populations. Their success confirms that progress on immunization can be achieved with strong domestic leadership, smart and sustained investments, and effective accountability mechanisms. Some countries with the highest number of unvaccinated children made the most progress, including the Democratic Republic of Congo, Ethiopia, and India. While these countries did not meet the target, all are moving in the right direction.

The long-standing problem of poor quality data persists, impairing the identification of populations that are being missed and the design of targeted corrective strategies. **Replacing guesswork with solid data can bring surprises.** After improving the accuracy of its immunization data, Mexico found that immunization coverage was actually 10% lower than previously thought. By making pockets of missed people visible, Mexico was able to make them a priority for remedial action.

Success stories in individual countries brighten the sobering picture considerably. Beginning in 2010, India made new investments in health systems, replacing and repairing cold chain equipment, training and accrediting thousands of social health activist workers, and using micro-planning to support immunization. These improvements and the intensification of services through special campaigns resulted in coverage jumping from 79% to 87%. In numbers, that meant two million more children received vaccination services in 2015 than in 2010.

Chad used the “Reaching every community” strategy to achieve hard-won coverage gains that rose from 39% to 55%, proving that progress is feasible in any determined country. Like Mexico, Uganda took risks to change systems and improve outcomes for the better even if the payoff is yet to come.

The assessment also revealed a general failure to appreciate the broader value-added benefits that a well-performing immunization programme brings to overall health care. When systems for vaccine procurement and delivery operate as a fully integrated component of a health system, they can drive the move towards universal health coverage.

Moreover, immunization has become a fundamental strategy for achieving more recent health priorities, from preventing liver and cervical cancer – the biggest causes of cancer in the developing world – through hepatitis B and human papilloma virus vaccines, to curbing antimicrobial resistance, to providing a platform for improving antenatal and newborn care and meeting the long-neglected needs of adolescents.

WHO is now challenging international and national health leaders to make immunization not only one of the biggest success stories of modern medicine, but the greatest success story ever. Technically, this is entirely feasible. Full implementation of the Global Vaccine Action Plan remains the best route for doing so. In a world where vast social inequalities create unrest and disturbing instability, the game-changing power of universal coverage with safe, protective, and cost-effective vaccines deserves a much higher profile.

Vaccines have been key contributors to the global reduction in under-five mortality since 2000



Source: WHO

Pandemic preparedness: increasing the supply of influenza vaccines

The wave of human infections with the H7N9 avian influenza virus that began in China in September 2016 has again raised alarm about the threat of a pending influenza pandemic. The Pandemic Influenza Preparedness Framework has worked in innovative ways to prepare the world for such an event. As an additional capacity-building measure, WHO established a Global Action Plan for Influenza Vaccines in 2006 to address the projected serious shortfall of vaccine supplies during the next pandemic. The plan, which was intended to operate for a decade, set out a three-pronged preparedness strategy: improve the use of seasonal vaccines, increase vaccine production capacity, especially in the developing world, and promote R&D for better vaccines and vaccine production technologies.

Its achievements have been significant. Studies over the past 10 years, documenting the burden of seasonal influenza, have encouraged 115 countries to put in place national policies for increasing the use of seasonal influenza vaccines, up from only 74 in 2006. Making good use of seasonal influenza vaccines not only protects health. It also provides the market incentive needed to increase production capacity and builds the delivery infrastructure that will be critically important during a pandemic.

In 2006, WHO estimated that global pandemic vaccine manufacturing capacity was around 1.5 billion doses per year, with all capacity concentrated in a few wealthy countries. A decade later, that capacity has more than quadrupled to reach 6.4 billion doses. An innovative technology transfer initiative brought the funding and technical support needed to establish 14 vaccine manufacturers in developing countries. Six of these countries have licensed locally produced influenza vaccines, of which three have been prequalified by WHO. Other countries are making steady progress towards this goal.

WHO has further worked to strengthen expertise in the national regulatory authorities of all 14 countries. Here, too, progress has been substantial. In 2006, only four of these countries had a functional regulatory authority. Now ten do. This progress highlights the synergy between the Global Action Plan for Influenza Vaccines and the Pandemic Influenza Preparedness Framework, which has an investment stream for strengthening the capacity of national regulatory authorities.

Vaccines and their production technologies also improved. Numerous advances include adjuvanted pandemic vaccines that permit dose-sparing and conserve the use of antigen, live attenuated vaccines with improved production efficiency and significant operational advantages, tetravalent vaccines with broader strain coverage, and tissue-culture and recombinant vaccines that avoid the need for huge quantities of eggs in the production process and can thus be produced more quickly and efficiently. However, the ideal product – a universal vaccine that protects, year after year, against both circulating seasonal strains and a pandemic strain – remains elusive.

Nonetheless, all of these improvements have left the world vastly better prepared to respond quickly, and with benefits fairly shared, when the next influenza pandemic inevitably comes.

A vaccine stockpile with a huge impact

As WHO further demonstrated, even something so seemingly simple as a stockpile of vaccines can have an outsized impact on outbreak response while also improving many of the factors that influence access to vaccines.

In 2013, WHO created a stockpile of oral cholera vaccines in response to a critical situation. Cholera epidemics were raging, yet the use of vaccines was low and manufacturers had little incentive to increase supplies. In establishing the stockpile, WHO made a commitment to buy and use 2 million doses a year in order to facilitate the availability of vaccine to underserved populations.

Although the cholera vaccine stockpile is essentially a vaccine access, procurement and distribution mechanism, it has generated multiple health benefits well beyond saving lives. It improved reporting. In public health, the promise of assistance is one of the strongest incentives to report epidemic-prone diseases immediately and transparently. As long experience shows, the temptation to cover up a cholera outbreak is great, given the potential impact on trade and tourism.

The stockpile improved access to oral cholera vaccine and therefore the capacities of emergency response, especially in the context of humanitarian crises, such as the ones currently being experienced in South Sudan and Somalia. Following receipt of a request by the International Coordinating Group, vaccines are due to arrive in the country within a maximum of 10 days. It also increased supplies. Three producers have now been prequalified by WHO, with vaccine supply set to triple in 2017. **These vastly increased supplies have opened the first opportunity for large scale campaigns in “hot spots” with repeated outbreaks.**

In addition, the stockpile decreased costs as more producers entered the market, and generated additional data on vaccine safety, effectiveness, and impact, thus strengthening the case for further investment.

In short, a seemingly simple thing, like the setting up of a stockpile, has transformed a vicious cycle of low demand, low production, high price, and inequitable distribution to a virtuous cycle of increased demand, increased production, reduced price, and greater equity of access. WHO regards a stockpile of rabies vaccine as a logical next step to follow.

This report is available on WHO's website
www.who.int/publications/10-year-review/en/