



17th TechNet Conference

Panama City, Panama | October 16-19, 2023

Immunization Programmes That Leave No One Behind

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Forecasting and Demand – Nigeria & Mozambique Case Studies

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October 18, 2023

A Multi-Level Approach to Vaccine Forecast and Demand in Nigeria

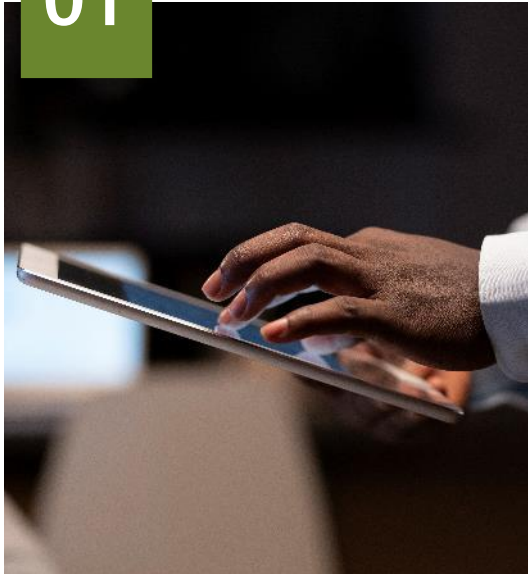
Implications for Micro-level Immunization Sustainable Financing

Kikelomo Lambo, CHAI Nigeria



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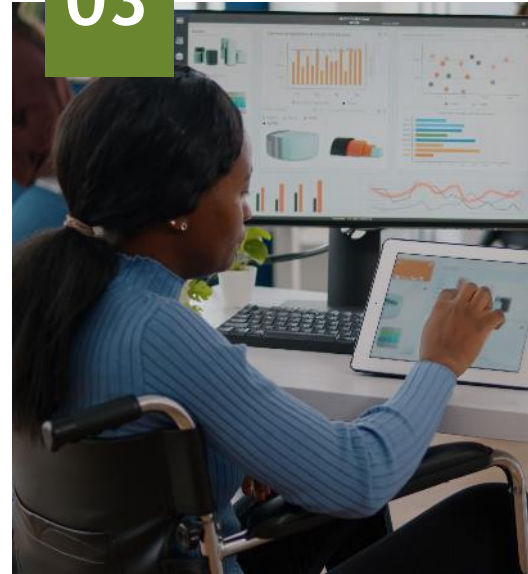
Introduction & Background

02



Vaccine Forecasting in Nigeria: Processes, Analytics and Tools

03



Multi-Level Approach to Vaccine Forecasting and Demand for Vaccines in Nigeria

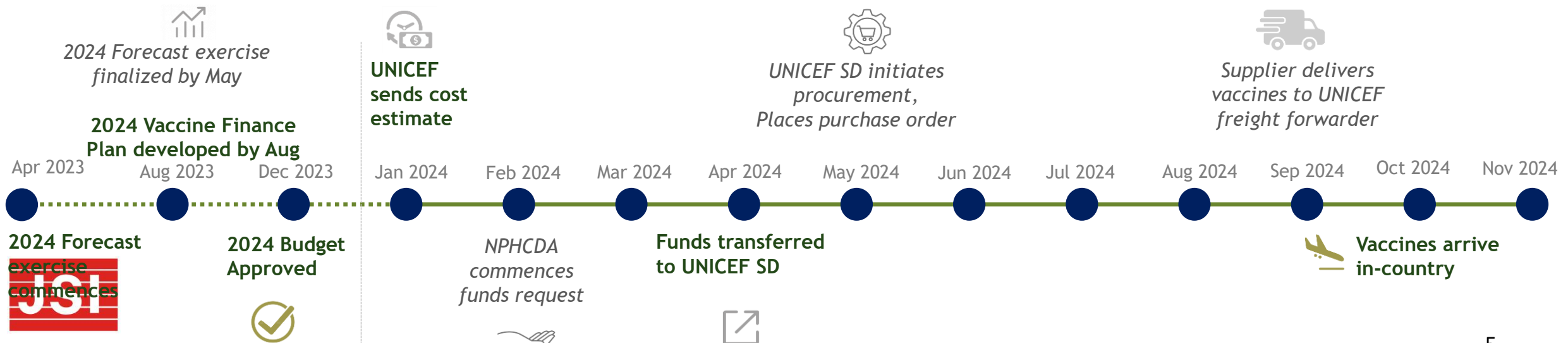
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Implications of the Multi-Level Approach to Vaccine Forecasting and Demand for Sustainable Financing of Immunization

