REPORT

on the

FOURTEENTH INTERNATIONAL

ROTAVIRUS SYMPOSIUM

MARCH 14–16 **2023** BALI INDONESIA

BILL & MELINDA GATES *foundation* PATH ROTA Rotavirus Organization of Technical Affairs SABIN VACCINE INSTITUTE

THE ORGANIZERS WOULD LIKE TO THANK
THE FOLLOWING FOR THEIR FINANCIAL
SUPPORT TOWARD THE ORGANIZATION
AND SUCCESS OF THIS MEETING

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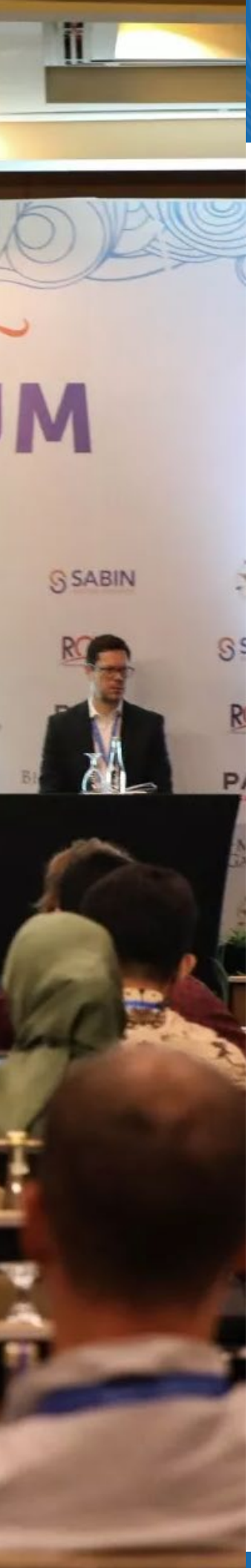


INTRODUCTION

The 14th International Rotavirus Symposium, hosted by the Indonesian Ministry of Health and the Sabin Vaccine Institute, was the first to be held since the COVID-19 pandemic began. It was a moment of reflection and celebration for the 275 rotavirus researchers, public health leaders, policy makers, and vaccine manufacturers who gathered from around the world. Their presentations spoke broadly to three main themes: tremendous progress made to date; setbacks and challenges; and opportunities to further lower the burden of rotavirus for young children, their families, and countries.

Since the discovery of rotavirus 50 years ago, a growing global community has dedicated itself to ending the heavy toll of deaths and disease in infants and young children caused by the ubiquitous rotavirus. Vaccines have played an important role in the reduction of rotavirus deaths among children under five years, together with improved socio-economic conditions and access to better health care. Rotavirus deaths have fallen from an estimated 440,000 in 2006 to 208,000 in 2018 (COVID19 has disrupted more recent surveillance).

Nonetheless, 58 million children, many who live in settings with high under-5 childhood mortality and high rotavirus diarrhea rates, still do not have access to rotavirus vaccines. In addition, the COVID-19 pandemic delayed new vaccination introductions and depleted vaccine coverage in many countries. Rotavirus vaccines are not yet implemented in many middle-income countries, despite high burdens of hospitalization as well as avoidable deaths. Holistic approaches to the prevention and treatment of acute diarrheal deaths are needed now to protect health and save lives, including through the better use of existing vaccines; the development of new, more effective vaccines; and treatment with Oral Rehydration Solution for children who become severely ill.

Photo Courtesy Bill & Melinda Gates Foundation

MAIN MESSAGES

Tremendous Progress

Four WHO pre-qualified rotavirus vaccines are now in use in 123 countries. The first two (Rotarix and RotaTeq) were introduced in 2006, and two newer vaccines (RotaVac and RotaSILL) became available for global use in 2018. The vaccines have contributed to a 59% global reduction in rotavirus hospitalizations (2006-2019). A recent modeling study based on combined rotavirus mortality datasets finds that these vaccines averted an estimated 141,000 child deaths from rotavirus since 2006.

The two newest vaccines were developed and are manufactured in India, representing a turning point for Asia and for the world in its fight against rotavirus, as India alone comprises more than one-fifth of the global population and caried a significant rotavirus burden. Indonesia has also joined the ranks of vaccine innovators and producers, and Phase 3 clinical trials of its neonatal vaccine, RV3-BB, are nearing completion. The vaccine follows all Halal guidelines, which would make it a good option for Muslim countries.

Challenges and Setbacks

Despite this progress, rotavirus remains the top cause of diarrheal deaths in children under five globally. This is due to both gaps in coverage (an estimated 58 million children still do not have access to rotavirus vaccines) and the lower efficacy of rotavirus vaccines in high-mortality, low-income settings. In addition, the COVID-19 pandemic set back the clock on childhood vaccination rates, which fell by 6% to 7% during the pandemic. Five million additional children received no vaccines during their first year of life in 2021. The decline in vaccination was concurrent with a rise in poverty and the over-extension of health systems. Challenges with vaccine costs and uncertain global supply continued to present obstacles to vaccine access, and disappointing results in the clinical trial of an experimental vaccine means it will likely be several years before next generation, non-replicating rotavirus vaccines are available.

Abundant Opportunities

A road paved by innovation now opens abundant opportunities to further reduce the burden of rotavirus on child health and survival. Countries are applying lessons learned from COVID-19 to strengthen immunization and health systems. Several countries are building new centers of vaccine innovation and manufacturing, and fresh data strengthens the case for rotavirus vaccine introductions in a number of low- and middle-income countries. Meanwhile, excellent science is further illuminating factors that impact vaccine efficacy and spurring new vaccine approaches, from neonatal to parenteral vaccines.

Countries are applying lessons learned from COVID-19 to strengthen immunization and health systems.

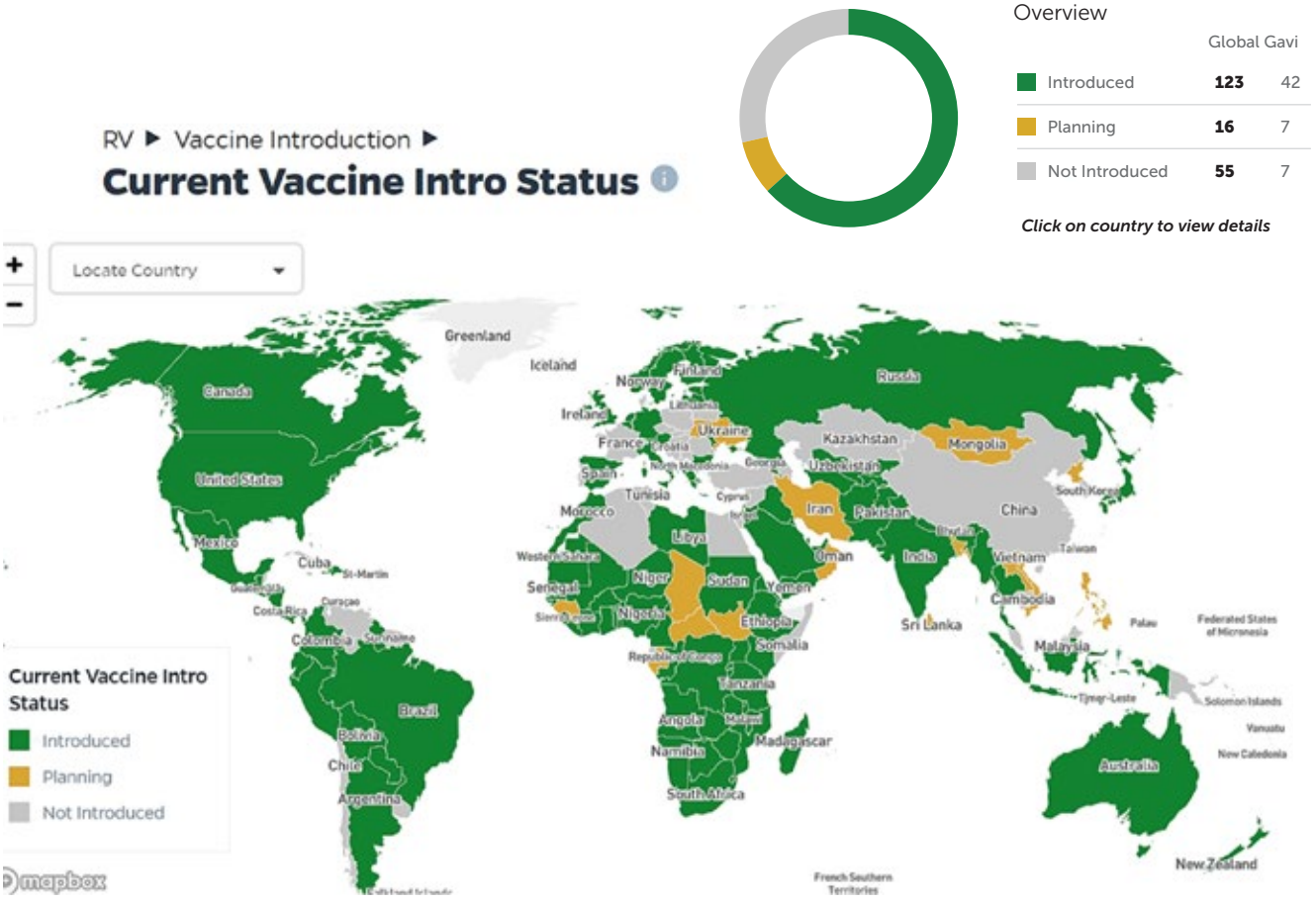
TREMENDOUS PROGRESS

FOUR WHO PRE-QUALIFIED rotavirus vaccines have contributed to a 59% global reduction in rotavirus hospitalizations and averted an estimated 141,000 child deaths by 2019. The first two vaccines (Rotarix and RotaTeq) were launched in 2006, and two more, RotaVac and RotaSIIL, were WHO-prequalified in 2018. Developed and produced in India, the two latest rotavirus vaccines present a turning point for Asia and for the world in its fight against rotavirus. Indonesia and Vietnam have also joined the ranks of vaccine innovators and producers, and Indonesia's neonatal vaccine, RV3-BB will complete its Phase 3 clinical trial later this year. Rotavirus vaccines are now used in 123 countries around the world.

