

# Available & New Rotavirus Vaccines



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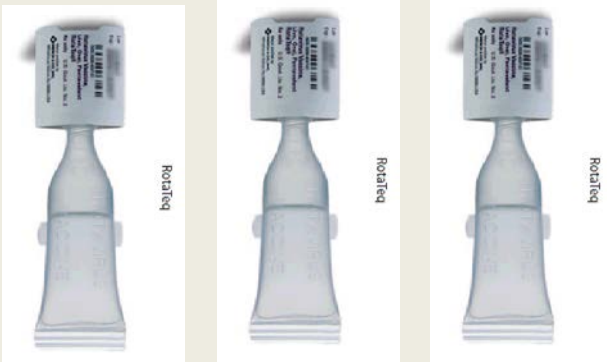
# Special thanks for slides



# RotaTeq & Rotarix licensed in 2006

## RotaTeq™ (Merck&Co., Inc.)

3 oral doses beginning at 6 weeks



## Rotarix™ (GlaxoSmithKline)

2 oral doses beginning at 6 weeks



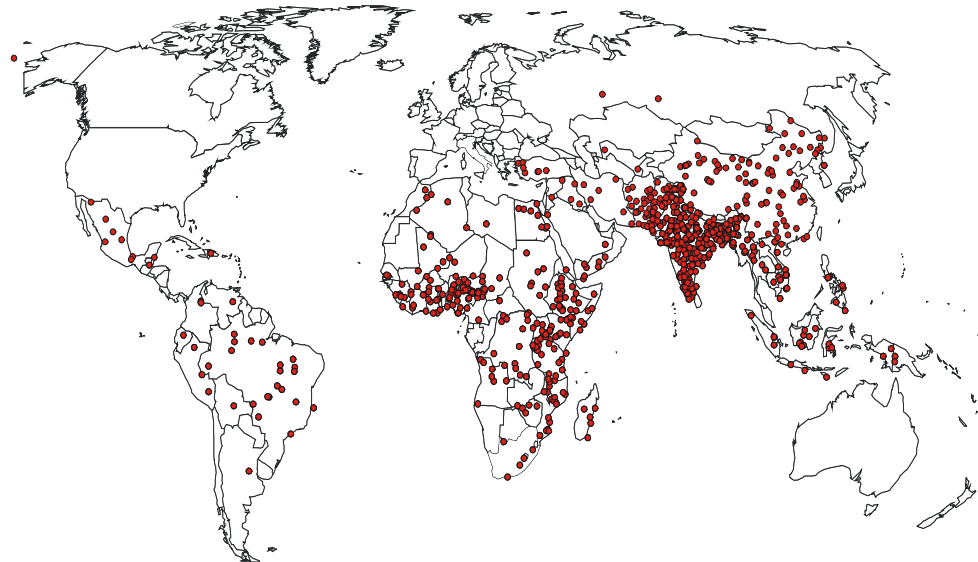