Nigeria's Life-Saving Vaccine forecast process overview

- ❑ In Tandem with the country's National Immunization Policy, the Federal government is responsible for ensuring that Vaccines are available for all children and women of child-bearing age in the country. The forecast is conducted annually ahead of procurement, shipment and distribution.
- ❑ Nigeria conducts the **forecasting exercise between April and May every year to fit into the national budget consolidation in June**. Carry-over stocks amongst other parameters are taken into consideration to determine procurement quantity.
- ❑ The outcome of **the forecast is a key input for a number of processes**, including annual country budgeting and planning for the health sector, negotiation and securing better pricing and securing Import Duty Exemption Certificate (blanket waiver) which requires procurement quantities, costs, and associated documents.
- ❑ **In line with Nigeria's Federation system, the Vaccine forecast was changed from a national-level activity to a state-specific (multi-level) activity** which amongst several benefits has resulted in efficiency and forecast accuracy.



UNICEF Designed an Excel-based Forecasting Tool for forecasting vaccines and related commodities

Processes, Analytics and Tools

Products: ROUTINE activities	Target Age Group		Target Population	Estimated Coverage 2021 (%)	No. of doses/tabs per person	Estimated Wastage 2021 (%)	Total no. of doses /tabs	Buffer #Safety Stock Qty	Current Stock		Activities for remainder of 2020						
	from	to							Qty	as per which date (DD/MM/YYYY)	Expected incoming Deliveries in doses after the stock count date (column M) for remainder of 2020 (Only the quantity ALREADY placed on PO (Purchase Order))	Expected incoming Deliveries in doses after the stock count date (column M) for remainder of 2020 (Only the quantity NOT YET placed on PO (Purchase Order))	Current Stock + Expected Deliveries not get placed on PO and already placed on PO	Consumption in doses after the stock count date (column M) for remainder of 2020	Expected stock at the end of the current year (2020)	Available stock at the end of the current year (2020) after withholding buffer needs	Estimated procurement needs in doses for 2021 (transferred to table 6)
BCG-20	0 month	11 month	8,997,866	89	1	70	26,693,669	6,673,417	1,951,610	05/01/2020	3,527,000	6,458,000	11,936,610	4,440,293	7,496,317	822,900	25,870,769
HepB-10	0 month	11 month	8,997,866	72	1	25	8,637,952	2,250,186	369,720	05/01/2020	4,351,300	487,640	5,208,660	2,548,507	2,560,153	409,967	8,227,985
BOPV-20	0 month	11 month	8,997,866	82	4	25	39,350,667	9,991,134	3,946,500	05/01/2020	12,080,000	20,334,470	36,360,970	16,810,779	19,550,191	9,559,057	29,791,610
DTP-HepB-Hib-10 (lqd)	6 weeks	11 month	8,547,973	86	1	25	9,801,676	2,487,665	140,740	05/01/2020	2,610,245	6,297,952	9,048,937	4,734,072	4,314,865	1,827,200	7,974,476
DTP-HepB-Hib-10 (lqd)	6 weeks	11 month	8,547,973	78	1	25	8,889,892	2,330,041	0	05/01/2020	2,610,242	6,297,953	8,908,195	4,483,445	4,424,750	2,094,709	6,795,183
DTP-HepB-Hib-10 (lqd)	6 weeks	11 month	8,547,973	76	1	25	8,661,946	2,247,775	0	05/01/2020	2,610,243	6,297,955	8,908,198	4,118,355	4,789,843	2,542,068	6,119,878
PCV10-4	6 weeks	11 month	8,547,973	86	1	10	8,168,063	2,073,054	3,153,724	05/01/2020	1,987,735	3,657,392	8,798,851	4,658,179	4,140,672	2,067,618	6,100,445
PCV10-4	6 weeks	11 month	8,547,973	78	1	10	7,408,243	1,941,700	0	05/01/2020	1,987,733	3,657,391	5,645,124	4,425,712	1,219,412	-722,288	8,130,531
PCV10-4	6 weeks	11 month	8,547,973	76	1	10	7,218,288	1,873,146	0	05/01/2020	1,987,732	3,657,392	5,645,124	4,062,539	1,582,585	-290,561	7,508,849
IPV-10	14 weeks	11 month	8,547,973	76	1	20	8,120,574	2,107,289	1,695,145	05/01/2020	2,300,000	3,866,800	7,861,945	4,265,565	3,596,380	1,489,091	6,631,483
Mea-10	9 month	11 month	8,547,973	86	1	40	12,252,094	3,102,230	2,989,320	05/01/2020	929,000	4,249,000	8,167,320	4,171,176	3,996,144	893,914	11,358,180
YF-10	9 month	11 month	8,547,973	83	1	40	11,824,696	2,988,101	1,389,060	05/01/2020	0	5,325,000	6,714,060	4,152,920	2,561,140	-426,961	12,251,657
Td-10	Pw	Pw	11,247,332	81	2	25	24,294,238	6,073,560	1,288,760	05/01/2020	0	8,096,000	9,384,760	7,716,187	1,668,573	-4,404,987	28,639,225
Mening A Conj-10 (pediatric)	9 month	11 month	8,547,973	80	1	30	9,769,112	2,537,038	577,860	05/01/2020	0	3,674,000	4,251,860	3,503,293	748,567	-1,788,471	11,557,583
RV1-5	6 weeks	11 month	8,547,973	60	3	30	21,980,501	5,754,495	0	05/01/2020	0	0	0	0	0	-5,754,495	27,734,996
Mea-10	12 month	23 month	8,547,973	83	1	40	11,824,696	2,988,101	2,989,320	05/01/2020	0	4,249,000	7,238,320	4,171,176	3,067,144	79,043	11,745,653
HPV4-1	9 years(F)	14 years(F)	12,372,066	68	2	5	17,711,589	4,581,988	0	05/01/2020	0	0	0	0	0	-4,581,988	22,293,577
Other							0	0	0	05/01/2020	0	0	0	0	0	0	0
Other							0	0	0	05/01/2020	0	0	0	0	0	0	0
Other							0	0	0	05/01/2020	0	0	0	0	0	0	0

