

# Forecasting Typhoid Conjugate Vaccine Introduction and Demand in Typhoid-Endemic LMICs

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# LAYOUT

**INTRODUCTION**

**FORECASTING: TCV ADOPTION YEAR**

**FORECASTING: TCV DEMAND**

**Q & A**

# INTRODUCTION

## Background

- ❖ Part of IVI's Policy & Economic Research of Typhoid Vaccine Investment Case Exercise
- ❖ Built on four factors that drive new vaccine introduction
- ❖ Address four areas of curiosity for typhoid endemic countries

## Our Curiosity

- ❖ What are the TCV candidates, developers & manufacturers?
- ❖ Expected introduction of TCV: Which country & when?
- ❖ How will the global demand for TCV look like?

# TCV INTRODUCTION FORECASTING



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# TYPHOID CONJUGATE VACCINE PIPELINE

## Vaccine Development & Technology Transfer Institutions

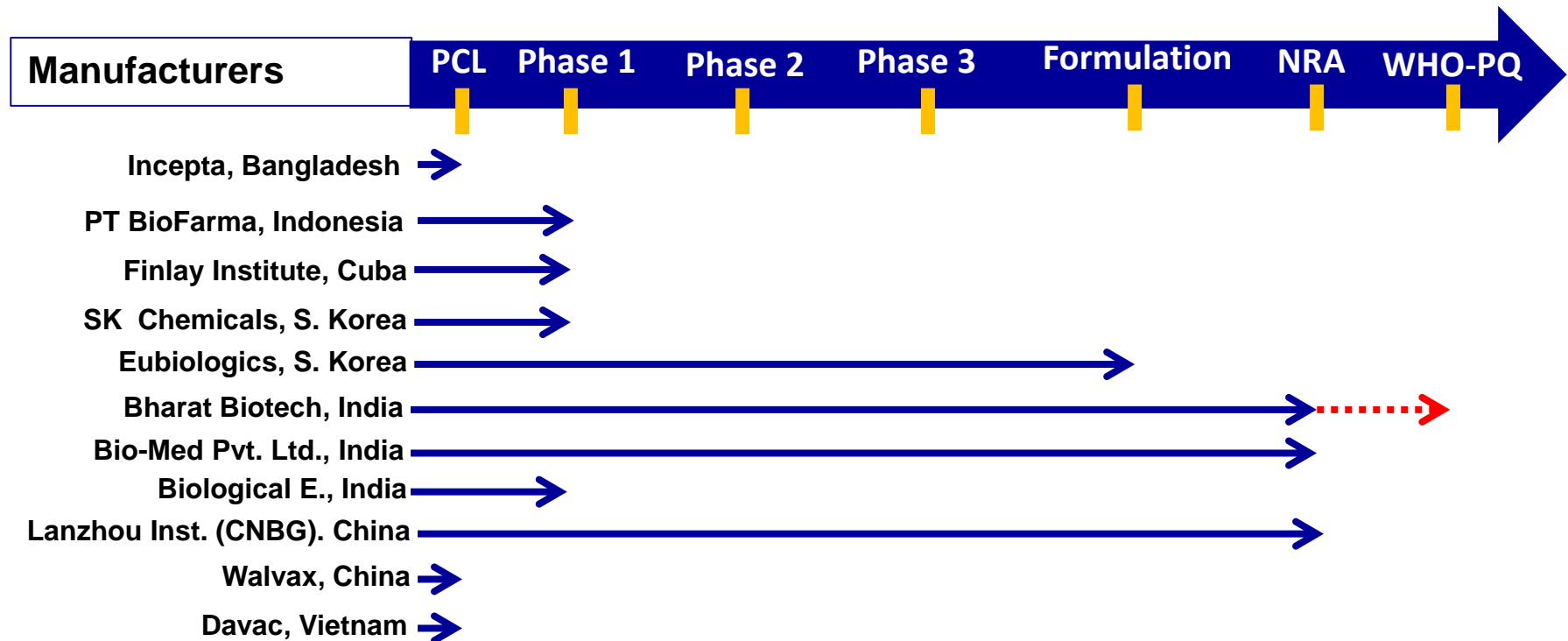
IVI, S. Korea: Vi-DT (Vi conjugated with Diphtheria Toxoid)