# 2009 – WHO Global Recommendation



World Health  
Organization

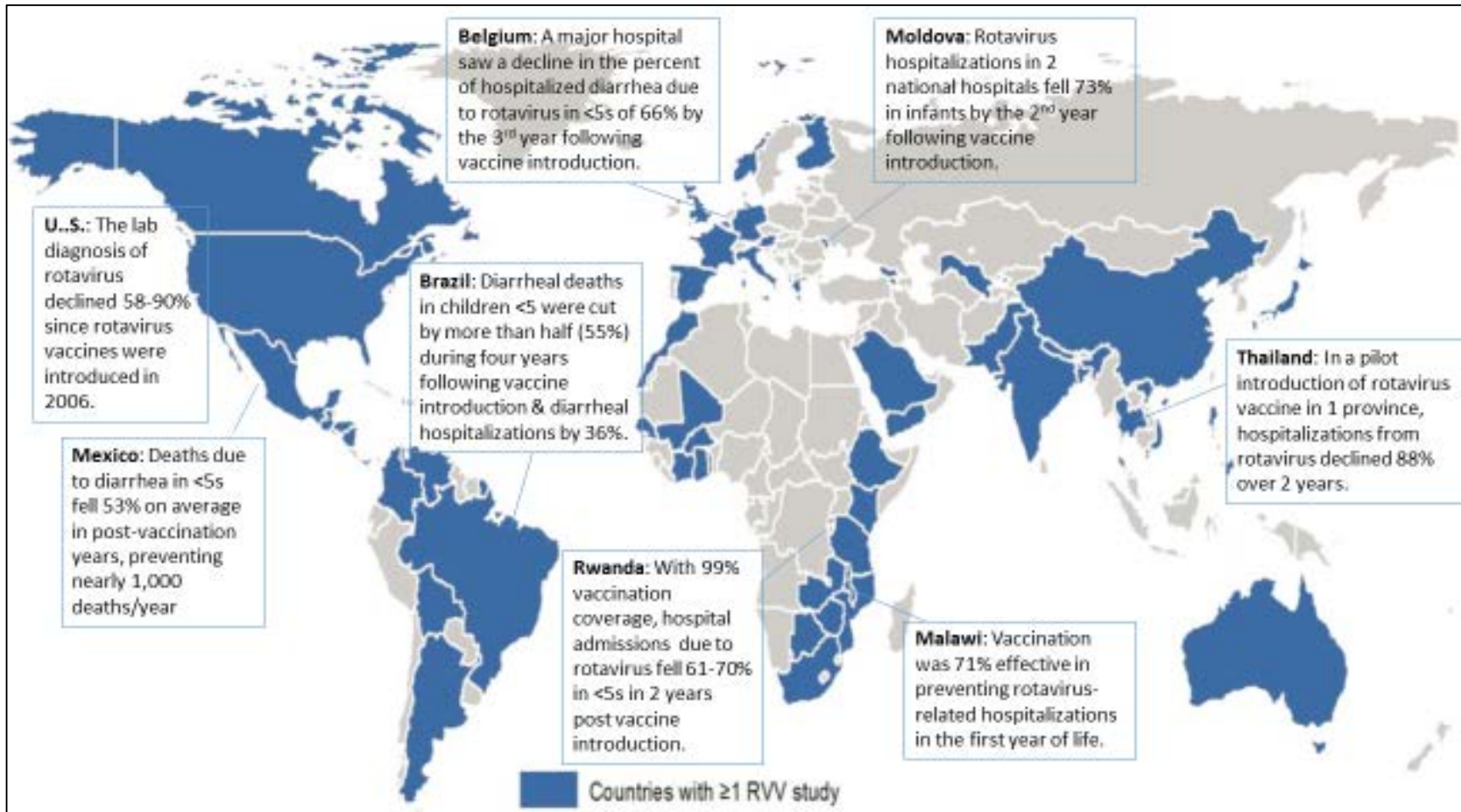


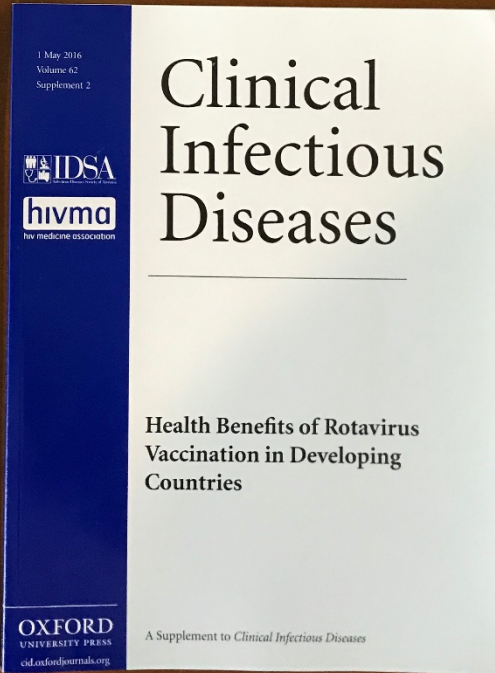
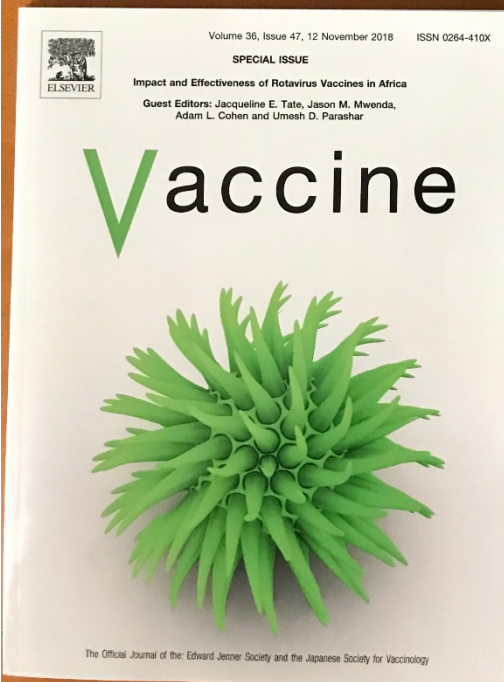
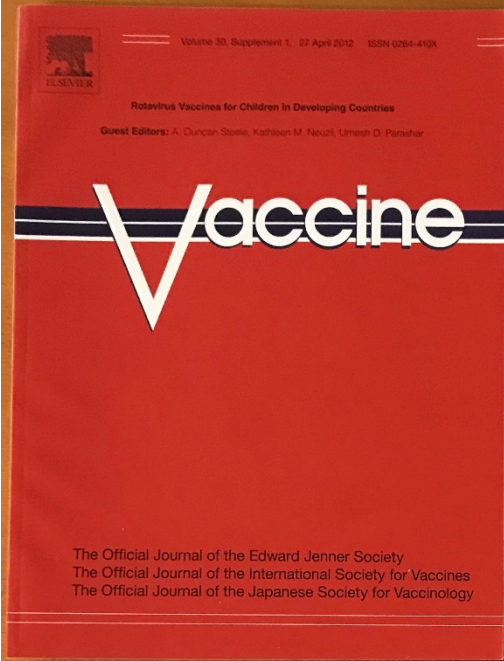
**WHO Recommends Global Use of Rotavirus Vaccines**  
*Decision Could Help Protect Millions of Children in Africa and Asia  
from Lethal Diarrheal Disease*