141,000

child deaths **averted** by

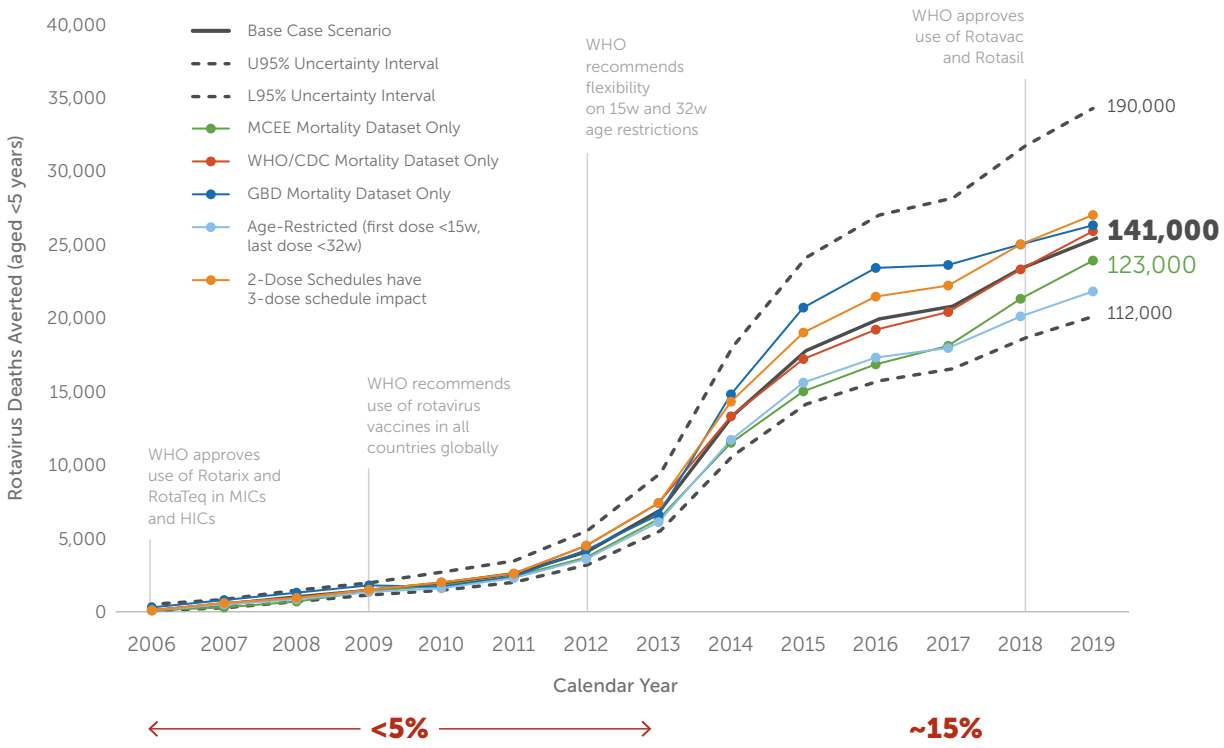
2019



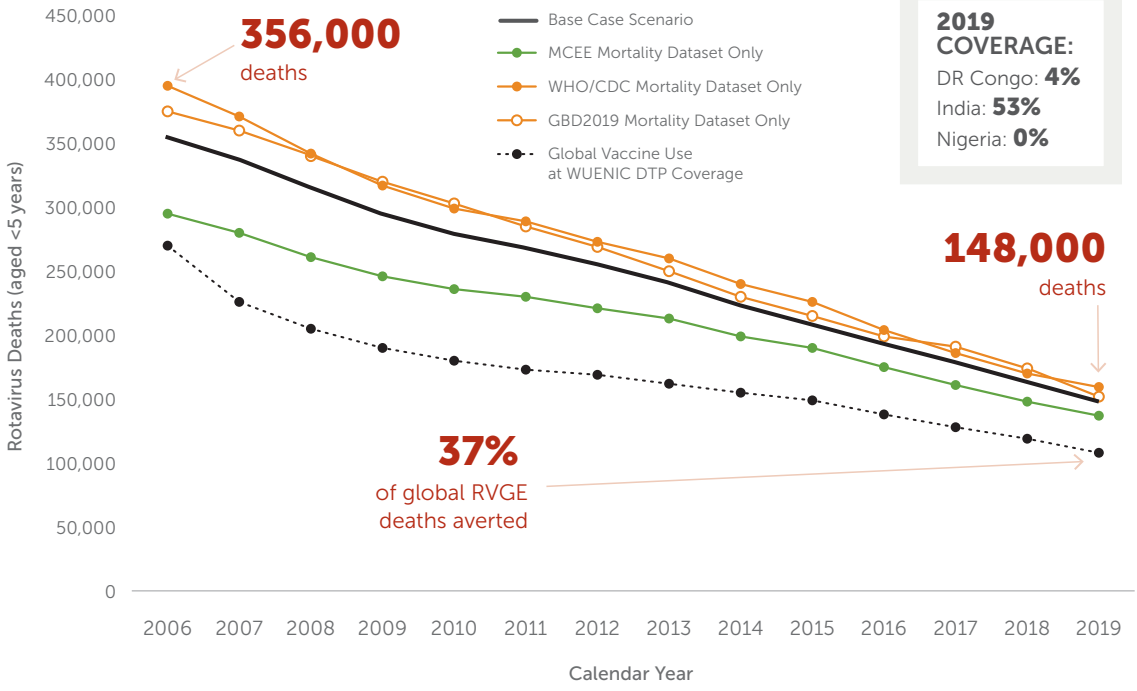
VIEW-hub

Global Mortality Reduction Impact of rvv in the Pre-COVID-19 Era

RESULTS:
RVGE Deaths Averted



RESULTS:
RVGE Deaths <5 Years



Sarwat Mahmud, London School of Hygiene & Tropical Medicine

Hugh Sitton/Getty Images

Lowered rates of severe disease, hospitalization and death

- **Huge decline in rotavirus deaths:** The number of rotavirus deaths among children under five years fell from an estimated 800,000 in 1985 to 440,000 in 2006 to 208,000 in 2018. Vaccines, improved socio-economic conditions, and better access to healthcare all contributed to this decline.

- **Rotavirus hospitalizations averted:** The median percentage of rotavirus-positive samples in children hospitalized with diarrhoea declined from 40% pre-vaccination to 20% four years following vaccine introduction.

- **Rates of severe childhood diarrheal disease plunge**. Rotavirus vaccination has helped lower overall rates of diarrheal disease in the countries where they are used. As of December 2019, there has been a 36% reduction in hospitalization for all acute gastroenteritis and 36% reduction in all such deaths.

- **Rotavirus hospitalizations fall in African countries:** Following vaccine introduction in The Gambia, Mali, and Kenya, the incidence of rotavirus hospitalizations dropped by 48%. Other diarrheal pathogens, including Cryptosporidium and Shigella, remain important etiological agents of acute, moderate diarrhoea in young children <5 years of age and require global public health intervention strategies.

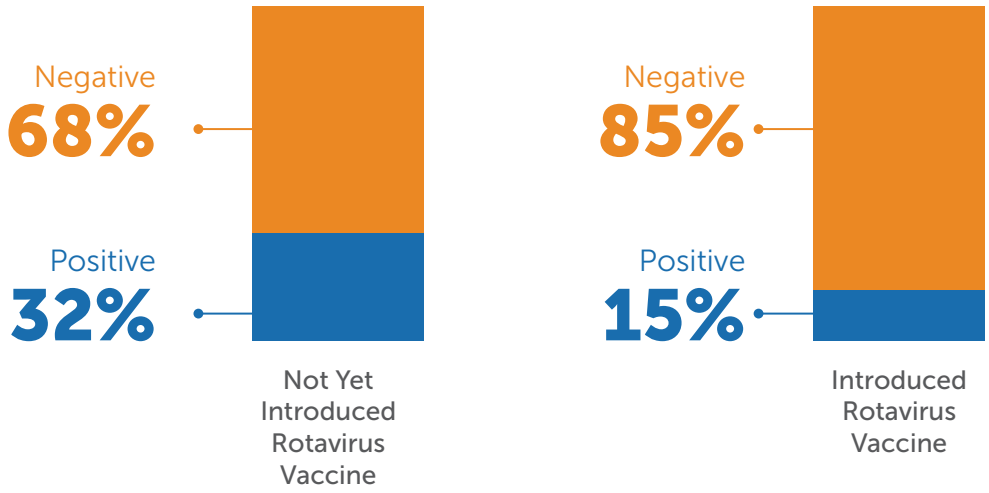
Vaccines Developed and Deployed

- **Four safe, effective, rotavirus vaccines are in use in 123 countries:** All four are oral vaccines, delivered in two or three doses starting from six to eight weeks of age. They self-replicate in the gut, eliciting an immune response that is protective. These vaccine products come in a range of formulations, including liquid, frozen and freeze-dried formulations with different price points and logistical considerations for a national immunization program. Vaccine efficacy is similar among the products, and averages <60% in low- and middle-income countries (LMICs) and >90% in high-income countries.

- **High-mortality countries introduce and scale rotavirus vaccine in midst of COVID-19 pandemic:** The high rotavirus mortality countries of India (2019), Democratic Republic of the Congo (2019), Indonesia (2022), and Nigeria (2022) have now introduced rotavirus vaccine. The DRC became the first Gavi-supported country in Africa to introduce India's RotaSIIL, and Nigeria opted to implement the RotaVac vaccine, following its use in Ghana.

- **Vaccine innovation, production and introduction leaps forward in Asia:** The development of WHO pre-qualified vaccines in India and Indonesia, two of the world's most populous countries, signals a new era for rotavirus vaccination. Some 25 million babies born every year in India, and 4.5 million babies in Indonesia will have access to locally manufactured safe and effective rotavirus vaccines.

Rotavirus Positivity was Significantly Lower in Countries with Rotavirus Vaccine



Data is based on hospitalized children under five years old in countries participating in the Global Rotavirus Surveillance Network.

Heidi Soeters, World Health Organization

Union Minister launches Rotavirus Vaccine in India, March 2016

Courtesy of Bill & Melinda Gates Foundation

» **Indian-made vaccines reach the world:** India's two new rotavirus vaccines are the monovalent RotaVac produced by Bharat Biotech and the pentavalent, reassortant, RotaSIIL produced by the Serum Institute of India. RotaVac was introduced into India's Universal Immunization Programme (UIP) in four States in 2016, to evaluate the programmatic feasibility of adding a new orally delivered vaccine into the world's largest Universal Immunization Program (UIP). The vaccine received WHO pre-qualification in 2018. RotaSIIL was also pre-qualified in 2018 and added to the Indian UIP in 2019, as rotavirus vaccines were made available to the entire country. By March 2023, 281.3 million doses of indigenous rotavirus vaccine had been administered nationally. Rotavirus hospitalization rates in India have declined between 40% to 58% (depending on the child's age) in the post-vaccination period. And are already protecting a significant percentage of the 25 million babies born every year.

Prior to vaccine introduction, rotavirus caused an estimated 11.37 million episodes of acute gastroenteritis (AGE) in children under five and 21,000 deaths annually. The average hospitalization cost per episode of rotavirus diarrhoea was around US $36, equal to 7.6% of an average Indian family's annual income, and hospitalizations nationally cost around $73 million each year.

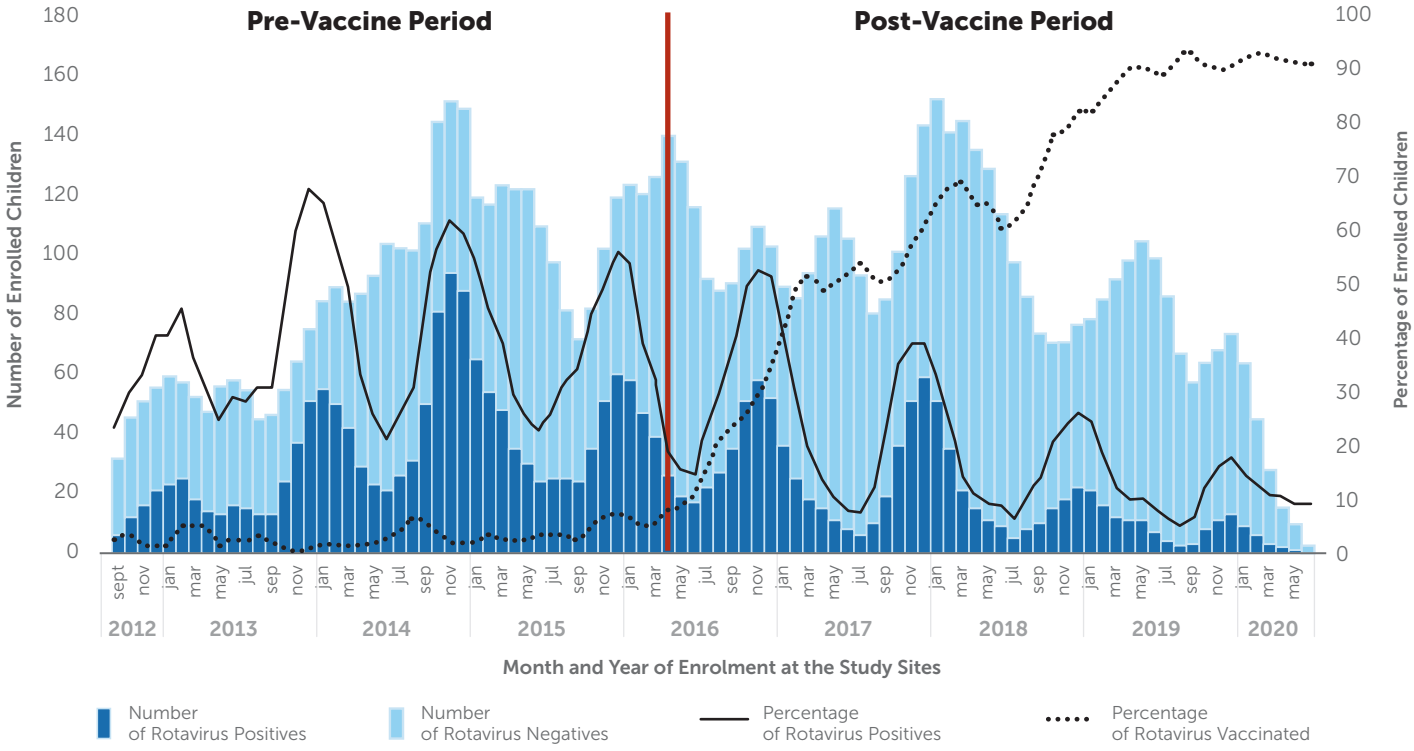
Both vaccines are now being used in other countries including several in sub-Saharan Africa and the Middle East.