\*Vi-TT (Vi conjugated with Tetanus Toxoid)

NIH, U.S.A.: Vi-rEPA (Vi recombinant exoprotein antigen)

NVGH, Italy: Vi-CRM (Vi conjugated with cross reacting material 197)

Own R&D: Davac – Vi-DT; Bharat & Bio-Med – Vi-TT\*; Eubiologics – Vi-CRM; Walvax – Vi-TT; Finlay - Unknown



# FORECASTING TCV INTRODUCTION

## Estimated through four indicators

### ❖ Typhoid fever disease burden

- Utilized data from Mogasale et al. 2014, Lancet Global Health

### ❖ Past vaccine adoption history

#### ❖ Hib, Hep B, pneumo CV, rota:

- Data for 92 countries from JHSPH IVAC-VIMS Database, March 2014 update

#### ❖ Pentavalent Vaccine Introduction:

- Data for Indian 35 States from Gavi (personal Communication with Melissa Ko)

### ❖ Immunization System Capacity

#### ❖ DTP3 coverage rate:

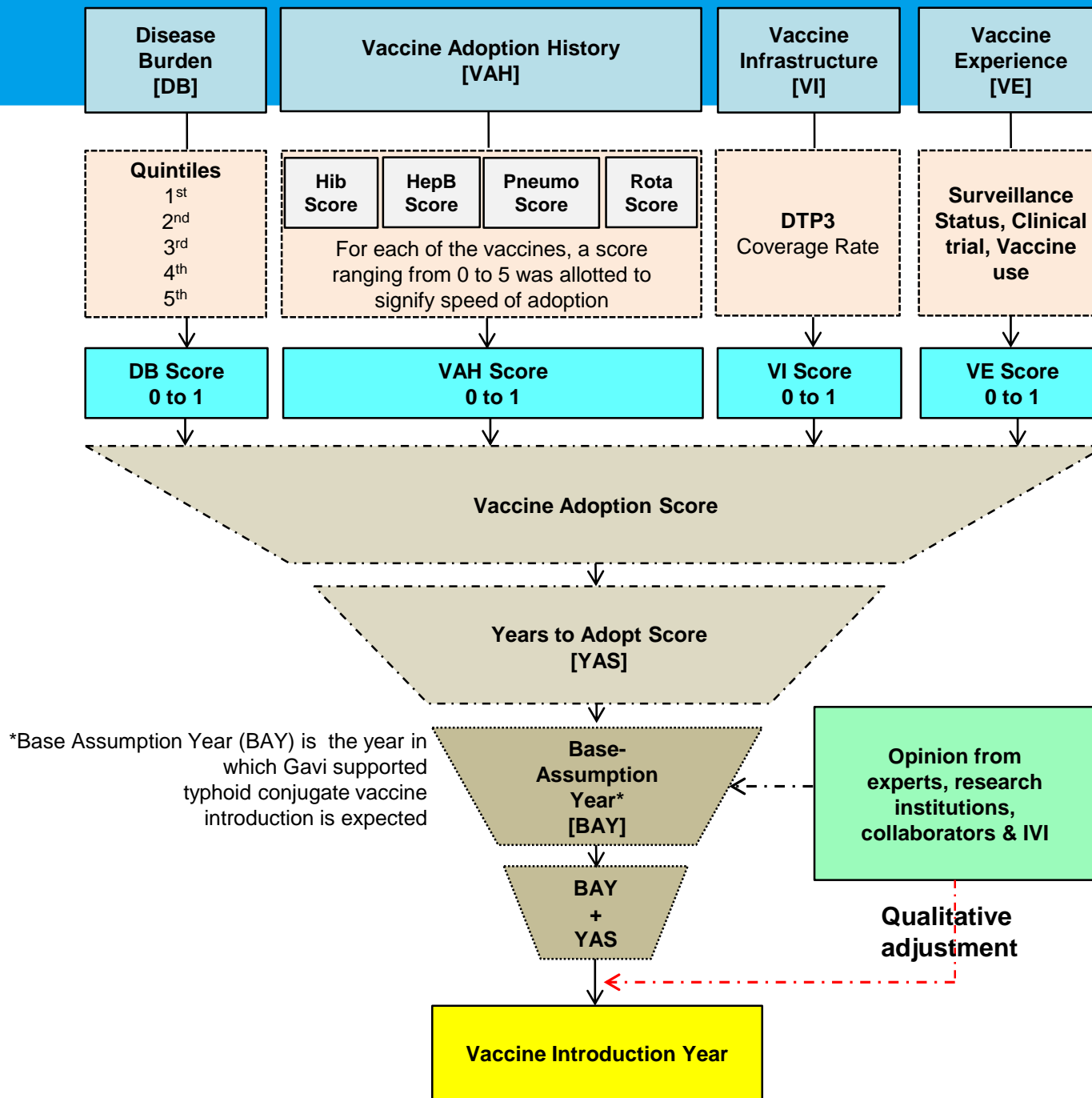
- Data for 92 countries from WHO 2014. Immunization System Indicator
- Data for Indian States from UNICEF-India 2009. Coverage Evaluation Survey report 2009 - State Fact Sheets