- **Products - Routine activities:** A list of the different vaccines to be forecasted
- **Target age group:** The age range of the target population for the vaccines
- **Target population:** Quantity of children and/or women in the target age group
- **Estimated coverage (%):** Percentage of the target population the vaccine is anticipated to reach. Use numbers from 0 to 100
- **Number of doses/tablets per person:** Number of doses/tablets required per child and/or woman
- **Estimated wastage (%):** Percentage of the quantity of vaccine that is expected to be wasted. Estimated wastage is calculated based on the quantity of product to be procured. Use numbers from 0 to 100
- **Buffer stock:** Required buffer stock quantity. For vaccines, typically 3 months' stock of annual requirement

Assumptions & Parameters used for Vaccines Forecasts



Target Population (P_{targ})

- The target population is the number (in Millions) we forecast for
- 2006 projected census has been the source data for the target population in the NSIPSS document and forecasting exercise

Target coverage (T_{vc})

- The projected coverage (in %) aimed to be reached with the vaccines.
- This is often based on the historical performance of the States

Doses per schedule

- The required number of doses needed for a Fully Immunized Child (FIC)/Target per vaccine
- Adapted from WHO recommendation & Nigeria Immunization Technical Advisory Group (NGI-TAG) recommendation

Wastage Factor

- The wastage rate is adapted from the WHO wastage calculator with consideration to existing data on vaccine wastage
- The wastage factor is usually deducted from the wastage rate
- **Wastage factor = $100 / (100 - \text{wastage rate})$**

Buffer stock

- Total quantity of antigen stock expected to be available at the start of the forecast year
- Also known as Safety stock
- 5% of the initial forecasted quantity is added to the forecasting figures

Estimating Quantity Requirements for Devices

Parameter	Explanation
Estimated Wastage Rate	Percentage of the quantity of vaccine that is expected to be wasted.
Total number of doses required	Target population × Target Coverage × No of doses per person × Wastage Factor $\left\{ \text{Wastage Factor} = \frac{100\%}{100\% - \text{Estimate wastage rate}} \right\}$
Normal buffer stock quantity	Required buffer stock quantity. For vaccines, typically 3 months' stock of annual requirement. 50% for coverage <60%; 25% for coverage >60%
Current Stock	Available vaccine stock quantity as at time of forecast