» **Indonesia introduces rotavirus vaccine and looks to the future:** Early surveillance data showed that rotavirus was responsible for 60% of under-five hospitalizations for severe diarrhoea, and for thousands of deaths every year.

A cost-effectiveness study found that vaccination could reduce rotavirus hospitalizations and deaths by 36% in children under five years of age and would be highly cost-effective. That study was based on use of RV3-BB, a birth-dose (or neonatal) rotavirus vaccine, now in development by BioFarma, a state-owned pharmaceutical enterprise in Indonesia.

In 2022, the Indonesian Health Minster approved introduction of rotavirus vaccine as part of national routine immunization. A phased introduction began in November that year, with plans to expand nationwide in 2023. The program is currently using RotaVac, with plans to switch to RV3-BB when it becomes available.

Impact of Rotavac® Vaccine After Introduction into the Universal Immunization Programme in India



This graph includes the combined pre- and post-introduction data of rotavirus vaccine for children less than five years of age admitted due to acute gastroenteritis from five sites, namely, PGIMS, Rohtak, Haryana; Hi-Tech hospital, Bhubaneswar, Odisha; RPGMC, Tanda, Himachal Pradesh; SVMC, Tirupati, Andhra Pradesh and CMC, Vellore, Tamil Nadu. Except Tamil Nadu, all other sites had rotavirus vaccine introduced into the immunization programme by April 2016 which is indicated by the vertical line in the graph.

Venkat Mohan, Christian Medical College, Vellore

Significant Progress Scored on Neonatal Rotavirus Vaccine

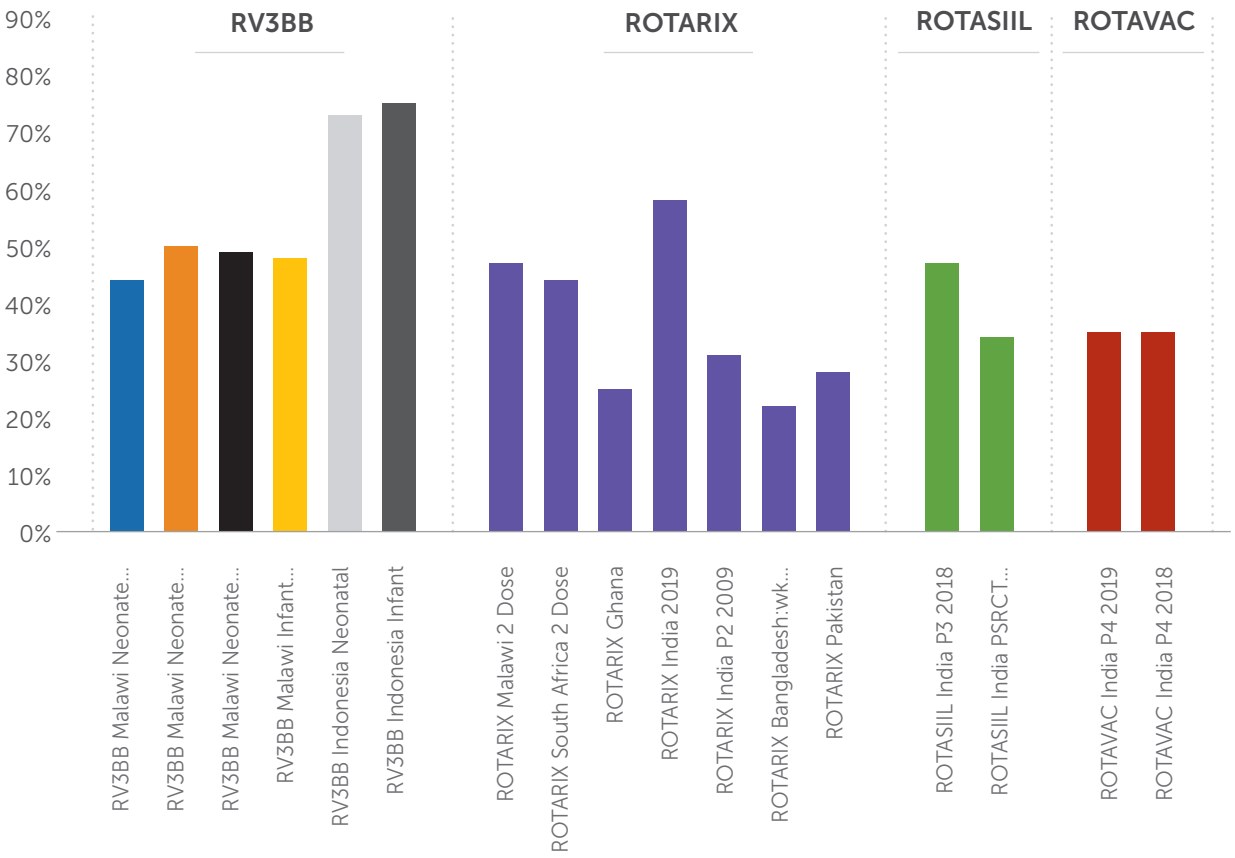
- **A vaccine designed to protect babies from birth (neonatal vaccine):** Initially developed by the late Ruth Bishop (12 May 1933 — 12 May 2022) and Graeme Barnes at the Murdoch Children's Research Institute (MCRI) in Australia, RV3-BB vaccine is based is on the naturally attenuated human neonatal rotavirus strain RV3 (G3P[6]). Researchers have postulated that a birth-dose vaccine would provide both earlier and better protection against rotavirus than current vaccines in LMICs.

- **An equitable approach to vaccine development:** MCRI licensed RV3 to emerging country vaccine manufacturers, including BioFarma in Indonesia, which supplies other vaccines to more than 152 countries. MCRI, BioFarma, and Indonesia's Gadja Mada University have been collaborating to develop and manufacture RV3-BB as an affordable, porcine-free vaccine that meets Islam's Halal requirements.

Potential to provide greater protection in LMICs: The final report of RV3-BB's Phase 3 clinical trial is expected in September 2023 — and BioFarma is already ramping up production capacity. Studies indicate that RV3-BB elicits a strong immune response in neonates and infants comparable to the licensed and pre-qualified vaccines. In Indonesian new-borns RV3-BB had an efficacy against severe rotavirus disease of 94% at 12 months and 75% at 18 months of age. Vaccine take is not affected by maternal or breast milk antibodies and does not disrupt the normal development of the infant's gut microbiome. RV3-BB can be safely co-administered with oral polio vaccine, without lowering the efficacy of either vaccine.

Positive serum IgA responses (%) at 18 weeks of ageRV3-BB and WHO PQ rotavirus vaccines in LIMCs

Age at blood test 18 weeks of age unless otherwise indicated
Only studies with >100 participants included



Julie Bines, Murdoch Children's Research Institute

Local **wisdom** from Indonesia: **Think big,** start small, **act now**

The Symposium honored Professor Yati Soenarto for 45 years of tireless work as a leader, researcher, mentor and advocate for diarrheal disease control in Indonesia. Prof. Soenarto described how she was guided by the local wisdom of "Think big, start small, and act now."

Prof. Soenarto and Prof. Ruth Bishop were close colleagues, collaborating for five decades. Soon after Prof. Bishop identified rotavirus in 1973, Prof. Soenarto showed that it was the agent responsible for widespread diarrheal disease and death in young children in Indonesia. She developed the Indonesian national rotavirus surveillance system, and, in 2011, her team conducted a clinical trial for the neonatal vaccine RV3-BB in collaboration with Professors Bishop, Barnes and Bines from MCRI.

Prof. Soenarto's work has bridged worlds of public health, medicine and policy. Among the symposium's 275 participants were dozens of young researchers and physicians from Indonesia and the region whom she has inspired and mentored. They represent a new generation of experts, standing shoulder to shoulder with the first — thinking big, starting small (sometimes), and acting now to end avoidable rotavirus deaths in infants and young children.

Among the symposium's 275 participants were dozens of young researchers and physicians from Indonesia and the region whom she has inspired and mentored.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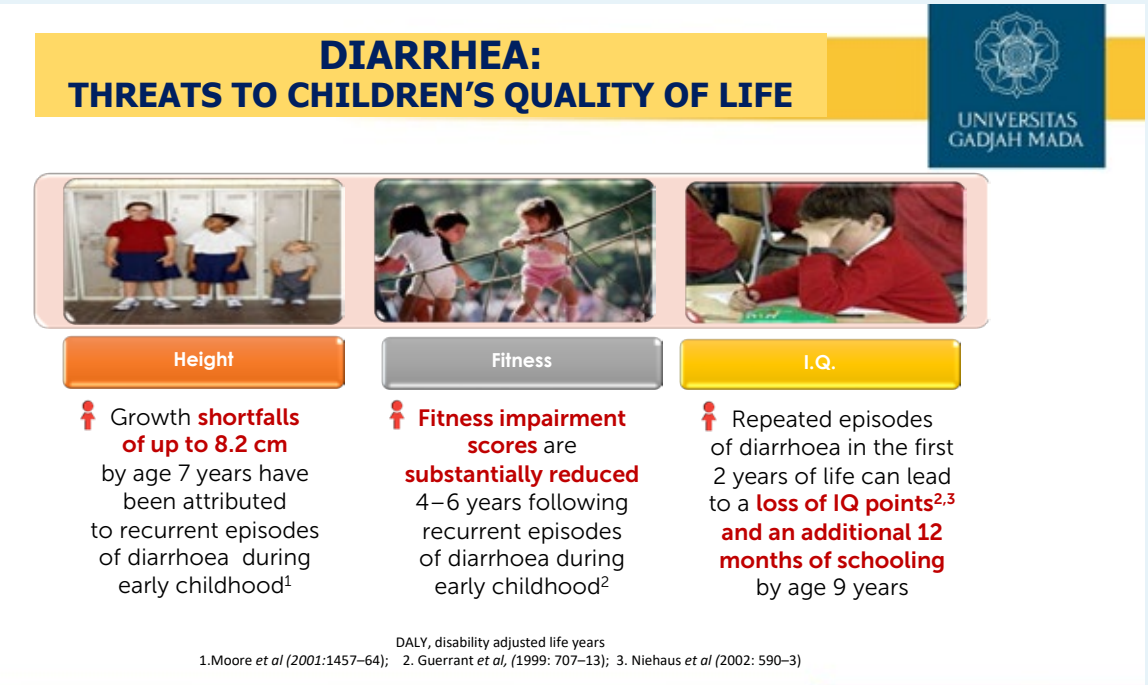
CHALLENGES AND SETBACKS