# Vaccine impact data available from all world regions and income groups



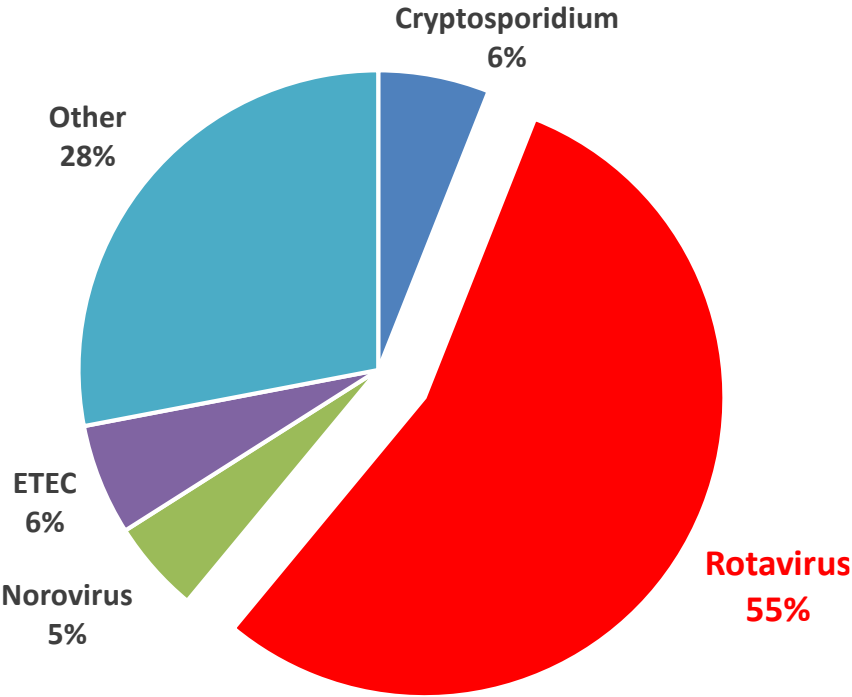


**What are the remaining challenges to global rotavirus vaccine introduction?**



# Rotavirus remains the leading cause of severe diarrhea in developing countries after rotavirus vaccine introduction

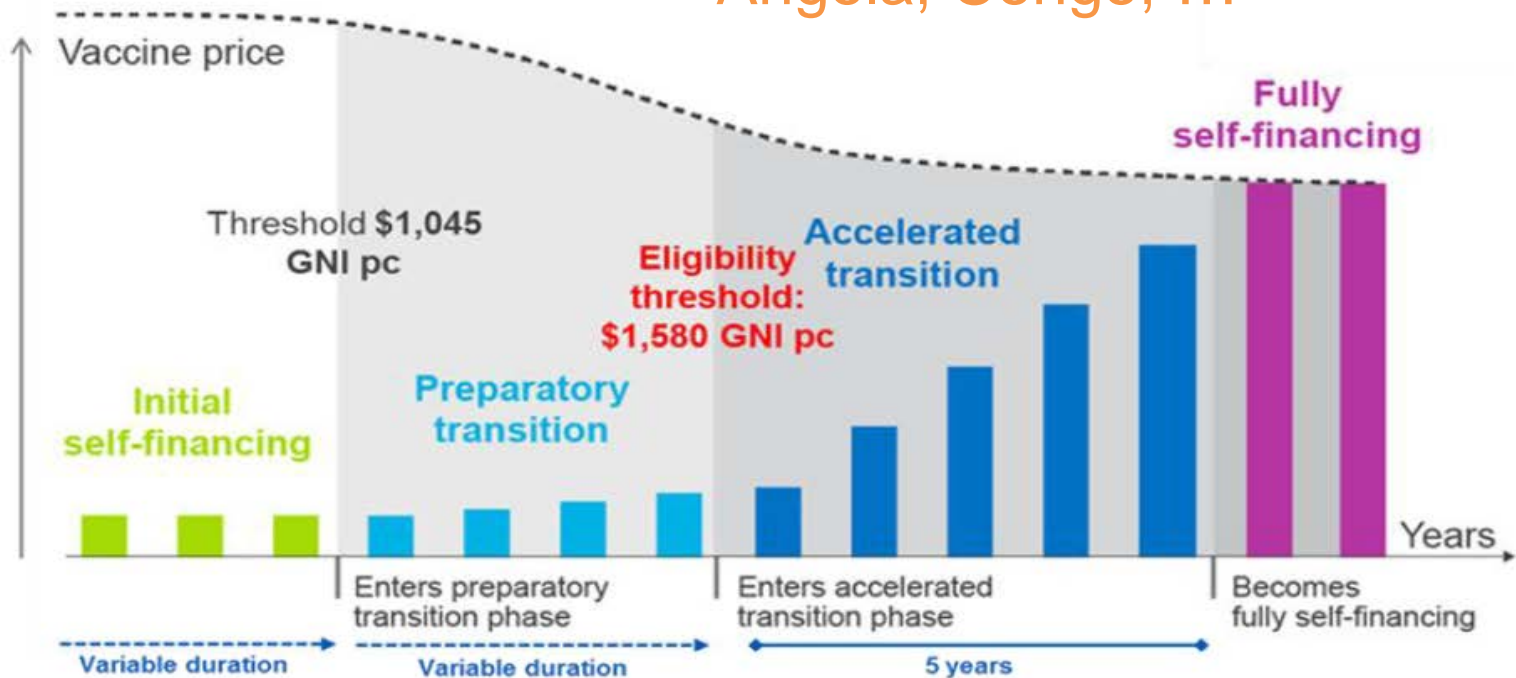
## Before vaccine



# Countries will transition from GAVI eligibility for vaccine subsidy support

Four phases of eligibility

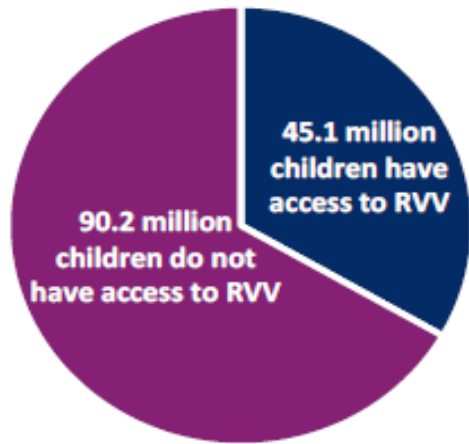
Angola, Congo, ...



Cost effectiveness of the vaccines are going to become more and more crucial - vaccine efficacy and costs of vaccine & vaccine delivery

# Rotavirus vaccine introductions are affected by global supply shortfall

More than 90 million children lack access to these life-saving vaccines.



## Gavi country introductions

**2018:** Afghanistan, Uganda, **Bangladesh, Benin, DRC, Nepal (all delayed due to supply issue)**  
**2019:** **Bhutan, CAR**, Kyrgyz Rep, Lao PDR, **Nigeria**, Solomon Islands, Sri Lanka  
**2020:** Indonesia, Myanmar, Timor-Leste, Ukraine  
**2021:** Azerbaijan, Korea DPR, Mongolia, Vietnam  
**2022:** Chad Comoros, Guinea

NPR

## Merck Pulls Out Of Agreement To Supply Life-Saving Vaccine To Millions Of Kids

The pharmaceutical giant will stop delivering its rotavirus vaccine to four West African countries and will begin to sell it in China for likely more than 10 times the cost.