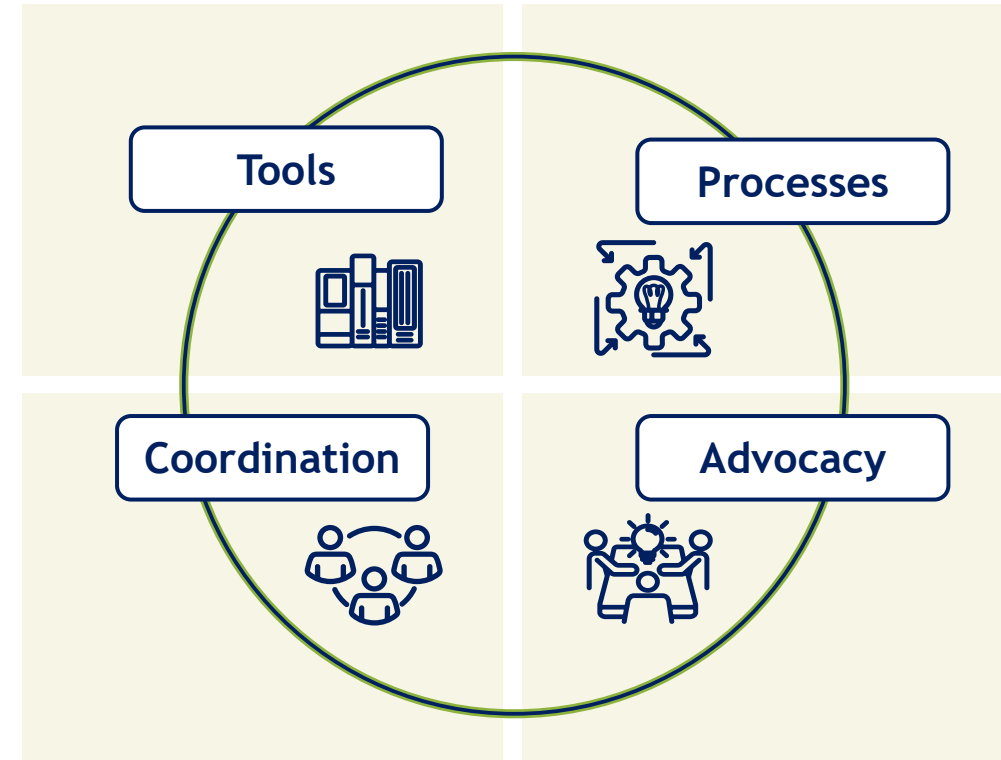
Estimating Quantity Requirements for Devices

Parameter	Explanation
Total number of AD-syringes	Total forecasted AD-syringes: $\text{Target population} \times \text{Target Coverage} \times \text{No of doses per person} \times 1.1$
Total Number of Reconstitution syringes (pieces)	Total forecasted Reconstitution syringes: $\frac{\text{Total number of doses}}{\text{Number of doses per vial}} \times 1.$
Total number of safety boxes	Total forecasted Safety boxes: $\frac{(\text{Total number of AD syringe} + \text{Total number of reconstitution syringes}) \times 1.1}{100 \text{ (Number of syringes per safety box)}}$

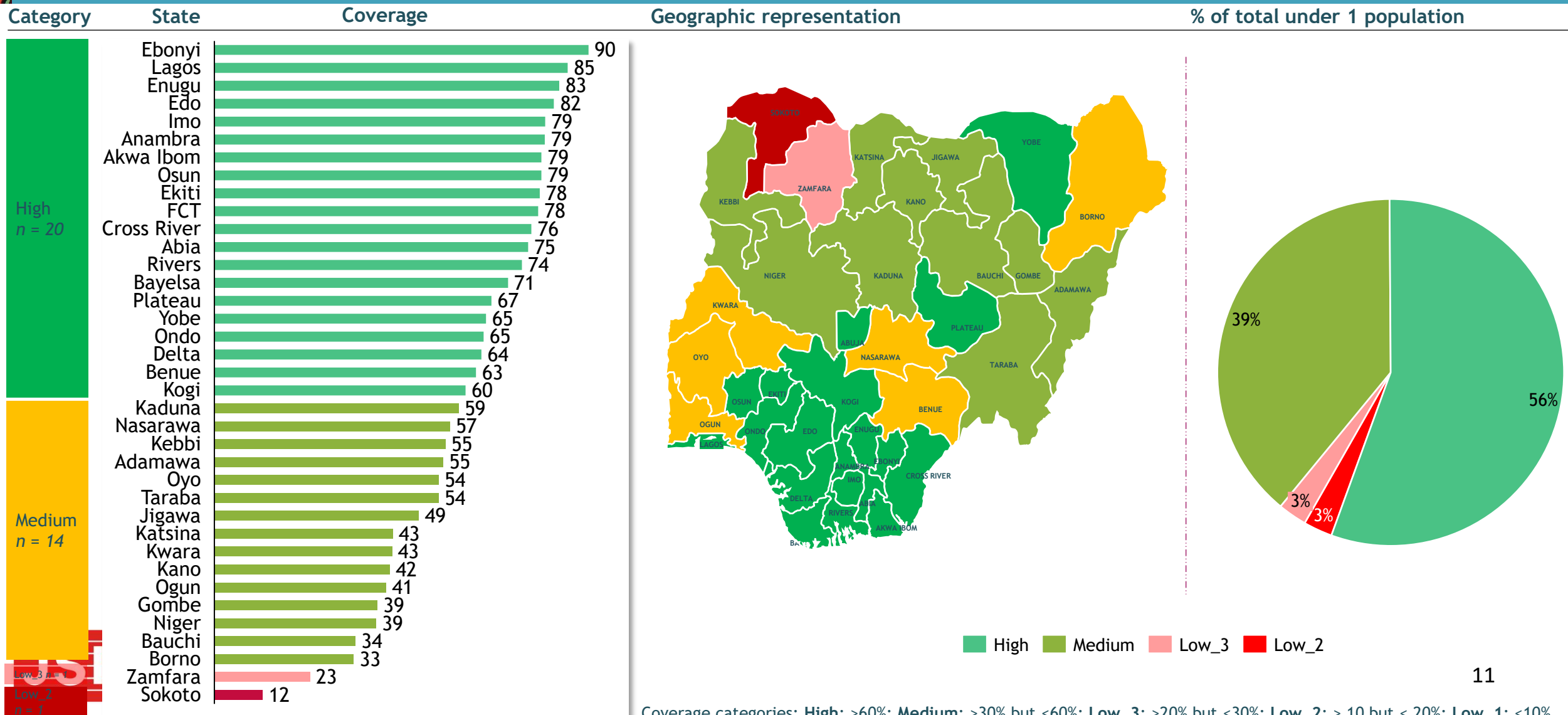
States and individually Unique. So should their Forecast