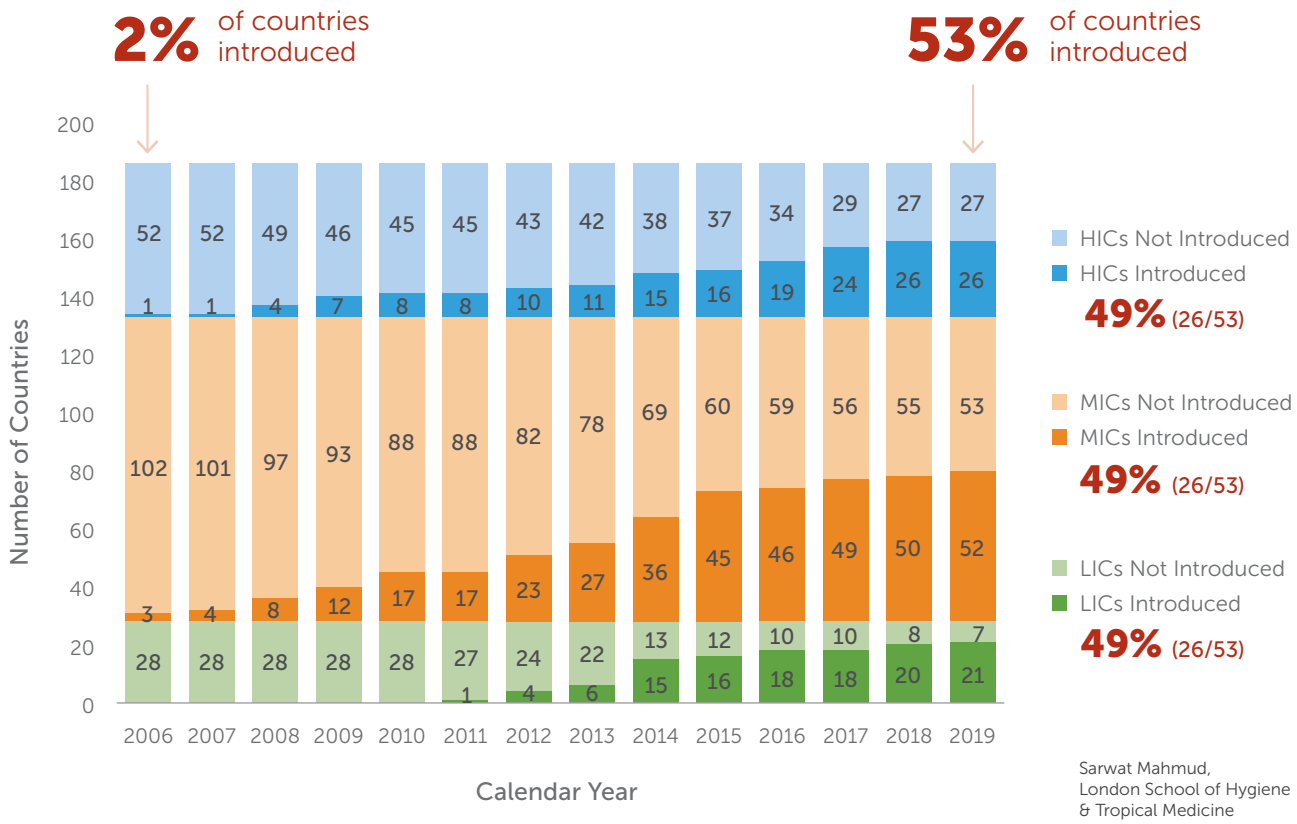
Despite this progress, rotavirus remains a leading cause of diarrheal deaths in children under five globally, mainly due to limited vaccine coverage (58 million children without access) and lower rotavirus vaccine efficacy in high-mortality, low-income settings. During the COVID-19 pandemic, childhood vaccination rates dropped by about 7%, and in 2021, five million additional children missed all vaccines in their first year of life. This decline in vaccinations occurred alongside increased global poverty and strained health systems. Vaccine costs, uncertain supply, and the need for product switching further hinder vaccine access, presenting programmatic challenges with varying dosing schedules, formulations, and healthcare training requirements.

Despite vaccine uptake in a growing number of countries, millions of children in low- and middle-income countries still lack access to rotavirus vaccines.



Hera Nirwati, Univeritas Gadjah Mada

Results: Vaccine Introduction



Sarwat Mahmud,
London School of Hygiene
& Tropical Medicine

Rotavirus Remains the Top Cause of Under-Five Deaths from Diarrheal Diseases

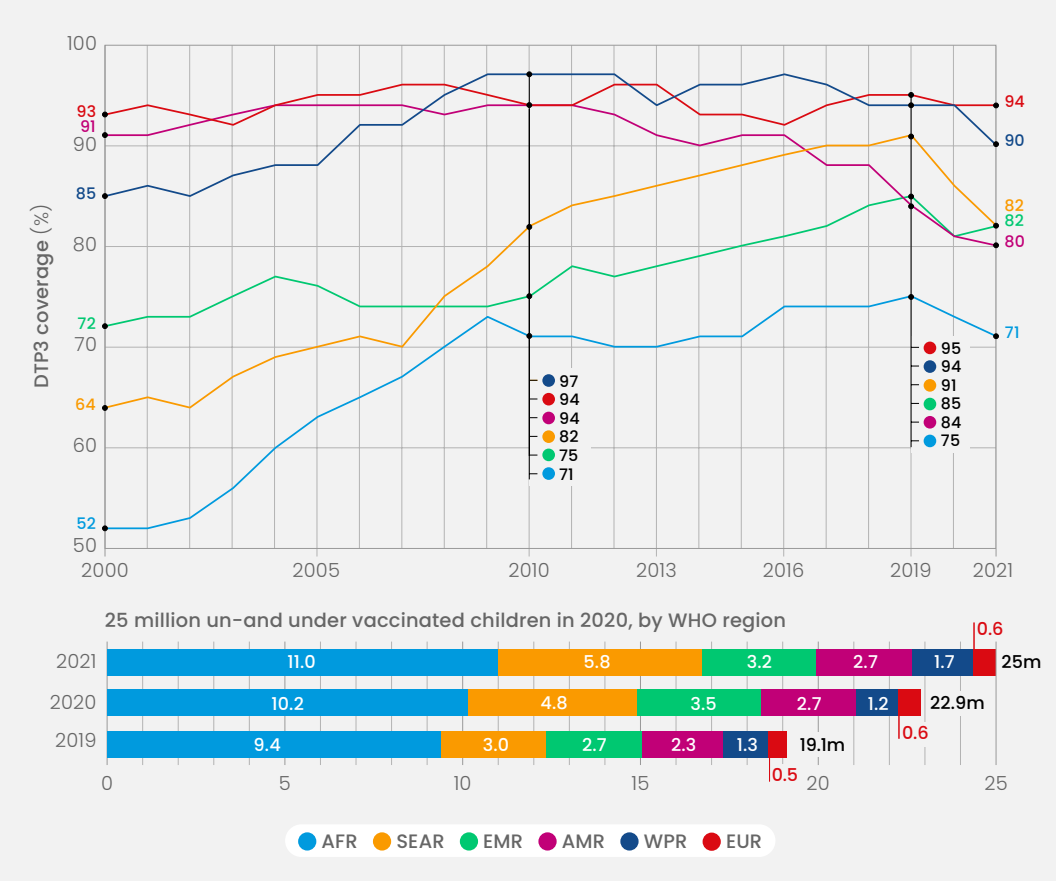
- **Global Pediatric Diarrhoea Surveillance Network,** which tracks all major causes of childhood diarrhoea across 28 countries globally, recently showed that rotavirus is still responsible for ~20% of under-five hospitalizations for gastroenteritis (down from 40% before rotavirus vaccines were in wide use). Yet, it remains the leading cause of diarrhea in hospitalized children, followed by , norovirus, adenovirus and sapovirus.

- **Ten major diarrheal diseases caused 582,295 deaths** in children under five in 2017-2018, or 9.1% of all deaths of children under five years old. Rotavirus caused 208,000 of these deaths, twice as many deaths as did *Shigella*, the 2nd largest cause. About 150,00 of these deaths were in Africa, with Southeast Asia and the Eastern Mediterranean also heavily affected. Ninety-nine percent of deaths are in low- and middle-income countries.

COVID-19 Set Back the Clock of Childhood Vaccination

- **Declines in childhood immunization:** The magnitude of the disruptions caused by COVID-19 are not yet fully known but current data suggests a 6% to 7% decrease in global immunization rates, with LMICs hit the hardest. The need for health workers to focus on the pandemic; lockdowns; changes in healthcare seeking behavior; and vaccine supply chain disruptions contributed to declining immunization rates. Conflict and climate change are also disrupting immunization services, such as during the 2022 flood disaster in Pakistan.

- **Number of zero-dose children rising:** An estimated 18 million children born in 2021 did not receive a single dose of any

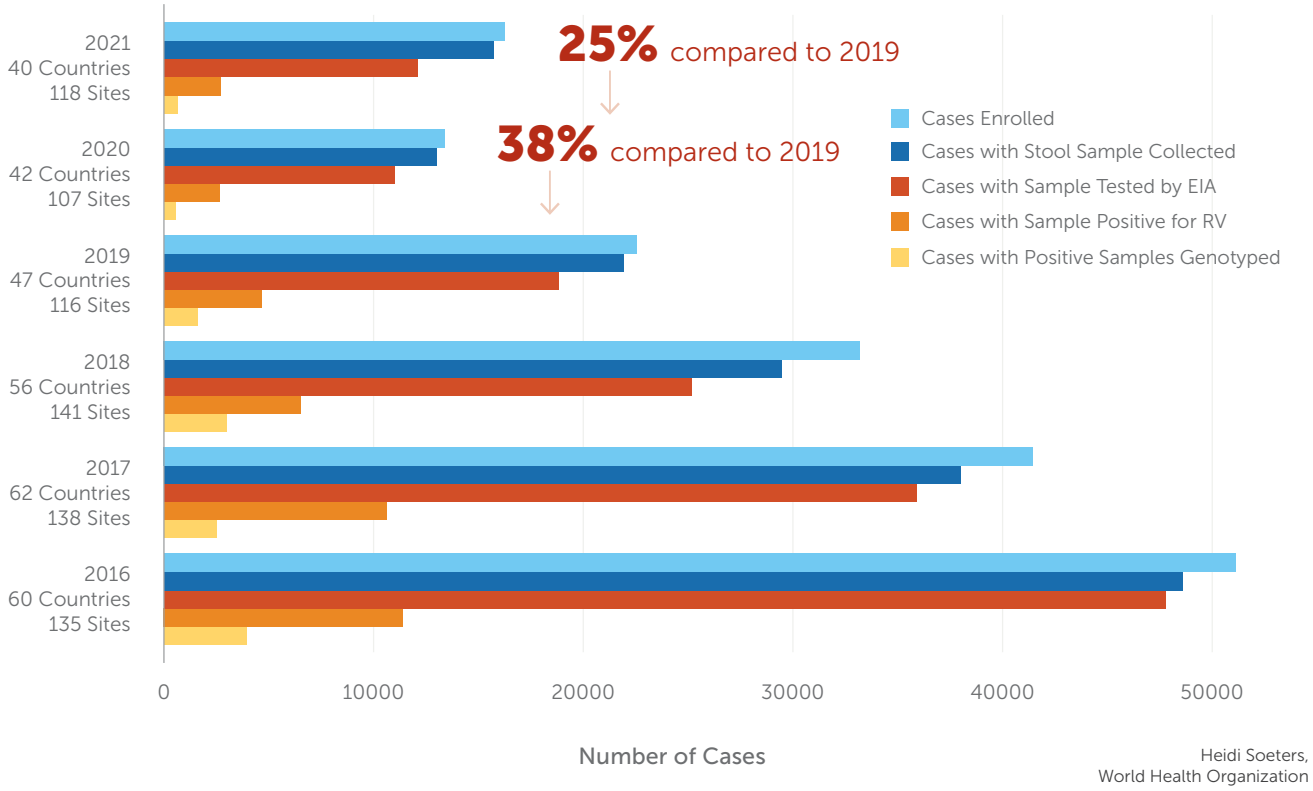


Impacts of COVID-19 on Childhood Vaccination

SOURCES: 2021 WUENIC Report: https://www.who.int/data/immunization

Duncan Steele, Bill & Melinda Gates Foundation

Global GRSN Surveillance Performance Trends, 2017–2021



Heidi Soeters,
World Health Organization

childhood vaccine. The number of such zero-dose children increased by 37% during the pandemic. Roughly 62% of zero-dose children live in ten countries; all but Brazil are in Africa and Asia. In India, Nigeria, Indonesia, and Ethiopia, between one-to-three million children remain zero-dose every year.

- **Vaccine hesitancy related to COVID** spilled over to routine childhood vaccination: For example, some parents in Indonesia who feared their children would be given COVID vaccine avoided their children's routine immunization. Health providers are therefore working to raise community awareness of rotavirus vaccine benefits.

- **Rotavirus disease surveillance was hit hard by COVID-19 disruptions:** Surveillance officers, laboratorians, and health care workers were redeployed to COVID-19 response, decreasing the human resources available for ongoing surveillance of rotavirus and other vaccine-preventable diseases. Logistical challenges arose with specimen transport, procurement and shipping of testing supplies and reagents. COVID-19 contributed to a decline in the number of countries participating in the Global Rotavirus Surveillance Network, which fell from 62 countries in 2017 to 47 countries in 2019, and, finally, to 40 countries in 2021. The declines and gaps in surveillance make it impossible to have a full picture of rotavirus over the last several pandemic years.