### ❖ Experience in typhoid fever research

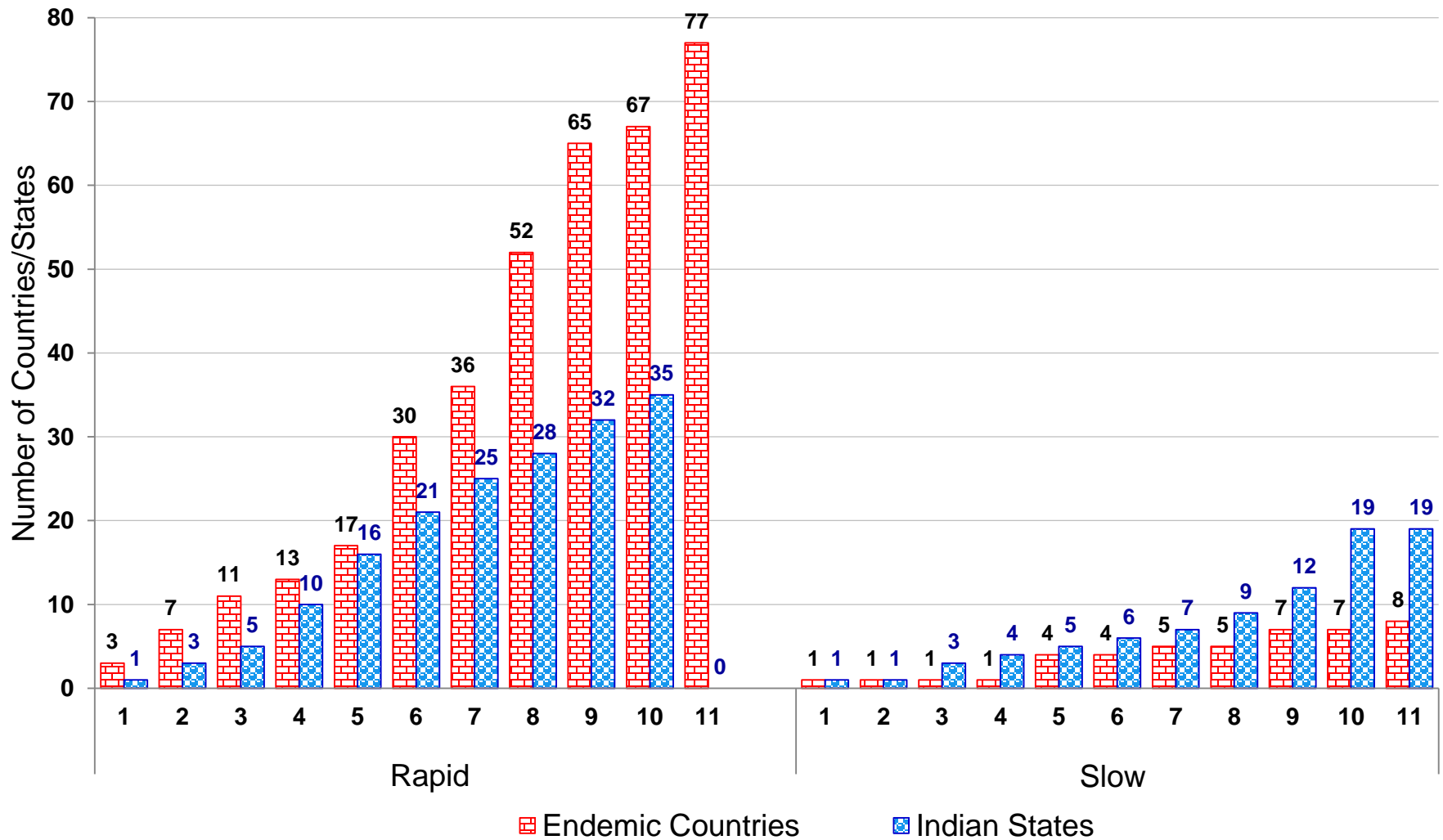
#### ❖ Typhoid surveillance, clinical trial, RCT, demonstration trial:

- Data from 22 studies on typhoid surveillance experience in 92 countries
- Data from 3 studies on Indian States typhoid surveillance experience

# METHOD OF FORECASTING



# FORECASTED TCV ADOPTION YEARS



1 = base assumption year is the year in which Gavi supported typhoid conjugate vaccine introduction is expected

Rapid introduction proxy: Rota vaccine according to Brooks et al. (2012)

Slow introduction proxy:



# TCV DEMAND FORECASTING

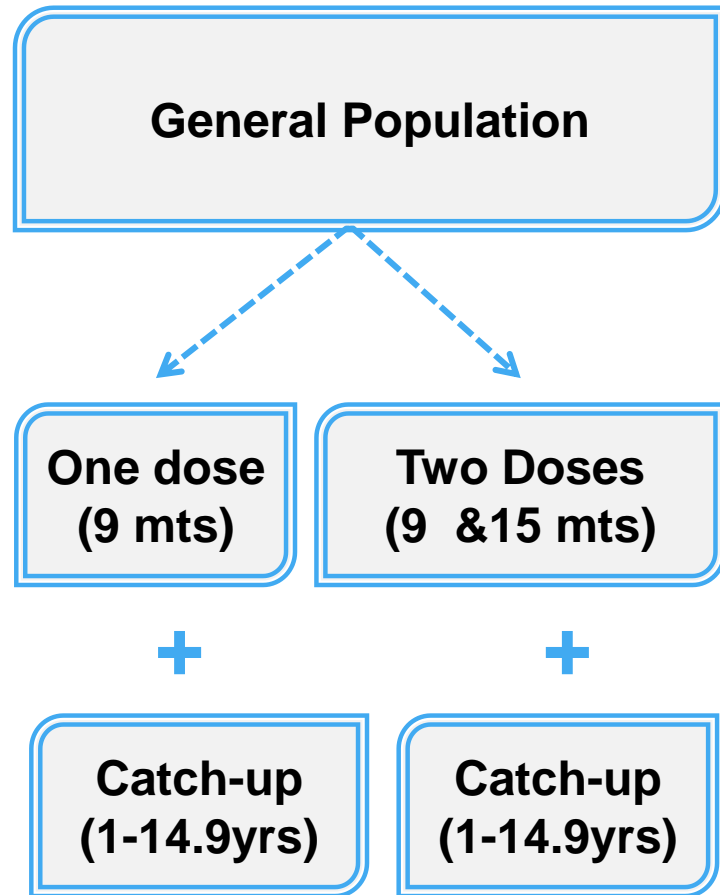
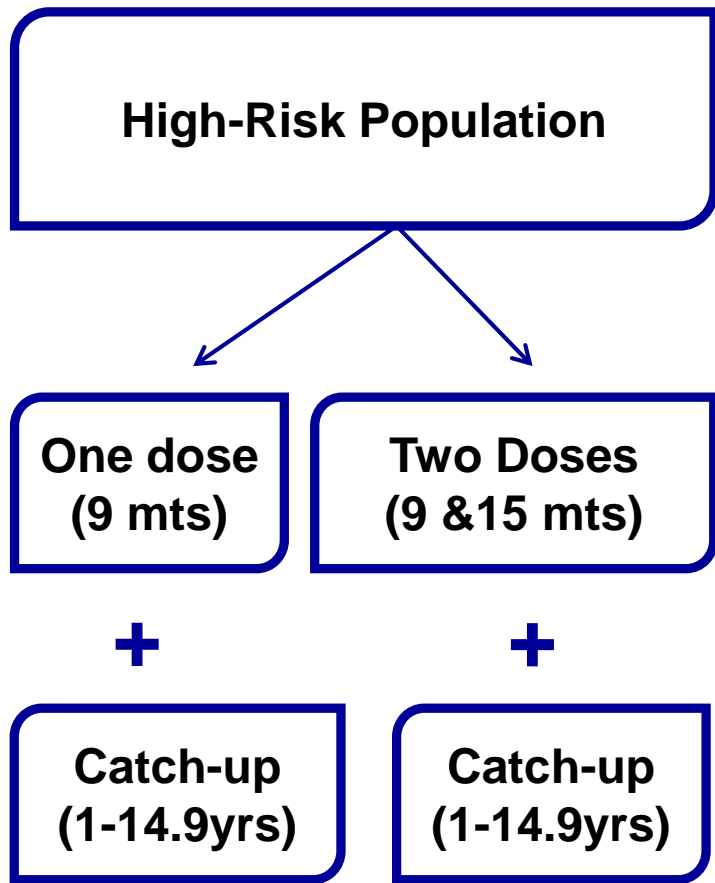