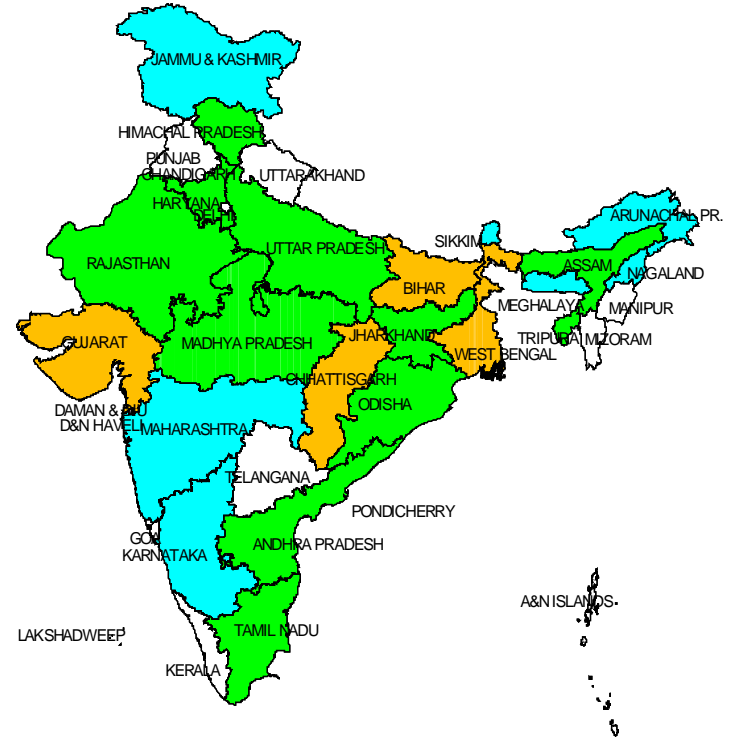
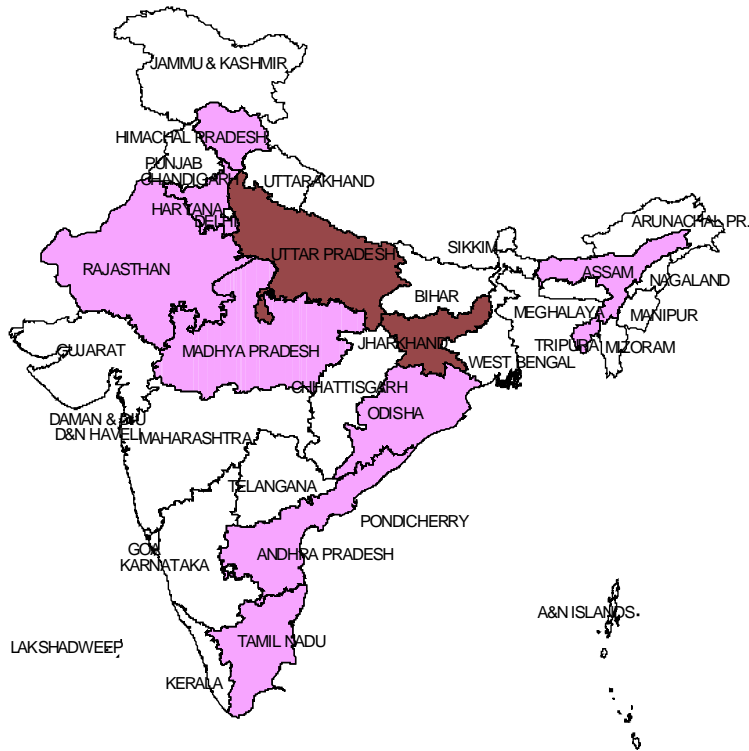
# Two Indian-made rotavirus vaccines licensed in 2018

**Prime Minister Modi**

***“Government of India will provide a rotavirus vaccine to all Indian children”***



# Rotavirus vaccine in NIP - Current and Proposed scale up by moHFW



- RVV States (9 States)
- RVV States in 2018 (2 states)

- RVV scale up in 2016-2018 (11 States)
- RVV scale up NNM in 2018 (3 NNM States)
- RVV scale up NNM in 2019 (9 NNM States)
- RVV scale up NNM in 2020 (Remaining states)