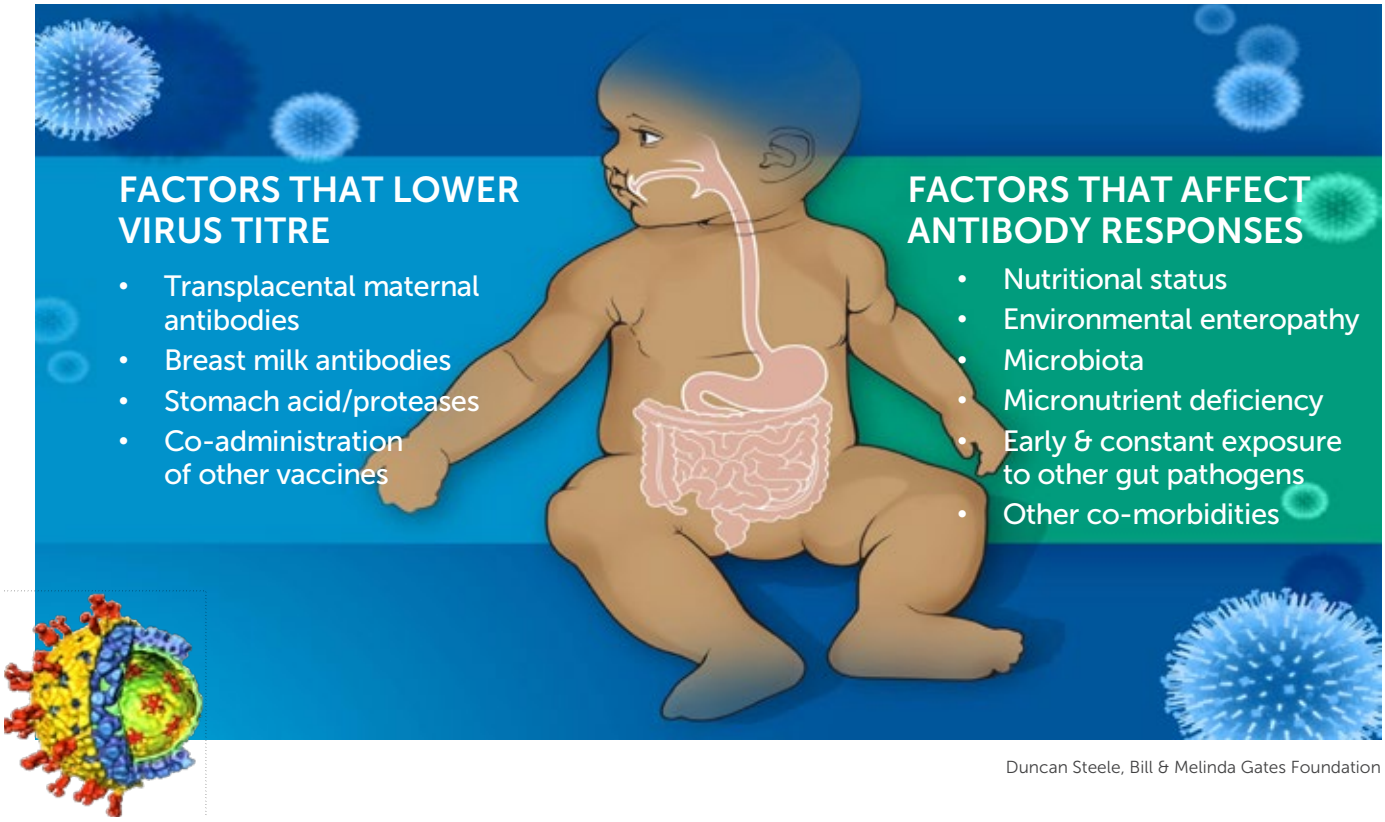
- **Fiscal stress threatens the recovery of health and surveillance systems:** Countries that incurred high debt to cope with the pandemic are unlikely to increase or even maintain their health budgets until 2026. This makes unlocking efficiency gains within vaccination and surveillance systems an imperative. The pandemic was concurrent with a global rise in poverty, hunger and malnutrition, which are worsening outcomes for disease. Meanwhile, the drop in vaccination is fueling a resurgence in diseases including polio, measles and diphtheria. All this has placed greater stress on health systems.

Gaps in Vaccine Efficacy Persist

- **Vaccine efficacy gap** Fully understanding and addressing the lower efficacy of oral, live vaccines in high-mortality, low-income settings remains a challenge. The vaccines' effectiveness depends on their ability to replicate and stimulate an immune response in the complex environment of the infant gut.

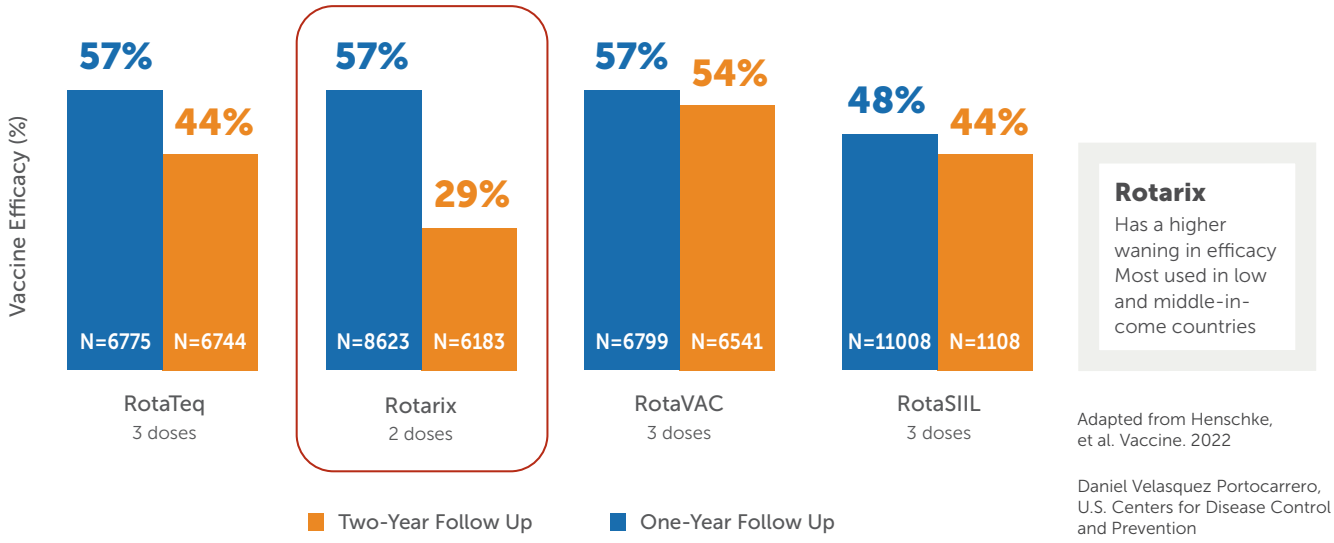
Factors that can interfere with vaccine take include other microbes, viruses and bacteria, especially when infants have early and constant

Challenges for Oral Rotavirus Vaccines



Duncan Steele, Bill & Melinda Gates Foundation

Rotavirus Vaccines Efficacy in High Mortality Countries in Africa and Asia



Rotarix
Has a higher waning in efficacy
Most used in low and middle-income countries

Adapted from Henschke, et al. Vaccine. 2022

Daniel Velasquez Portocarrero, U.S. Centers for Disease Control and Prevention

exposure to other gut pathogens. In addition, nutritional status can have a big impact on vaccine take. These factors are likely to present higher barriers to vaccine take in LMICs than in HIC. Other factors that may impede vaccine efficacy include transplacental maternal antibodies; breast milk antibodies; and the baby's stomach acid. Research is slowly disentangling these factors, and pointing toward ways to both strengthen efficacy of current vaccines and develop alternatives (see section "Abundant Opportunities").

Nutritional status can have a big impact on vaccine take.

Disappointing Results From An Experimental Vaccine

- **Clinical trial of P2-VP8 parenteral vaccine ended early:** Scientists are working to develop injectable, non-replicating vaccines (parenteral vaccines) that bypass the complicated environment of the child gut and allow for a stronger immune response. Until recently, the P2-VP8 vaccine was the most hopeful of these vaccines. However, interim results of a Phase 3 trial in infants in Ghana, Malawi and Zambia found that it did not perform any better than existing vaccines (Rotarix, specifically). Therefore, the trial was halted, and age-eligible trial participants received a pre-qualified oral rotavirus vaccine. Final analysis of the trial data is due mid-2024. Despite this setback, the vaccine was shown to be safe, and as one next step researchers plan to explore prime-boost regimens that combine the oral rotavirus vaccines and P2-VP8.

Insecure Global Supply and High Cost of Rotavirus Vaccines

- **Challenges to vaccine supply have impacted more than 20 countries:** These challenges have forced some countries to switch to a different rotavirus vaccine, a process that is costly in time and money. Significant supply disruptions began when Merck pulled RotaTeq from the GAVI market in 2018 and four African countries had to swiftly switch vaccines. Disruptions continued in 2021/22, due to production and delivery issues including of Rotarix and RotaVac 5D, causing another seven countries to switch vaccines. These issues have delayed introduction and caused stock outs, leaving infants unimmunized.
- **Costs can be prohibitive for some countries:** Gavi, the Vaccine Alliance, provides financial and product support to low-income countries. However, as national incomes rise, co-financing levels required of governments do as well, until countries are fully self-financed. This transition can be difficult, and funding gaps can raise the risk of backsliding in vaccine coverage or of putting off introductions of new vaccines. Of the 19 countries that have transitioned off Gavi support as of 2022, 13 have not yet introduced at least one of rotavirus vaccine, pneumococcal conjugate vaccine (PCV), or human papillomavirus (HPV) vaccine. In addition, some middle-income countries (MICs) that never qualified for Gavi support have yet to introduce rotavirus vaccine. Although there is no easy fix, new options and solutions are being found (see "Abundant Opportunities" section).

Of the 19 countries that have transitioned off Gavi support as of 2022, 13 have not yet introduced at least one of rotavirus vaccine, pneumococcal conjugate vaccine (PCV), or human papillomavirus (HPV) vaccine.

What is the Significance of Increasing Strain Diversity?

Surveillance continues to confirm that the rotavirus vaccines provide significant protection against rotavirus disease and deaths caused by all major human rotavirus strains. However, since the introduction of rotavirus vaccines there has also been an increasing diversity of more minor strains. They often originate in other animals, including dogs, cats, horses, pigs and bats.

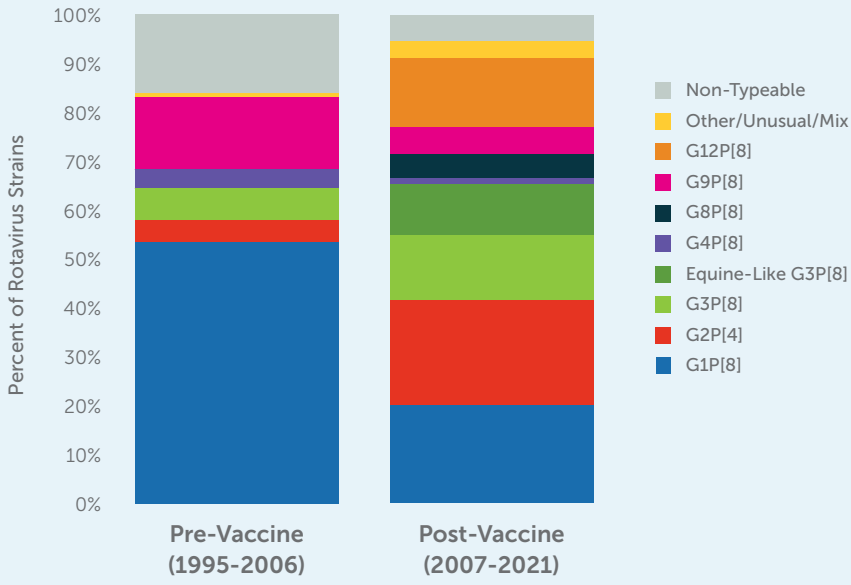
Natural shifts occur in strain diversity whether or not rotavirus vaccines are being used. The question is whether vaccine use is driving the emergence of the newly identified strains, and whether existing vaccines are as effective against them.