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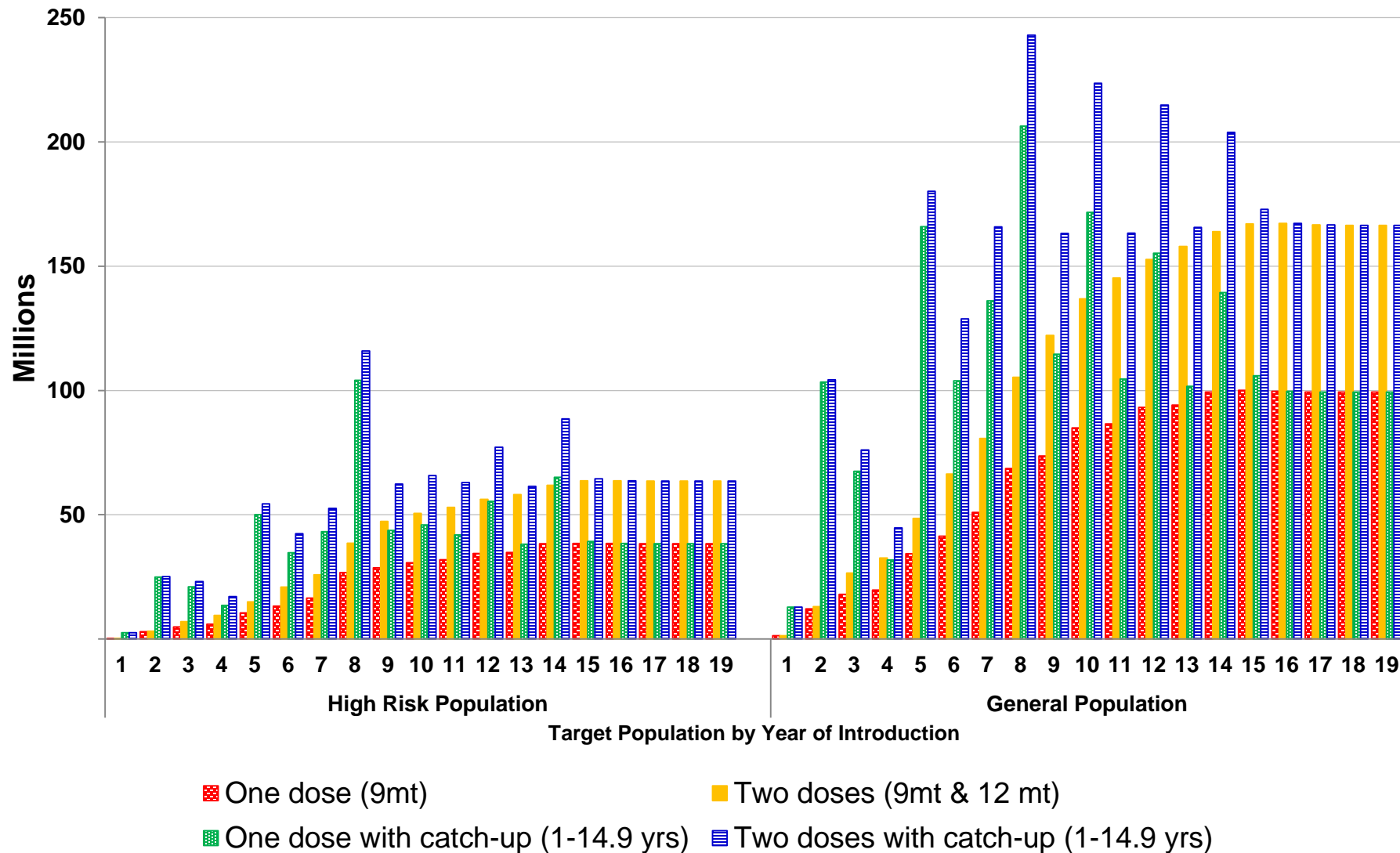
## What is needed