# Rotavac and RotaSiIL were pre-qualified by WHO in 2018



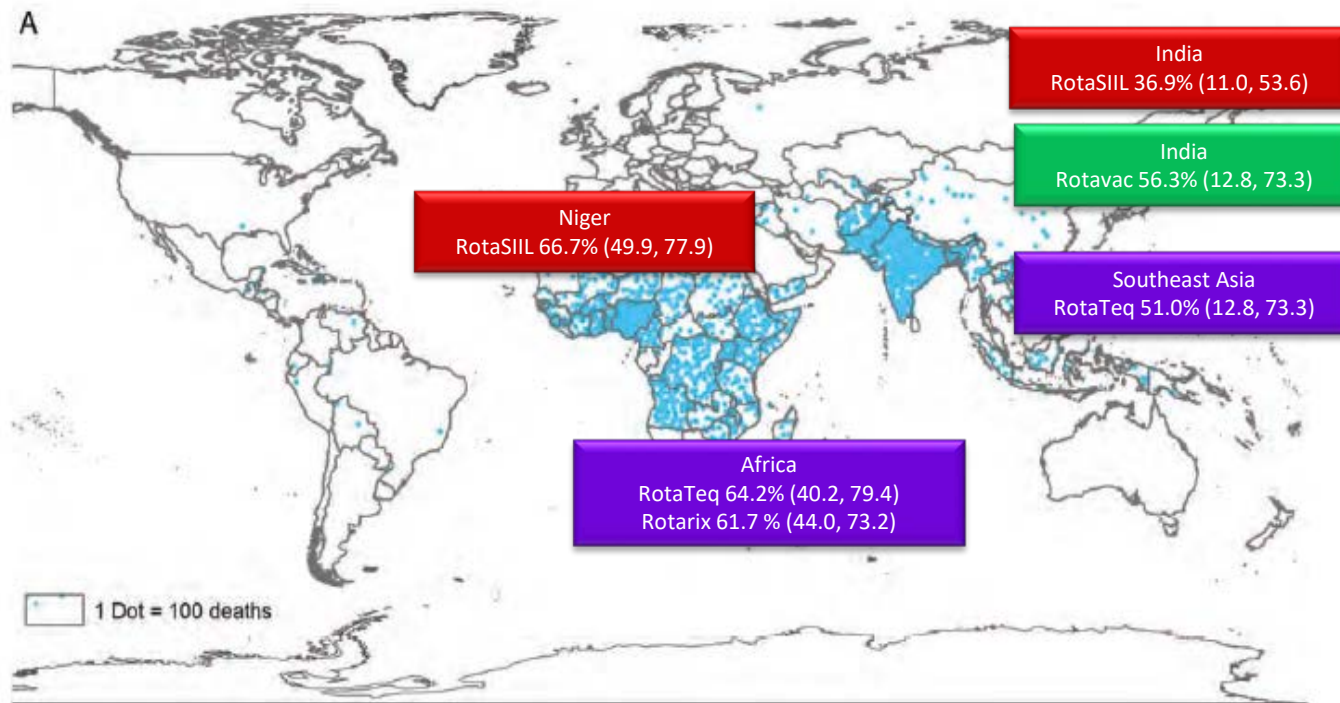
ROTAVACTM, Bharat Biotech

(derived from a single Indian neonatal strain of human rotavirus) G9P11

RotaSiIL™, Serum Institute

(Reassorted bovine-human rotavirus)  
Genetically engineered vaccine consisting of 5 different strains to protect against the 5 most common human rotaviruses G1,2,3,4 & 9

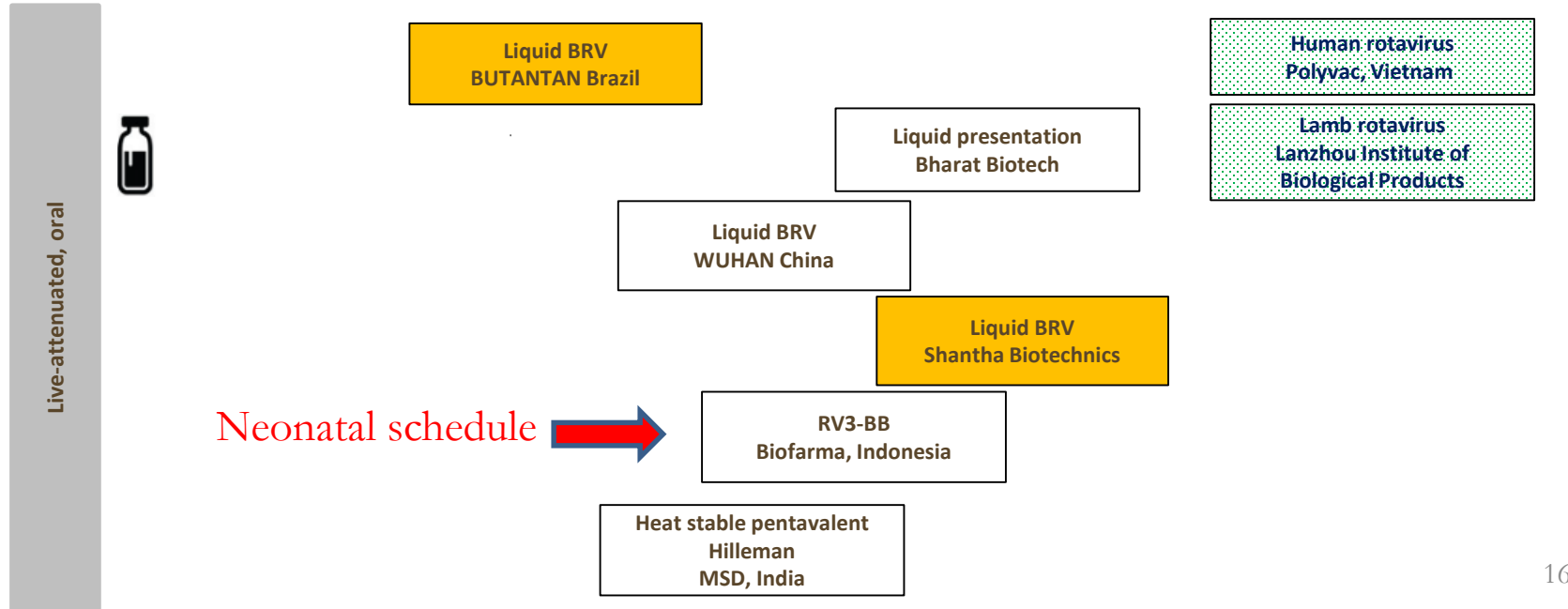
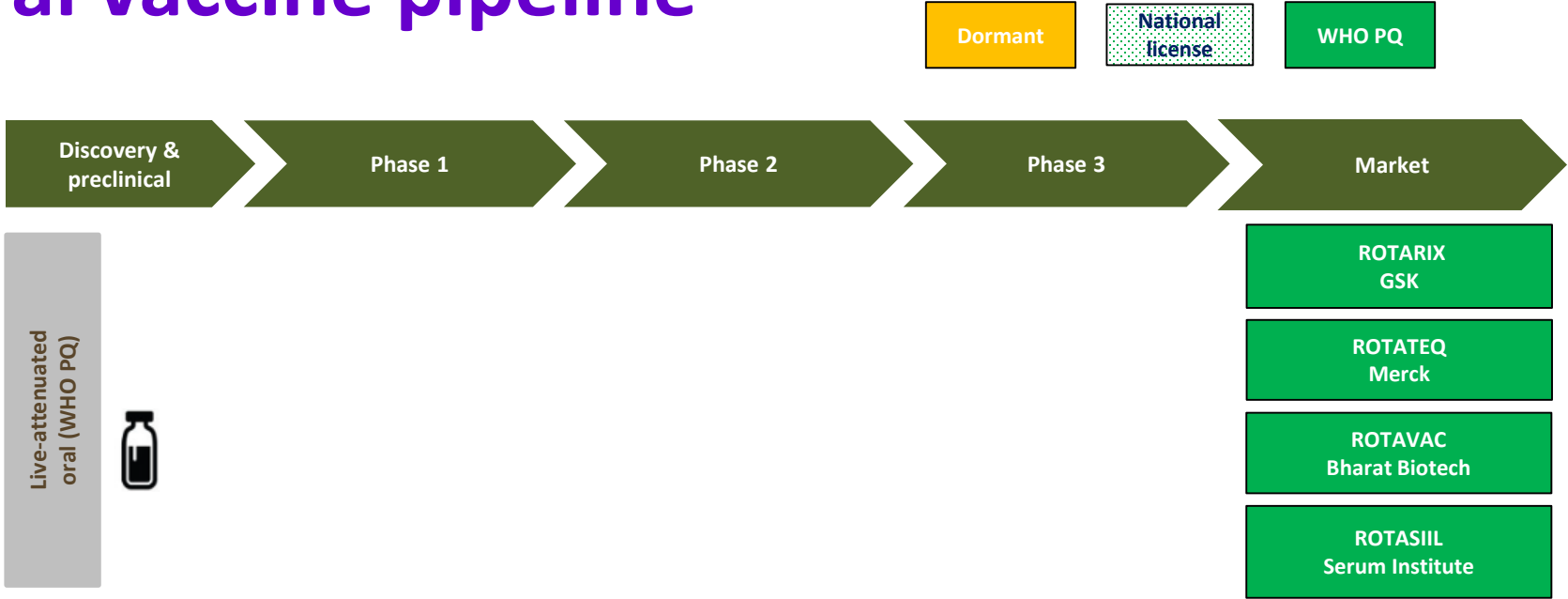
# Efficacy of Indian rotavirus vaccines is comparable to multi-national vaccines