One potential concern is newly detected strains with an unusual equine-like configuration (known as a DS-1 backbone). In Taiwan, for example, where both Rotarix and RotaTeq have been used in the private market in 2006, 100% of strains had the DS-1 backbone by 2014. In addition, the DS-1 strains have typically arisen in countries that use the monovalent vaccine Rotarix, suggesting the possibility of vaccine-induced viral evolution.

The rapid rise of DS-1 in some countries reinforces the need for ongoing post-introduction surveillance. It also raises the question of whether a DS-1 vaccine is needed—and one is already in early stages of development at the US CDC.

A comparison of strain diversity in Australia, pre- and post-vaccine.

A Comparison of Strain Diversity in Australia, Pre- and Post-Vaccine



Celeste Donato,
Murdoch Children's Research Institute

ABUNDANT OPPORTUNITIES

In the aftermath of the COVID-19 public health emergency, countries are applying lessons learned from the pandemic to strengthen immunization and health systems. In addition, several countries are building new centers of vaccine innovation and manufacturing; and fresh data strengthens the case for rotavirus vaccine introductions in a range of LMICs. Meanwhile, basic science continues to illuminate factors that impact vaccine efficacy and spur new vaccine approaches, from neonatal to parenteral vaccines.

Applying Lessons from the COVID-19 Pandemic to Strengthen Health and Immunization Systems

- **Indonesia undertakes health system transformation:** Indonesia's Minister of Health Ms. Rizka Andalucia noted that last pandemic not only showed the importance of accessible vaccines for national recovery, but also the underlying need to close gaps in the health system. The government has therefore committed to a health transformation agenda with six pillars, the priority of which is the transformation of primary healthcare. This includes expanding adding vaccines—including for rotavirus—to the new national immunization program, with the target of reaching 4.3 million children annually.

- **India shares lessons from COVID-19:** The pandemic disrupted but did not derail rotavirus vaccine rollout in India. Now, innovations that addressed pandemic challenges are being used to strengthen vaccination programs. The IT platform developed for COVID vaccination is being applied to routine immunization and an augmented cold chain is available for childhood vaccines. Inter-sectoral coordination during COVID that included the health and education sectors, and self-help groups provides a model for greater collaboration in rotavirus and all childhood immunization.

India's Post-Introduction Evaluation Team

Photo Courtesy of Veena Dhawan, Additional Commissioner, Immunization Division
Ministry of Health & Family Welfare, Government of India

› Better targeting needed to reach all children: The deepening crisis of zero-dose children has highlighted the need for bold approaches that boost immunization by better engaging communities, women and professionals closest to service delivery, and by supporting ultra-local approaches that respond to the highly diverse and heterogeneous needs of countries and communities. Successes from three very different contexts—Chad, Dakar, and Nigeria—provide examples of possible approaches.

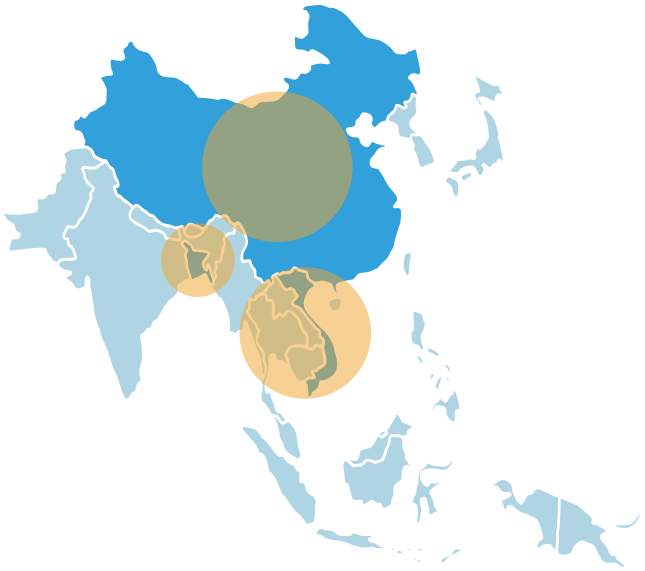
New Data Underscores Importance of Vaccine Introduction and Scale-Up, Particularly in Asia

› **Breakthroughs in India and Indonesia:** The adoption of rotavirus vaccines in routine immunization in India and Indonesia will protect millions of children against rotavirus in a region that has been slow to incorporate rotavirus vaccines. New data from several countries lends additional strong support for the introduction or scale-up of rotavirus vaccine.

» **Bangladesh:** Vaccine against rotavirus is available in the private market only in Bangladesh, despite past documentation of the virus' tragic impacts on child health and survival in the country. Adding to this critical mass of data, a new study shows that rotavirus vaccination in the capital of Dhaka would reduce disease by 59%-to-71% for infants and 34%-to-49% for children 1 year or older. The government has previously considered introduction of rotavirus vaccine, and the new data provides new incentive to act.

» **China:** A study in China, where rotavirus vaccines are only available in the private market, provides fresh insights into the impact of rotavirus. Researchers conducted a birth cohort study in rural Zhengding, North China, working with village doctors who visited the babies' households once a week. They collected information and fecal samples, and analysis revealed that rotavirus accounted for 41% diarrhea cases, the highest proportion of any pathogen.

» **Vietnam:** Vietnam has had rotavirus vaccine available in the private market since 2012. The state-owned company Polyvac and the US CDC collaborated to create the Rotavin vaccine, which was approved nationally in 2012. An improved version of the vaccine, Rotavin-M1, has now demonstrated vaccine efficacy of 56%-to-68%—on par with RotaTeq and Rotarix. Acting on the data, the government decided to add rotavirus vaccine its national routine immunization program, starting with Rotarix with plans to switch later to Rotavin-M1.



Vaccine Innovation and Manufacturing in Middle-Income Countries Opens Possibility

- **India's indigenous vaccine industry:** A highly sophisticated, indigenous industry propelled India's leap forward in rotavirus vaccination, and the Indian-made vaccines RotaVac and RotaSIIL are being taken up by countries around the world. Indonesia has likewise built a vaccine innovation and production hub responsible for creating what may well become the world's first neonatal rotavirus vaccine. Vietnam is also primed to become a focal point of rotavirus vaccine manufacture as its Rotavin-M1 vaccine moves forward.
- **Researchers from Bangladesh to Malawi shed light on vaccine impact:** Researchers in countries with high rotavirus mortality and low-income are deepening understanding of crucial factors in vaccine efficacy and immunology as they unravel the real-world impacts of rotavirus vaccination in these settings.

WHO Prequalified Oral Rotavirus Vaccines

Rotarix (GSK)	RotaVac (Bharat)	RotaSIIL (Serum Institute)	RotaTeq (Merck)
Monovalent attenuated human rotavirus strain	Monovalent attenuated human strain	Pentavalent, human-bovine reassortant vaccine	Pentavalent, human-bovine reassortant vaccine
G1P[8]	G9P[11]	G1-4, G9 human proteins with P[5] bovine in bovine rotavirus backbone	G1-4, P[8] human proteins in WC3 backbone
2 dose regime	3 dose regime	3 dose regime	3 dose regime
liquid presentation 1.0ml, single dose Plastic/BFS	Frozen & Liquid presentation 5&10 dose vial frozen 1&5 dose vial liquid	Lyophilized & liquid 1&2 dose presentation	Liquid presentation: 2ml, single dose Do not supply GAVI withdrew 2018
2008 	2016 	2016 	2008 

Duncan Steele, Bill & Melinda Gates Foundation

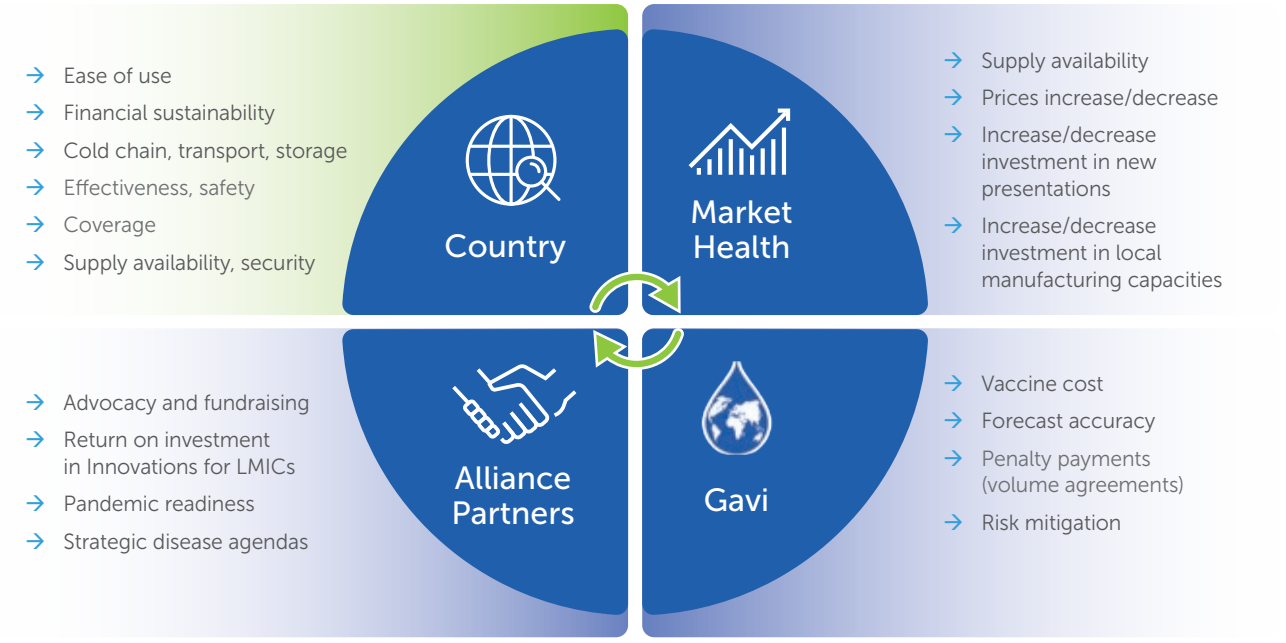
Making Rotavirus Vaccines More Affordable and Accessible

- **Cost-effectiveness shown in middle-income countries:** The largest number of unvaccinated children globally reside in MICs, but many MICs are unable to afford vaccines at full cost. A cost-effectiveness study suggests it is time to take another look. It assessed the cost-effectiveness of Rotarix, RotaVac and RotaSIIL in 63 MICs and found that RotaSIIL would be the most cost-effective choice for all countries, followed closely by RotaVac. From the government perspective, 77% of the countries had at least one cost-effective rotavirus vaccine option. Vaccine introduction would prevent 16,759 deaths over 10 years in just 17 countries where the vaccine is likely to be most cost effective.
- **Evaluating vaccine options:** The number of WHO pre-qualified rotavirus vaccines has expanded from the initial two in 2006 to four, with multiple presentations now available, including more affordable options than in the past. Therefore, countries that have used rotavirus vaccine for several years could possibly benefit from re-evaluating their choice of vaccine. Likewise, middle-income countries that have not yet incorporated rotavirus vaccines may find new cost-effective options.
- **Vaccine interchangeability:** Researchers in India reported that RotaVac and RotaSIIL can be used interchangeably, safely and effectively. A study of 1,852 children in urban and rural areas showed that mixing the vaccines can increase immune response in some cases and help prevent vaccination dropout. The findings are important for India where internal migration

Countries that have used rotavirus vaccine for several years could possibly benefit from re-evaluating their choice of vaccine. Likewise, middle-income countries that have not yet incorporated rotavirus vaccines may find new cost-effective options.

Countries Switching Vaccine Preferences Can Have Systemic Impact

A single country's vaccine switch can impact the market and affect vaccine choices available to other countries. It is critical to ensure that switch decisions are evidence-based, well planned and coordinated, anticipating potential impacts on timing and/or product options.



Veronica Denti, Gavi, the Vaccine Alliance

affects millions of people. Children who have only received one or two doses may move to a state where a different vaccine is used. Parents and health care providers now know the two vaccines can be used interchangeably, and the Ministry of Health has approved this practice.