- ❖ Vaccination strategy: Age and risk group targeting
  
- ❖ Assumptions
  - ❖ For each country we assume TCV coverage at:
    - 9 month to be same (100%) as MCV1 coverage for that country
    - 15 – 18 months to be 75% as MCV1 coverage for that country
    - Catch-up dose: MCV1 coverage to be 75%
  - ❖ Wastage factor: Routine=1.33 and Campaign=1.11

# TCV VACCINATION STRATEGY



# FORECASTED TCV DEMAND



1 = base assumption year is the year in which Gavi supported typhoid conjugate vaccine introduction is expected

# LIMITATIONS

- ❖ **Gavi funding shift**
- ❖ **Other potential interventions**
- ❖ **Rapid economic growth**
- ❖ **TCV competition with other health interventions incl. new vaccines**
- ❖ **Political instability and/or natural disasters**

# TAKE HOME MESSAGE

- ❖ Effective and improved TCV WHO-PQ around the corner
- ❖ Increased interest from donors, procurers & policy makers
- ❖ Mutual partnership for humanity: Producers & Manufacturers
- ❖ TCV demand ranging from 40 – 160 million doses/year



**Global Policy Maker-Donor  
Collaboration is Needed in Developing  
Policy Framework for TCV Introduction  
to Meet Projected Demand**

# COMING OUT SOON: PUBLICATION

## Forecasting typhoid conjugate vaccine introduction and demand in typhoid endemic low and middle countries

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### Key words

Typhoid conjugate vaccine, demand forecast, vaccine introduction

## ❖ **IVI-VIVA Investment Case Advisory Committee**

- Alejandro Cravioto
- Thomas F. Wierzba
- Georges Thiry
- Sushant Sahastrabuddhe
- Rodney Carbis

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- Melissa Ko
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## **IVI-VIVA Investment Case Collaborators**

Policy and Economic Research Dept.  
VIVA Investment Case Advisory Committee

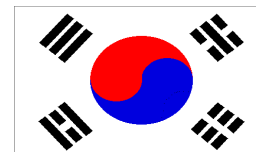


Project Specific: Bill & Melinda Gates Foundation

Core Funding 1: Government of the Korea Republic

Core Funding 2: Government of Sweden

**BILL & MELINDA**  
*GATES foundation*







**ASANTE !  
THANK YOU !**



# BACK-UP SLIDES



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# FORECASTED TCV ADOPTER COUNTRIES