## Efficacy against severe disease in first year of life

Vesikari T, Matson DO, Dennehy P et al. NEJM 2006; 354:23-33; Ruiz-Palacios GM, Perez-Schael I, et al. NEJM 2006; 354:11-22  
Madhi SA, Cunliffe NA, Steele AD et al. NEJM 2010; 362: 346-357; Zaman K, Anh DD, Victor CV et al. Lancet 2010; 376: 615-23  
Armah GE, Sow S, Breiman RF et al. Lancet 2010; 376: 606-614; Bhandari N, Rongsen-Chandola T, Bavdekar A, et al. Lancet 2014; 383:2136-43; Isanaka S, Guindo O, Langendorf C, et al. N Engl J Med. 2017; 376:1121-1130; Kulkarni PS, Desai S, Tewari T, et al. Vaccine 2017;

# Oral vaccine pipeline





# Non-replicating rotavirus vaccines

## Safety and immunogenicity of a parenteral P2-VP8-P[8] subunit rotavirus vaccine in toddlers and infants in South Africa: a randomised, double-blind, placebo-controlled trial

Michelle J Groome, Anthonet Koen, Alan Fix, Nicola Page, Lisa Jose, Shabir A Madhi, Monica McNeal, Len Dally, Iksung Cho, Maureen Power, Jorge Flores, Stanley Cryz



Vaccine 36 (2018) 2233–2236



Contents lists available at [ScienceDirect](#)

Vaccine

journal homepage: [www.elsevier.com/locate/vaccine](http://www.elsevier.com/locate/vaccine)



Short communication

The future control of rotavirus disease: Can live oral vaccines alone solve the rotavirus problem? ☆



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# Achieving rotavirus introduction and impact in developing countries

## Challenges

- Insufficient global supply
- Vaccine cost
- Large cold-chain footprint
- Efficacy in low income countries half that observed in high income countries

## Approach

- Support existing suppliers
- Support new suppliers
- Ensure second generation and new rotavirus vaccines have acceptable presentation
- Pursue next generation rotavirus vaccines (i.e., parenteral, adjuvanted) to improve efficacy

# Key Resources





































































































# GAVI rotavirus vaccine profiles

Attribute	GSK (Rotarix)	Merck (RotaTeq)	BBIL (ROTAVAC)	SIIL (ROTASIL)
<b>Presentation</b>	Liquid (1 dose plastic tube)	Liquid (1 dose plastic tube)	Liquid (frozen) (1, 5 or 10 dose vial)	Lyophilized (1 or 2 dose vial)
<b>Doses/Course</b>	2	3	3	3
<b>Price/Course</b>	\$5.00	\$10.50	\$3.00	~\$4.80
<b>Volume/Course</b>	34 cm <sup>3</sup>	139 cm <sup>3</sup>	94.8 cm <sup>3</sup> /28.2 cm <sup>3</sup> /11.7 cm <sup>3</sup>	105.5 cm <sup>3</sup> /63.3 cm <sup>3</sup> <i>(Including diluent)</i>
<b>VVM</b>	7	None	2	30
<b>PQ date</b>	2008	2008	2018	2018

<https://www.gavi.org/library/gavi-documents/supply-procurement/rotavirus-vaccine-profiles/>