› **Support from Gavi and UNICEF:** Selecting the best vaccine requires analysis of all the costs, advantages and disadvantages. Beyond price point, considerations include efficacy and safety; ease of use; costs of wastage, cold chain, transport and storage; and supply availability and security. Gavi supports countries to consider their choices through conducting evidence-based assessments with tools and technical assistance. This can generate stronger demand predictability, which can mitigate the risk of supply disruptions. Gavi also supports vaccine switches through grants that help cover costs. In addition, UNICEF negotiates vaccine price on behalf of MICs.

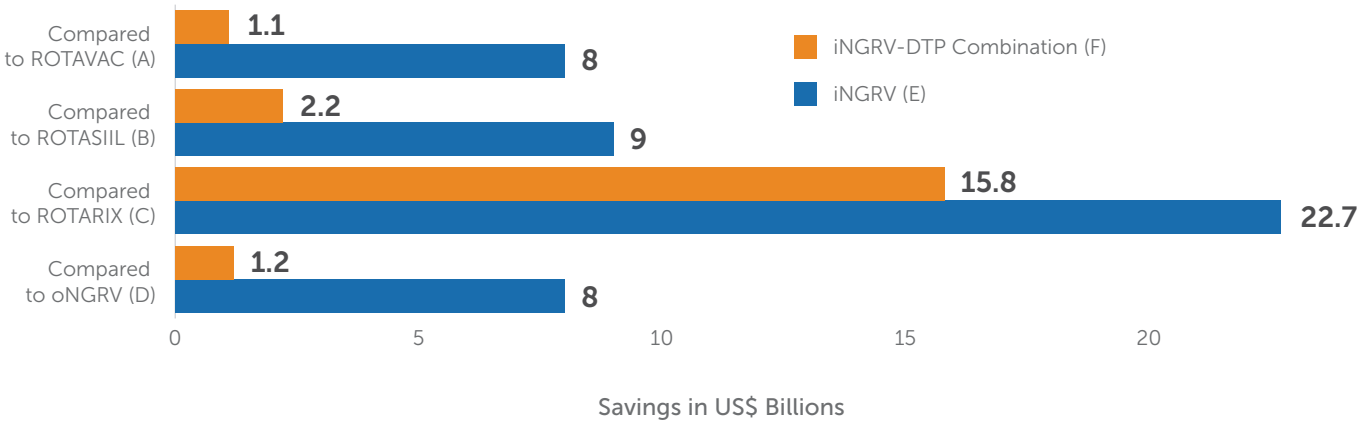
› **Vaccine switch cost-effective in Ghana:** When Ghana transitioned off Gavi support in 2020 it switched from Rotarix to RotaVac. The change-over cost ~$450,000 in strictly financial terms. On the other hand, the government saves US$20 million in vaccine and supplies procurement with ROTAVAC 5-dose and $23 million with ROTAVAC 10-dose compared to Rotarix. Even without Gavi support, rotavirus vaccination is cost-effective in Ghana.

Science Spurs New Vaccine Approaches and Sheds Light on Vaccine Efficacy

- **New vaccines show promise in reducing death and disease:**
  - **RV3-BB:** As discussed above (see page 14), a neonatal rotavirus vaccine is now completing its Phase 3 clinical trial. Results of every study conducted to date have indicated its potential to help reduce rotavirus and protect babies at the earliest possible time. Studies indicate that its efficacy in high-mortality, low-income settings may exceed that of currently available vaccines.
- **Parenteral vaccines:** Ideally, high-efficacy, injectable, non-replicating vaccines would be added to a licensed combination childhood vaccine (such as DPT), avoiding the need for another shot and saving on cost. Such vaccines could also address lingering safety concerns around intussusception. Despite disappointing results of one experimental vaccine (see page 23), research continues. An important issue is which component/s of the virus to incorporate. One vaccine being developed at the US CDC is CDC-9, which uses the VP5 antigen. It has been highly effective in pre-clinical animal studies and Phase 1 clinic trials are scheduled to begin in 2023.
  - **Other experimental approaches:** Among a number of other experimental approaches is the use of virus-like particles (VLPs) as vaccines. One such vaccine is already in use—protecting calves from rotavirus.

Vaccination Programs with iNGRV Could Save Billions of Dollars Compared to All Oral Options

Vaccination program cost savings in 137 LMICs over 10 years starting from 2025 if all countries were using LORVs



Note: The distribution of vaccination program cost savings between Gavi and countries is dependent on each countries co-financing share and how quickly they transition from Gavi support.

Frédéric Debellut, PATH

› **Insights to improve vaccine efficacy:**

» **Dosing matters:** A study in Australia among Northern Territory Aboriginal infants showed that a third (booster) dose of oral Rotarix vaccine significantly improved immune responses. This could help reduce the disproportionate impact of rotavirus on Aboriginal children in Australia. But to influence vaccine policy, the researchers must show that the observed immune response translates into improved real-world clinical protection against illness.

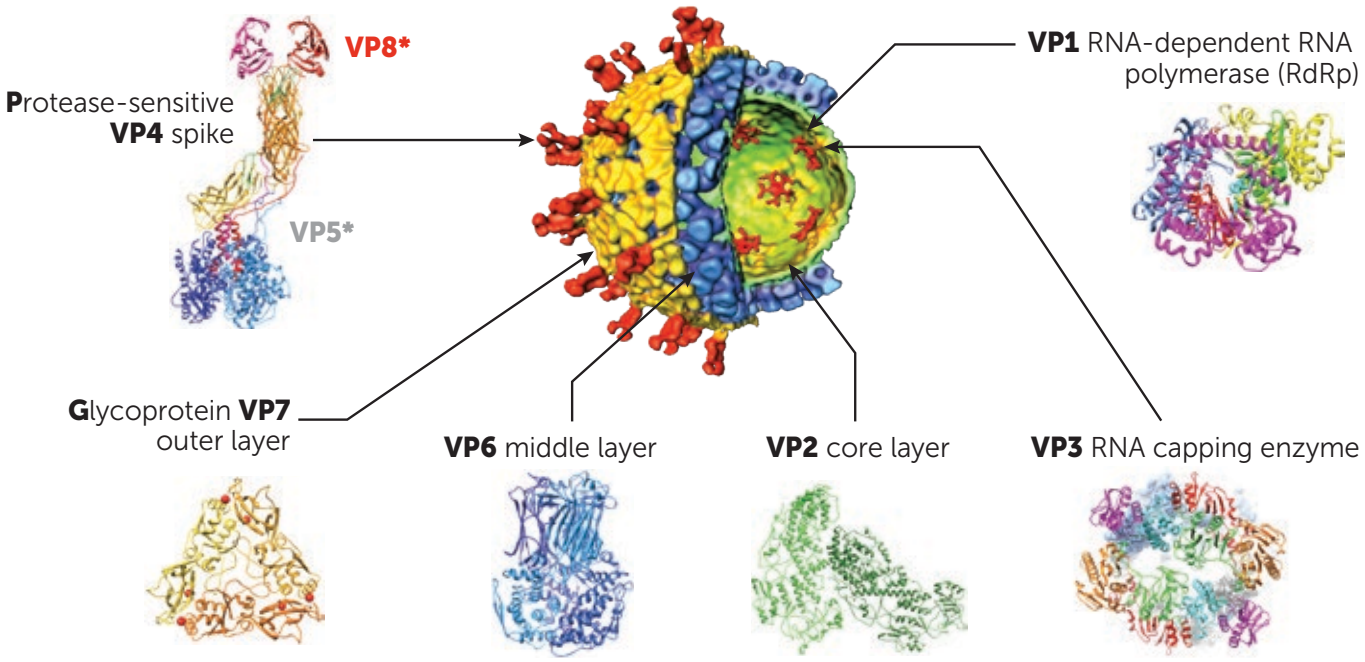
» **Vaccine choice matters:** Studies show that Rotarix efficacy wanes more steeply than does RotaTeq over both one and two years, yet it is the most-used rotavirus vaccine in LMICs. A comparison of the two vaccines in infants in Bangladesh showed that IgA seroconversion was higher with RotaTeq than Rotarix.

» **Nutritional status matters:** Following rotavirus vaccine introduction in India, 31 hospitals collected information and stool samples from children hospitalized with severe diarrhoea from 2016 to 2020. All forms of undernutrition (wasting, stunting and malnutrition) were significantly associated with severe and very severe acute gastroenteritis.

» **Blood-type genetics play a role in Bangladeshi infants:** Histo-blood group antigens (HBGA) that determine blood type are expressed on the surface of red blood cells; they may also be expressed in cells that line the gut. A recent study confirmed that babies who do not secrete HBGA antigens in their guts have lower immunogenicity following vaccination with either RotaTeq or Rotarix.

Scientists continue to probe rotavirus for new insights: The cellular mechanisms that enable rotavirus to cause severe disease are complex. Some insights point to a potential role of Tuft cells (chemosensory cells that are rare in the intestine) in immune response after they have been infected by rotavirus. Researchers also continues to search for a correlate of protection, a biological signal that accurately predicts how well a vaccinated person would be protected from future infections.

Can a Correlate of Protection be Found Among the Structural Components of the Rotavirus Triple-Layered Particle or NSP4?



Prasad et al., Nature, 1996; Aoki et al., Science, 2009; Settembre et al., EMBO J, 2011; Kumar et al., Sci Adv. 2020

CONCLUSION: BENDING THE ARC ON CHILD MORTALITY

Diarrheal diseases remain the second leading infectious cause of death of children under five years of age, and rotavirus is responsible for the biggest share of these deaths. To bend the arc on childhood morbidity and mortality in the era of COVID, enhanced diarrhea prevention strategies are needed. These include full use of oral rehydration fluid when needed; improved access to health care; extending the use and coverage of existing rotavirus vaccines; dramatically lowering the number of zero-dose children; and the development of more effective rotavirus vaccinations for low- and middle-income countries. Vaccine researchers and manufacturers in LMICs have a vital and growing role in this fight to save lives and prevent debilitating disease.

AGENDA

DAY 1 — TUESDAY 14 MARCH 2023		
8:00 – 9:00	Registration	
OPENING SESSION MODERATORS — MATHU SANTOSHAM AND ANURADHA GUPTA		
9:00 – 9:15	Welcome and Introduction	Moderators
9:15 – 9:30	Opening Address by the Minister of Health	Hon. Budi Gunadi Sadikin
9:30 – 9:50	Challenges to childhood immunization during the COVID-19 pandemic	Anuradha Gupta, Sabin Vaccine Institute
9:50 – 10:15	Honoring Prof Yati Soenarto: Leader, mentor and advocate for diarrheal disease control in Indonesia	Duncan Steele, Bill & Melinda Gates Foundation Julie Bines, Murdoch Childrens Research Institute Jarir At Thobari, University of Gadjah Mada
10:15 – 11:00	Coffee Break	
SESSION I: ROTAVIRUS DISEASE AND CONTROL IN INDONESIA MODERATORS — JULIE BINES AND JARIR AT THOBARI		
11:00 – 11:20	The burden of rotavirus disease in Indonesia	Hera Nirwati, Universitas Gadjah Mada
11:20 – 11:40	A cost-effectiveness analysis of rotavirus vaccine for Indonesia	Jarir At Thobari, Universitas Gadjah Mada
11:40 – 12:00	Model based estimation of the impact on rotavirus disease of the RV3-BB vaccine administered in a neonatal or infant schedule in Indonesia	Vicka Oktaria, Universitas Gadjah Mada
12:00 – 12:15	Development of the neonatal rotavirus vaccine at PT Biofarma	Adriansjah Azhari, Biofarma
12:15 – 12:30	Plans for implementation of Rotavirus Vaccine in Indonesia	Prima Yosephine, Ministry of Health, Indonesia
12:30 – 13:30	Lunch Break	

DAY 1 — TUESDAY 14 MARCH 2023

SESSION II: GLOBAL ROTAVIRUS DISEASE BURDEN AND IMPACT OF ROTAVIRUS VACCINES
MODERATORS – HEIDI SOETERS AND UMESH PARASHAR