Gavi	YEAR											
	2020	2021	2022	2023	2024	2025	2026	2027	2028	2029	2030	2031+
Eligible	Nepal Bangladesh <sup>3</sup>	Pakistan Rwanda	Malawi Burundi Kenya	Eritrea	Burkina Faso Madagascar	Gambia Kyrgyzstan Uganda Cambodia	Tajikistan Senegal Tanzania	Comoros Mozambique Sudan Zimbabwe Afghanistan Congo, DR Ethiopia	Mali Sierra Leone Yemen Benin	Myanmar	Liberia Mauritania Niger Togo CAR#	Guinea-Bissau [2031] Korea, DPR [2031] Chad [2031] Somalia [2031] Guinea [2032] Haiti [2033]
Indian States	Delhi	Puducherry Tamil Nadu	Jammu & Kashmir West Bengal	A&N** Islands Arunachal Pradesh D&N_Haveli Daman&Diu Himachal Pradesh	Andhra Pradesh Assam Goa Karnataka Kerala Punjab	Chhattisgarh Chandigarh Haryana Uttarakhand Orissa	Gujarat Jharkhand Meghalaya Maharashtra	Mizoram Nagaland Sikkim	Lakshadweep Madhya Pradesh Manipur Tripura	Bihar Rajasthan Uttar Pradesh		
Graduating	Cuba <sup>3</sup>	Indonesia <sup>3</sup> Vietnam <sup>1</sup>	India <sup>2</sup> *			Guyana Nicaragua <sup>1</sup> Congo, Rep. Cameroon <sup>2</sup> STP ^^ Zambia <sup>2</sup>	Ghana <sup>1</sup> Sri Lanka	Honduras Uzbekistan <sup>1</sup> Cote d'Ivoire <sup>2</sup> Djibouti <sup>2</sup>	Mongolia Armenia Lao PDR <sup>2</sup> Lesotho <sup>2</sup>		Kiribati Timor-Leste Bolivia Georgia	Solomon Is. <sup>1</sup> [2031] PNG ## [2032] Azerbaijan [2032] Nigeria <sup>1</sup> [2033]
Non-eligible				Angola <sup>4</sup>	Bhutan <sup>4</sup> Philippines	Ecuador El Salvador Maldives	Fiji	Iran Morocco Paraguay Turkmenistan Guatemala	Jordan Micronesia Swaziland Belize Cape Verde	Egypt	Marshall Islands	Iraq [2031] Tonga [2031] Tunisia [2031] Samoa [2031] Vanuatu [2033] Syria [2034]

^^ Sao Tome e Principe # Central African Republic \*\* Andaman and Nicobar ## Papua New Guinea \*India as a single country

1 Gavi eligible in 2014 but forecasted by Gavi to graduate by 2015

2 Gavi eligible in 2014 but will graduate by 2020

3 Qualitatively forecasted to introduce earlier as forecasted based on communication with experts from IVI and BMGF

4 Will be 100% self-financing beginning 2020 [Communication with Melissa Ko]

Gavi forecasted graduation dates are based on World Bank GNI estimates released in July 2014 and IMF growth rates released in October 2014

**Note: Forecasted years are subject to change based on base adoption year (WHO PQ)**



# PROJECTED STRATEGIC DEMAND

## Doses per Year

Population	One Dose (9 months)	Two Doses (9 – 12 months)	One Dose Catch- Up (1-14.9 yrs.)	Two Doses Catch- Up (1-14.9 yrs.)
High Risk	40 million	65 million	40 million (Peaks at 110, stabilizes at 40)	65 million (Peaks at 120, stabilizes at 65)
General	100 million	166 million	100 million (Peaks at 206, stabilizes at 100)	166 million (Peaks at 243, stabilizes at 166)

# THREE TYPES OF TYPHOID VACCINES

- ❖ **Ty21a**
- ❖ **Injectable Vi polysaccharide Vaccine**
- ❖ **New Generation Injectable TCV**