Multi-Level Approach to Vaccine Forecasting

- ❑ Importantly, in recent years, Nigeria has been implementing a **state-specific forecasting process that incorporates the diversity of our federating states and the federal capital as well as their unique variable values.**
- ❑ Each assumption and parameter for the forecast is individualized to each state
 - ❑ Each state's parameters and assumptions are then used to develop a template for the 36 states and Federal Capital Territory such that they have their **specific forecast figures handy to make state-specific decisions and conduct analysis.** These unique state values are further weighted via analysis to arrive at the single figures that are entered into the national template.
 - ❑ This approach further **strengthens the understanding, acceptance and ownership of the forecast process and its resultant outputs and outcomes by all the stakeholders** who will in turn contribute to the successful implementation of the forecast (including financing) and subsequent discussions/reviews.



In 2017, all 36 states + FCT were categorized into 4 groups based on their Penta 3 coverage in the 2021 MICS/NICS, to develop tiered targets for vaccine forecasting



Coverage categories: High: $\geq 60\%$; Medium: $\geq 30\%$ but $< 60\%$; Low_3: $\geq 20\%$ but $< 30\%$; Low_2: $\geq 10\%$ but $< 20\%$; Low_1: $< 10\%$

Projected Coverages for State-Specific Forecasting

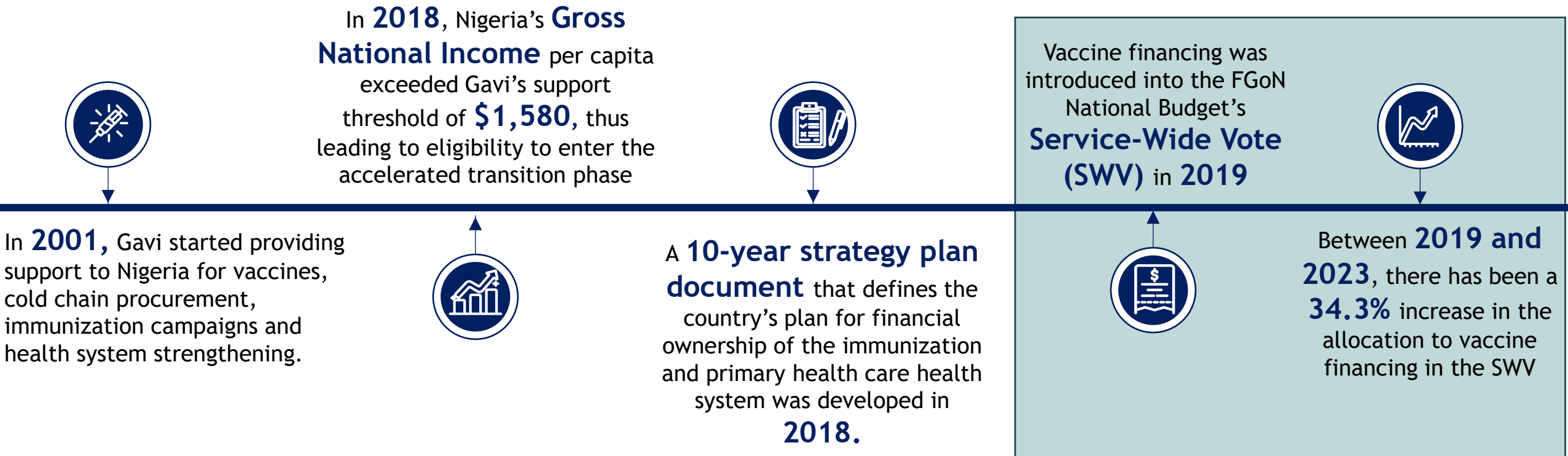
Multi-Level Approach to Vaccine Forecasting