13:30 – 13:50	Rotavirus hospitalizations among children under 5 years of age, 2017-2021: Findings from the Global Rotavirus Surveillance Network	Heidi Soeters, World Health Organization
13:50 – 14:10	Etiology of hospitalized diarrhea in children in low- and middle-income countries: Results from the Global Pediatric Diarrhea Surveillance Network, 2017-2020	James Platts-Mills, University of Virginia
14:10 – 14:30	Leveraging the African Regional Diarrhea Surveillance Network (Afr RSN) to better understand diarrhea disease burden, safety and impact of rotavirus vaccination.	Jason Mwenda, World Health Organization, Regional Office for Africa
14:30 – 14:50	Changing landscape of moderate-to-severe diarrhea among children in three sub-Saharan African countries following rotavirus vaccine introduction: The Vaccine Impact on Diarrhea in Africa (VIDA) Study	Dilruba Nasrin, University of Maryland
14:50 – 15:10	Global impact of rotavirus vaccination in the pre-COVID-19 era: A modelling analysis	Sarwat Mahmud, London School of Hygiene & Tropical Medicine
15:10 – 15:30	Impact of rotavirus vaccination in 112 countries from 2006 to 2034	Aniruddha Deshpande, Emory University
15:30 – 16:00	Coffee Break	

SESSION III: INSIGHTS ON ROTAVIRUS DISEASE BURDEN AND ROTAVIRUS VACCINE INTRODUCTION IN THE REGION
MODERATORS — JACKIE TATE AND MATHU SANTOSHAM

16:00 – 16:15	Rotavirus epidemiology and the potential impact of vaccination in Dhaka, Bangladesh	Ernest O Asare, Yale University
16:15 – 16:30	A decade long study on Group A rotavirus infection and genotype diversity among children with acute gastroenteritis in Kolkata, East India (2012-2022)	Shanta Dutta, ICMR-National Institute of Cholera and Enteric Diseases
16:30 – 16:45	Etiology of gastroenteritis pathogens among hospitalized children under 5 years of age in the Philippines, 2017-2019	CEI Lazaro-Oasin, Department of Health-Research Institute for Tropical Medicine
16:45 – 17:00	Early impact on rotavirus disease by the monovalent Rotavac vaccine in India	Venkata Raghava, Christian Medical College Vellore
17:00 – 17:15	Post-introduction Evaluation in India	Veena Dhawan, Ministry of Health and Family Welfare, India
17:30 – 20:00	Poster Session — Welcome Reception	

DAY 2 — WEDNESDAY 15 MARCH 2023

SESSION IV: ROGER GLASS KEYNOTE LECTURE
MODERATOR — ROGER GLASS

8:30 – 8:40	Introduction of 5th Roger Glass Keynote Lecture	Roger Glass, Fogarty International Center, National Institutes of Health, US
8:40 – 9:10	Roger Glass Lecture — From discovery to implementation: the journey of RV3BB to target disease prevention from birth	Julie Bines, Murdoch Childrens Research Institute

SESSION V: POLICY, ACCESS AND IMPLEMENTATION OF ORAL ROTAVIRUS VACCINES
MODERATORS — DEBORAH ATHERLY AND TONY NELSON

9:10 – 9:30	GAVI rotavirus vaccines support: supply challenges, implementation challenges, and optimization opportunities for countries	Veronica Denti, Gavi, the Vaccine Alliance
9:30 – 9:50	Rotavirus vaccine product switch: Experience under the Universal Immunization Programme in India	Seema Singh Koshal, John Snow Inc.
9:50 – 10:10	Impact and cost-effectiveness of rotavirus vaccination in Non-Gavi Low- and Middle-Income Countries	Frédéric Debellut, PATH
10:10 – 10:30	Rotavirus vaccine product switch in Ghana: An assessment of service delivery costs, program switch costs and cost-effectiveness	Richmond Owusu, School of Public Health, University of Ghana
10:30 – 11:00	Panel Discussion: Increasing rotavirus vaccine coverage-opportunities and challenges	Deborah Atherly, PATH Zulkifli Ismail, KPJ Healthcare University College, Malaysia Tony Nelson, Chinese University of Hong Kong Shenzhen
11:00 -11:30	Coffee Break	

SESSION VI: REAL WORLD IMPACT OF ROTAVIRUS VACCINES
MODERATORS — VERONICA DENTI AND GEORGE ARMAH

11:30 – 11:45	Impact assessment of rotavirus vaccine introduction in Pakistan's routine immunization program	Shazia Sultana, Aga Khan University
11:45 – 12:00	Early impact of rotavirus vaccine on diarrhea hospitalizations in the Democratic Republic of Congo (DRC), 2009-2021	Christophe Luhata Lungayo, National Expanded Program for Immunization DRC
12:00 – 12:15	Impact and effectiveness of Rotavin-M1 under conditions of routine use in two provinces in Vietnam, 2016-2021	Nguyen Van Trang, National Institute of Hygiene and Epidemiology
12:15 – 12:30	Impact of the introduction of Rotarix (2016-2018) and Rotavac (since 2018) in the West Bank, Palestinian Territories	Musa Hindiyeh, Caritas Baby Hospital
12:30 – 13:45	Lunch Break	

DAY 2 — WEDNESDAY 15 MARCH 2023

SESSION VII: NEW INSIGHTS INTO ROTAVIRUS IMMUNE RESPONSES AND VIROLOGY
MODERATORS — VANESSA HARRIS AND UMESH PARASHAR

13:45 – 14:05	Induction of systemic and mucosal neutralizing antibodies to norovirus and rotavirus after oral administration of a live recombinant rotavirus to suckling mice	Harry Greenberg, Stanford University
14:05 – 14:25	Maternal breast milk secretor phenotype does not affect infant susceptibility to rotavirus diarrhea	Benjamin Lee, University of Vermont College of Medicine
14:25 – 14:45	Elevated levels of pre-existing growth factors and cytokines are associated with rotavirus vaccine take in Malawian infants	Khuzwayo Jere, Malawi-Liverpool Wellcome Trust Clinical Research Programme
14:45 – 15:05	RotaTeq and Rotarix rotavirus vaccines immunogenicity in malnourished infants in Bangladesh and Bolivia	Daniel Velasquez-Portocarrero, Centers for Disease Control and Prevention, US
15:05 – 15:35	Coffee Break	

SESSION VIII: ADVANCES IN OUR UNDERSTANDING OF ROTAVIRUS PATHOPHYSIOLOGY
MODERATORS — GAGANDEEP KANG AND KHUZWAYO JERE

15:35 – 15:50	Understanding the interplay between host, microbiome and an orally delivered probiotic rotavirus vaccine platform	Gregg Dean, Colorado State University
15:50 – 16:05	Harnessing the potential of the gut microbiome to improve oral rotavirus vaccine responses	Grace Adeniyi-Ipadeola, Baylor College of Medicine
16:05 – 16:20	Profiles and influence of maternal and infant histo-blood group antigens on oral rotavirus vaccine (Rotarix) immunogenicity in Zambia	Adriace Chauwa, Centre for Infectious Disease Research in Zambia
16:20 – 16:35	Rotavirus NSP4 mediated increase in intracellular calcium results in increased levels of the pro-inflammatory eicosanoid, prostaglandin E2, during infection	Hester O'Neill, University of the Free State
16:35 – 16:50	Host long non-coding RNAs: Key modulators in rotavirus infection dynamics	Shreya Banerjee, ICMR-National Institute of Cholera and Enteric Diseases
16:50 – 17:05	The role of aryl hydrocarbon receptor (AhR) signaling in determining the susceptibility to rotavirus infection	Nurul Iffat Wirusanti, Department of Global Health, Amsterdam UMC

DAY 3 — THURSDAY 16 MARCH 2023

SESSION IX: RUTH BISHOP KEYNOTE LECTURE
MODERATOR — CARL KIRKWOOD

9:00 – 9:05	Introduction to the 3rd Ruth Bishop Keynote Lecture	Carl Kirkwood, Bill & Melinda Gates Foundation
9:05 – 9:35	Ruth Bishop Lecture — New Insights into Rotavirus Pathogenesis and Vaccines	Mary Estes, Baylor College of Medicine

SESSION X: ADVANCES IN UNDERSTANDING OF ROTAVIRUS DISEASE
MODERATORS — ROGER GLASS AND CELESTE DONATO

9:35 – 9:50	Rotavirus in the time of SARS-CoV-2: The South African story, 2018-2022	Nicola Page, National Institute for Communicable Diseases
9:50 – 10:05	Association between maternal breast milk microbiota composition and rotavirus vaccine responses in Africa, Asian and European infants	Jonathan Mandolo, Malawi Liverpool Wellcome Trust
10:05 – 10:20	Immunogenicity of a third scheduled dose of Rotarix in Australian indigenous children: A Phase IV, double blind, randomized, placebo-controlled clinical trial	Bianca Middleton, University of Sydney
10:20 – 10:35	Comparison of rotavirus and norovirus post-rotavirus vaccine introduction in 3 sub-Saharan African countries, 2015-2018	Richard Omore, Kenya Medical Research Institute
10:35 – 11:00	Coffee Break	
11:00 – 11:15	Interchangeable vaccine dosage algorithm for available rotavirus vaccine products in India: A pragmatic alternative to single vaccine product regimens	Suman Kanungo, ICMR-National Institute of Cholera and Enteric Diseases
11:15 – 11:30	Natural Killer T-cells are altered in Malawian infants immunized with the neonatal RV3-BB rotavirus vaccine	Prisca Benedicto-Matambo, Kamuzu University
11:30 – 11:45	Cohort study of the characteristics of neonatal rotavirus infection and the establishment of a transmission kinetic model in China	Si-Jie Wang, Fudan University Shanghai Medical College
11:45 – 12:00	Assessment of nutritional status and its association with clinical severity among Under 5 children admitted with diarrhea in India	Namrata Kharat, Christian Medical College Vellore
12:00 – 13:00	Lunch	

DAY 3 — THURSDAY 16 MARCH 2023

SESSION XI: ROTAVIRUS MOLECULAR EPIDEMIOLOGY PRE- AND POST-VACCINE INTRODUCTION

MODERATORS — DUNCAN STEELE AND JASON MWENDA

13:00 – 13:15	Rotavirus genotype distribution after the introduction of rotavirus vaccines in India, 2016-2020	Tintu Vargese, Christian Medical College Vellore
13:15 – 13:30	Genotypic surveillance and epidemiologic trends of rotavirus infection among children with gastroenteritis in Bangladesh, 2014-2021	Shuvra Kanti Dey, Jahangirnagar University
13:30 – 13:45	Genomic constellation of human G8 strains in Brazil over a 13-year period: Detection of the novel bovine-like G8P[8] DS-1-like virus	Adriana Luchs, Adolfo Lutz Institute
13:45 – 14:00	Epidemiology of enteric viruses in children Under 5-years before and after rotavirus vaccine introduction in Manicha District, Mozambique, 2007-2019	Percina Chirinda, Manhiça Health Research Center
14:00 – 14:15	Characterizing the diversity of unusual rotavirus strains in Australian children and adults	Celeste Donato, Murdoch Childrens Research Institute
14:15 – 14:30	The molecular epidemiology of human rotavirus and strain diversity in Kenya pre- and post- rotavirus vaccine introduction: A review	Grace Irimu, University of Nairobi
14:30 – 15:00	Coffee Break	

SESSION XII: PROGRESS TOWARDS NEXT GENERATION ROTAVIRUS VACCINES

MODERATORS — CARL KIRKWOOD AND MICHELLE GROOME

15:00 – 15:15	Interim results from a phased 3 trial of a parenteral rotavirus vaccine candidate in healthy infants in Africa	Tushar Tewari, PATH
15:15 – 15:30	Progress towards clinical trial of inactivated rotavirus vaccine	Baoming Jiang, Centers for Disease Control and Prevention, US
15:30 – 15:45	Potential impact and cost-effectiveness of injectable, next generation rotavirus vaccines in 137 LMICs: A modelling study	Frédéric Debellut, PATH

SESSION XIII: CLOSING CEREMONY

MODERATORS — MATHU SANTOSHAM AND ROGER GLASS

15:45 – 16:00	Closing address	Gagandeep Kang, Christian Medical College Vellore
16:00 – 16:15	Best Poster Awards	Moderators