# UNICEF vaccine product menu

## PRODUCT MENU FOR VACCINES SUPPLIED BY UNICEF FOR GAVI, THE VACCINE ALLIANCE

Vaccine	Form	Presentation	Number of awarded manufacturers	Storage space (cm <sup>3</sup> /dose)		VVM		Product availability								Projected Weighted Average Price per Dose			
				Vaccine	Diluent			2019		2020		2021		2022		2019	2020	2021	2022
								Supply exceeds demand	Limited supply	Supply exceeds demand	Limited supply	Supply exceeds demand	Limited supply	Supply exceeds demand	Limited supply				
DTP-HepB-Hib	Liquid	 1 ds	6	10.3 - 16.8	-	VVM14	Yes		Supply exceeds demand		Supply exceeds demand		Supply exceeds demand		Supply exceeds demand	\$1.16	Pending tender	Pending tender	Pending tender
DTP-HepB-Hib	Liquid	 10 ds	4	2.1 - 4.4	-	VVM14	Yes		Supply exceeds demand		Supply exceeds demand		Supply exceeds demand		Supply exceeds demand	\$0.70	Pending tender	Pending tender	Pending tender
HPV4	Liquid	 1 ds	1	15.0	-	VVM30	Yes		Limited supply		Limited supply		Limited supply		Limited supply	\$4.50	Pending tender	Pending tender	Pending tender
HPV2	Liquid	 2 ds	1	4.8	-	VVM30	Yes		Limited supply		Limited supply		Limited supply		Limited supply	\$4.60	Pending tender	Pending tender	Pending tender
IPV	Liquid	 1 ds	1	15.7	-	VVM7	Yes		Limited supply		Limited supply		Limited supply		Limited supply	\$3.50	\$2.80	\$2.80	\$2.80
IPV	Liquid	 5 ds	2	4 - 8.7	-	VVM7	Yes		Limited supply		Limited supply		Limited supply		Limited supply	\$2.67	\$2.67	\$2.65	\$2.65
IPV	Liquid	 10 ds	1	2.46	-	VVM7	Yes		Limited supply		Limited supply		Limited supply		Limited supply	€1.81	€1.81	€1.81	€1.81
Meningococcal A (10mcg)	Lyophilised	 10 ds + diluent	1	2.60	3.11	VVM30	Yes		Supply exceeds demand		Supply exceeds demand		Supply exceeds demand		Supply exceeds demand	\$0.71	Pending tender	Pending tender	Pending Tender
Meningococcal A (5mcg)	Lyophilised	 10 ds + diluent	1	2.10	3.11	VVM30	Yes		Supply exceeds demand		Supply exceeds demand		Supply exceeds demand		Supply exceeds demand	\$0.54	Pending tender	Pending tender	Pending tender
OCV	Liquid	 1 ds	2	11 - 16.8	-	VVM30	Yes		Needs planning		Needs planning		Needs planning		Needs planning	\$2.00	Pending tender	Pending tender	Pending Tender
OCV	Liquid	 1 ds	1	7.85	-	VVM30	Yes		Needs planning		Needs planning		Needs planning		Needs planning	\$1.24	Pending tender	Pending tender	Pending tender
PCV10	Liquid	 2 ds	1	4.84	-	VVM30	Yes		Needs planning		Needs planning		Needs planning		Needs planning	\$3.05	\$3.05	\$3.05	\$3.05
PCV10	Liquid	 4 ds	1	2.40	-	VVM30	Yes		Needs planning		Needs planning		Needs planning		Needs planning	\$3.05	\$3.05	\$3.05	\$3.05
PCV13	Liquid	 1 ds	1	12.01	-	VVM30	Yes		Needs planning		Needs planning		Needs planning		Needs planning	\$3.30	\$3.30	\$3.30	\$3.30
PCV13	Liquid	 4 ds	1	3.50	-	VVM30	Yes		Needs planning		Needs planning		Needs planning		Needs planning	\$2.90	\$2.90	\$2.90	\$2.90
Rota1	Liquid	 1 ds	1	17.12	-	VVM14	Yes		Limited supply		Needs planning		Needs planning		Needs planning	€1.88	€1.88	€1.88	Pending Tender
Rota5	Liquid	 1 ds	1	46.25	-	-	No		Limited supply		Limited supply		No supply		No supply	\$3.20	No supply	No supply	Pending Tender
Rota5	Lyophilised	 2 ds	1	10.54	-	VVM30	Yes		Needs planning		Needs planning		Needs planning		Needs planning	\$0.95	\$0.95	\$0.95	Pending Tender
Rota1	Liquid	 5 ds	1	4.30	-	VVM2	Yes		Needs planning		Needs planning		Needs planning		Needs planning	0.95*	0.95*	No supply	No supply
Rota1	Liquid	 5 ds	1	4.30	-	VVM2	Yes		Needs planning		Needs planning		Needs planning		Needs planning	\$0.85	\$0.85	\$0.85	Pending Tender

[https://www.unicef.org/supply/files/Product\\_Menu\\_June\\_2019.pdf](https://www.unicef.org/supply/files/Product_Menu_June_2019.pdf)

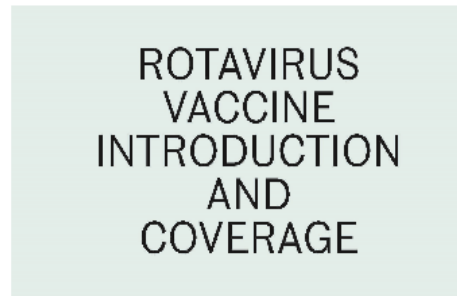
# Rotavirus Disease and Immunization: Series of Briefs (2019)

Six rotavirus-focused briefs cover epidemiology and disease burden, available vaccine products, the impact of vaccination, economic costs of rotavirus disease and the value of vaccines, safety, and introduction and coverage status. The Council's series also includes a supplemental brief on the broad impact of early childhood diarrhea.

View the Council's webinar launch of the briefs from 7 May, 2019.

Share the briefs using the Council's social media toolkit.