Antigen	Target Coverages				
	High	Medium	Low 3	Low 2	Low 1
BCG	96%	93%	82%	84%	73%
Hep B	86%	82%	81%	71%	52%
OPV	94%	90%	83%	76%	70%
Penta 1	94%	91%	86%	75%	71%
Penta 2	92%	87%	82%	72%	59%
Penta 3	91%	83%	77%	69%	47%
PCV 1	94%	91%	86%	75%	71%
PCV 2	92%	87%	82%	72%	59%
PCV 3	91%	83%	77%	69%	47%
IPV 1	91%	83%	77%	69%	47%
IPV 2	88%	80%	74%	66%	44%
Measles 1	92%	92%	87%	75%	72%
Measles 2	91%	90%	86%	75%	72%
YF	91%	90%	86%	75%	72%
Td	92%	84%	89%	79%	75%
Men A	91%	90%	86%	75%	72%
RV 1	88%	74%	39%	26%	11%
RV 2	85%	71%	36%	23%	8%
RV 3	82%	68%	33%	20%	5%
HPV	76%	72%	71%	51%	25%

The Multi-level forecast an endpoint success determinant for Nigeria's successful transition from GAVI support.

Forecast implications for Sustainable Immunization Financing

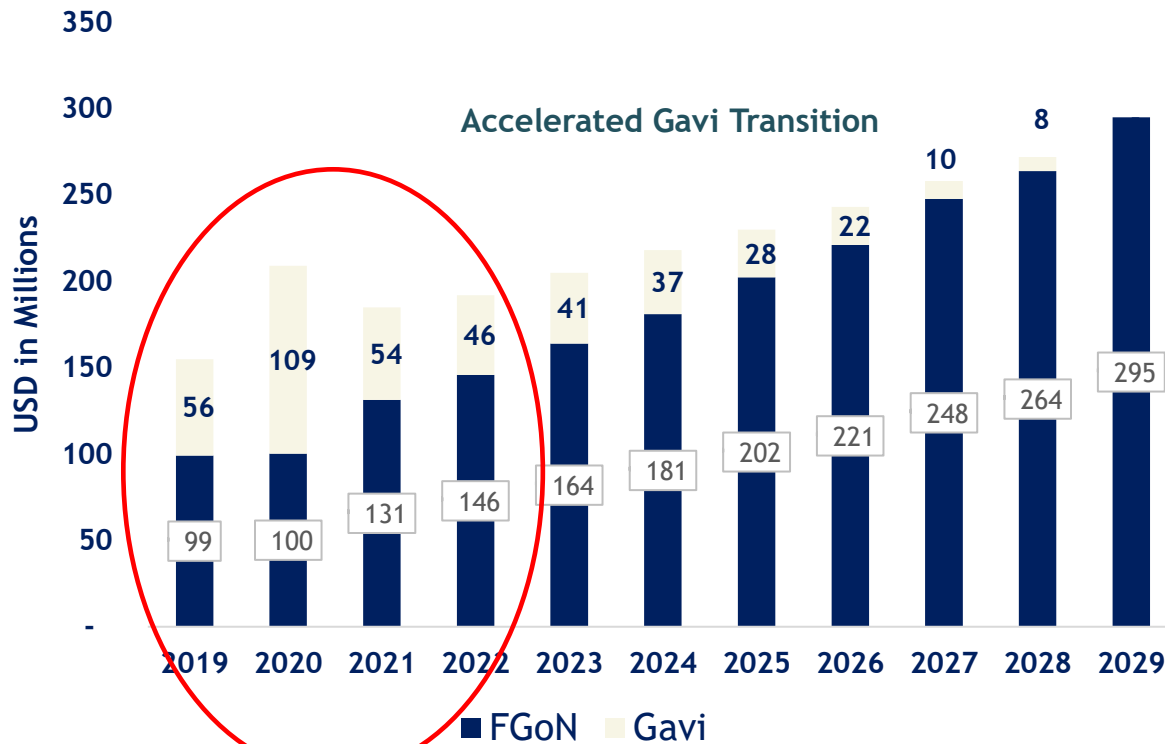
Overview of the trajectory of GAVI transition