## Rotavirus Vaccine Introduction and Coverage



**ROTAVIRUS VACCINE INTRODUCTION AND COVERAGE**

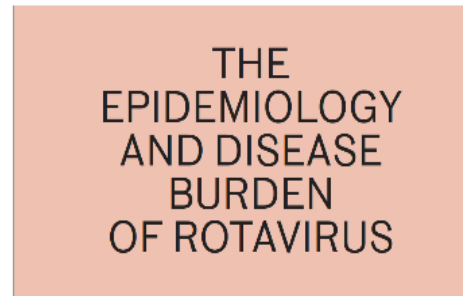
**THE STATUS**

Rotavirus is the most common cause of severe dehydrating diarrhea in children worldwide. In 2018, an estimated 210 million children under the age of 5 years were affected by rotavirus disease, resulting in 1.1 million deaths and 20 million hospitalizations. Rotavirus is a leading cause of diarrhea in children in low-income countries, where it is responsible for 18% of all deaths and 20% of all hospitalizations. In high-income countries, rotavirus is a leading cause of hospitalization and is responsible for 10% of all deaths in children under the age of 5 years.

More than 100 countries have introduced rotavirus vaccine into their national immunization schedules. In 2018, 100 countries had introduced rotavirus vaccine into their national immunization schedules, up from 70 in 2010. The most recent introductions were in Cambodia and the Philippines in 2018. The most recent introductions were in Cambodia and the Philippines in 2018.

**FIGURE 1. PERCENT OF INFANTS WORLDWIDE WHO LIVE IN COUNTRIES THAT HAVE INTRODUCED ROTAVIRUS VACCINES\***

## The Epidemiology and Disease Burden of Rotavirus



**THE EPIDEMIOLOGY AND DISEASE BURDEN OF ROTAVIRUS**

**INTRODUCTION**

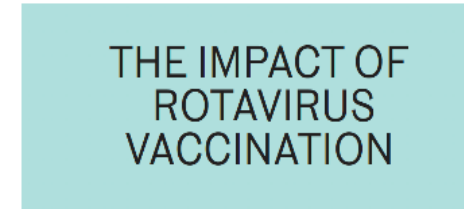
Diarrhea is one of the world's leading killers of children, and rotavirus remains among the most common causes of severe diarrhea in children under the age of 5 years worldwide.

Rotavirus is a virus that causes gastroenteritis, an inflammation of the stomach and intestines. Rotavirus primarily infects the small intestine, destroying the surface tissue and preventing the absorption of nutrients, causing diarrhea. Typical symptoms can range from mild watery diarrhea to severe diarrhea with vomiting and fever.

While efforts to increase ORT use should continue, providing ORT to most acute episodes of acute diarrhea in resource-poor settings is challenging because of the high transmissibility of the disease, which is often spread person-to-person and through contaminated objects, surfaces, food and water, and in fecal matter, including in high and middle income countries with advanced water and sanitation systems. In fact, nearly all children experience at least one rotavirus infection during the first two years of life in most parts of the population.

While recommended treatment, such as oral rehydration and zinc, can reduce the severity of rotavirus disease, it can be particularly challenging in low-income countries, due to limited access to these services.

## The Impact of Rotavirus Vaccination



**THE IMPACT OF ROTAVIRUS VACCINATION**

**INTRODUCTION**

Rotavirus, the most common rotavirus vaccine, is the most common cause of severe dehydrating diarrhea in children under the age of 5 years worldwide. In 2018, an estimated 210 million children under the age of 5 years were affected by rotavirus disease, resulting in 1.1 million deaths and 20 million hospitalizations. Rotavirus is a leading cause of diarrhea in children in low-income countries, where it is responsible for 18% of all deaths and 20% of all hospitalizations. In high-income countries, rotavirus is a leading cause of hospitalization and is responsible for 10% of all deaths in children under the age of 5 years.

More than 100 countries have introduced rotavirus vaccine into their national immunization schedules, including more than 100 countries in high-income countries or Africa, and more than 100 countries in Eastern Europe and the former Soviet Union, and in middle income and Asian countries. A more complete picture of the impact of rotavirus vaccination is necessary to measure the impact of vaccination and with varying levels of disease burden and child mortality burden.

In this series, we present data from countries in which rotavirus vaccine introduction has been implemented, showing the impact of rotavirus vaccine on rotavirus disease burden and child mortality burden.

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**FIGURE 1. PERCENT OF INFANTS WORLDWIDE WHO LIVE IN COUNTRIES THAT HAVE INTRODUCED ROTAVIRUS VACCINES\***

# CURRENT AND UPCOMING ROTAVIRUS VACCINES

## INTRODUCTION

The rotavirus vaccine landscape, or availability of products, has recently expanded considerably and is expected to continue to do so. With the prequalification by WHO of two new vaccines produced in India, there are now four globally available rotavirus vaccines. Additional vaccines are in advanced stages of development and thus the pipeline of rotavirus vaccines will continue to grow in the coming years (see Table 1). The increase in the number of rotavirus vaccines is beneficial for several reasons. It increases the choice countries have in

selecting vaccine products and presentations and helps to improve the global supply of rotavirus vaccines to meet current and future demand. The expanded number of products could help lower vaccine costs, a major barrier to introducing rotavirus vaccines in some countries. In addition, some products in development have shown higher rates of efficacy in low-income countries. This brief focuses on the currently available rotavirus vaccines and those most likely to become available in the next several years.

TABLE 1 CURRENT ROTAVIRUS VACCINES AND CANDIDATES IN ADVANCED STAGES OF DEVELOPMENT (MANUFACTURER, COUNTRY)

WHO prequalified	Nationally-licensed	In advanced stages of development
<b>ROTARIX®</b> (GlaxoSmithKline Biologics, Belgium)	<b>Lanzhou Lamb Rotavirus</b> (Lanzhou Institute of Biological Products, China)	<b>RV3-BB</b> (PT Biofarma, Indonesia)
<b>RotaTaq®</b> (Merck & Co., Inc, U.S.A.)	<b>ROTAVIN-M1</b> (POLYVAC, Vietnam)	<b>LLR reassortants</b> (Lanzhou Institute of Biological Products, China)
<b>ROTAVAC®</b> (Bharat Biotech, India)		<b>Trivalent P2-VP8 (Injectable subunit vaccine)</b> (SK Chemicals, South Korea)
<b>ROTASIL®</b> (Serum Institute of India Pvt. Ltd., India)		