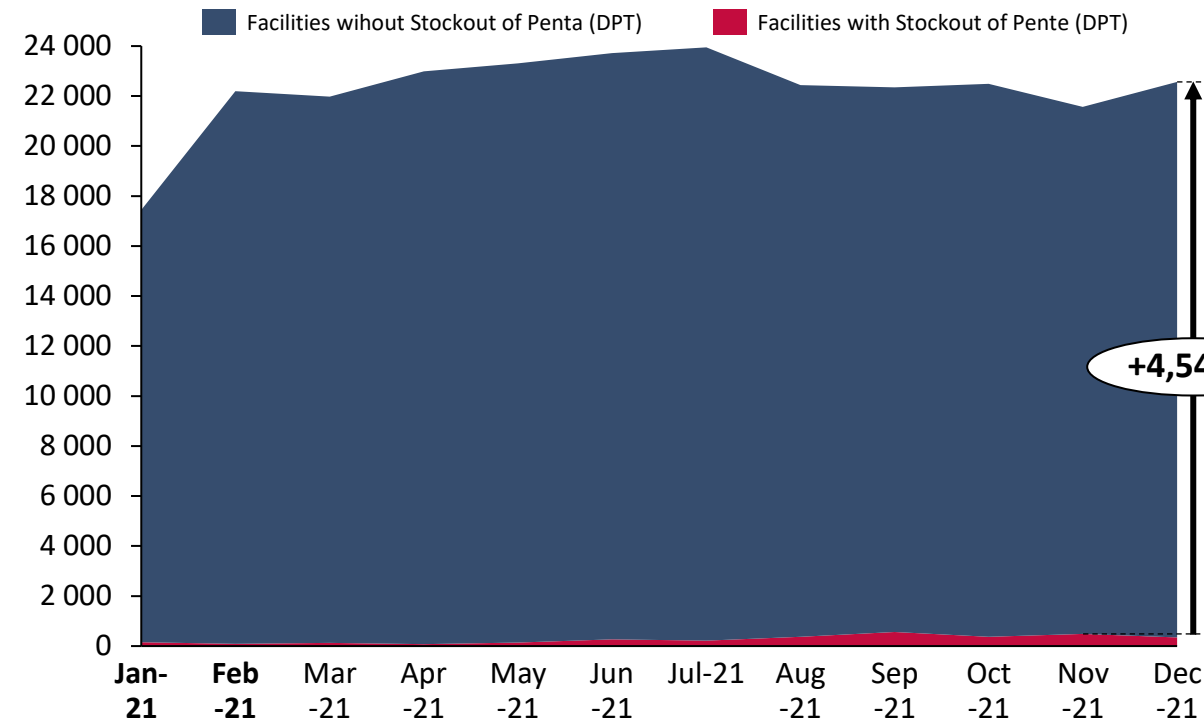
Since 2019, there has been a 34.3% increase in the allocation to vaccine financing in the service wide vote

Forecast implications for Sustainable Immunization Financing

Projected routine immunization funding for vaccines & devices committed in Nigeria by funding source per NSIPSS



A reduction in the number of facilities with a stock of DPT-containing vaccine



The impact of the Multi-level Forecasting process is Limitless with the ultimate goal of ensure the availability of life-saving vaccines

- 1. Forecasting plays a critical role in the reduction of Maternal and Infant mortality in Nigeria** and The multi-level approach to vaccine forecasting ensures that forecasting is more accurate and reliable, leading to improved vaccine availability and security.
- 2. This efficiency impacts positively the country's ability to meet its co-financing obligation by minimizing excesses and vaccine wastages** in the system in the context of limited resources and competing priorities.
- 3. This forecasting approach is also driving sustainable financing conversations** through the possibility of mobilizing financial resources at the sub-national level to guarantee adequate funding for immunization programs. This financing bottom-up approach can help to ensure that vaccines are available and accessible to all, whilst sharing in the financing responsibility with the federal government
- 4. It is recommended that Ministries of Health and partners organize forecasting workshops, review and clarify the parameters/assumptions (data) and process,** and issue quantities to manufacturers for production that would adequately cater for the diverse program needs within countries and be robust and flexible enough to respond to and withstand emergencies as driven by the coherent, sustainable and immediate stakeholders understanding, especially, in a system requiring multi-level of funds processing, approval and releases.

Alternative vaccination forecasts and supply plans: Mozambique case study

Laila Akhlaghi, JSI



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Outline



Objective: Provide Mozambique with strong evidence to get “over forecasts” for routine vaccines approved for funding

Outline:

- Review traditional vaccine forecasting and planning in LMICs
- Mozambique case study
 - Forecasting
 - Supply planning
 - Results
- Next steps

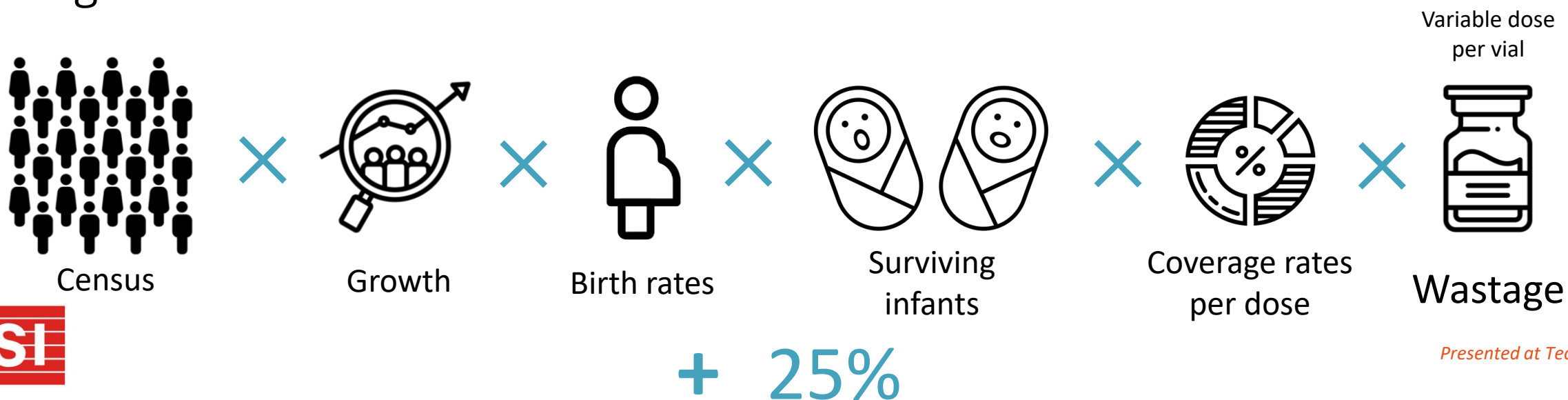
Current process and guidance on vaccine forecasting

Objective:

- Point forecast (doses) for annual procurement + 25% safety stock
 - Determined by MoHs and UNICEF

Method:

- Demographic-based on coverage goals
- Distribution to lower levels follow the same demographic and coverage goals



Limited quality data available for forecasting

Source:
Daily tally sheet

Rep: [Redacted]
 Min: [Redacted]
 Mo: [Redacted]
 Posto Fixo Brigada Móvel

FICHA DE RESUMO DIÁRIO DO PAV PARA POSTO FIXO -BRIGADA MOVEL

Vacinas	Crianças dos 0-11 meses			12-23 meses			TOTAL	Absentes
	Masculino	Femenino	Total	Masculino	Femenino	Total		
	a	b	a+b	d	e	d+e		
BCG	8	6	14	0	0	0	14	01
Pólio 0	7	6	13	0	0	0	13	
Pólio 1ª Dose	4	1	05	0	0	0	05	
Pólio 2ª Dose	3	6	09	01	0	01	10	05
Pólio 3ª Dose	8	13	21	0	0	0	21	
IPV	15	20	35	01	0	01	36	07
DPTHePB+Hib 1ª Dose	0	0	0	0	0	0	0	
DPTHePB+Hib 2ª Dose	0	0	0	0	0	0	0	
DPTHePB+Hib 3ª Dose	0	0	0	0	0	0	0	0
PCV 1ª Dose	4	1	05	0	0	0	05	
PCV 2ª Dose	5	6	11	01	0	01	12	
PCV 3ª Dose	1	7	08	0	01	01	09	06
RV 1ª Dose	4	1	05	0	0	0	05	
RV 2ª Dose	2	6	08	0	0	0	08	13
MR 1ª Dose	2	8	10	0	01	01	11	
CCV < 1 ano	2	8	10	Apenas para 18 a 23 meses de idade				
MR 2ª Dose				3	1	04		02

VACINA ANTITETÂNICA

VAT	1ª Dose	2ª a 5ª Dose
Mulheres Grávidas	04	06
MIF'S 15 a 49 anos	Comunidade	30
	Estudante	0
	Trabalhador	0
	Total	30
Não MIF'S	Estudante	0
	Trabalhador	0
Outros	2	4
TOTAL VAT	36	17

Simose Categoria

Fields:

- Date
- Province, district
- Vaccine type
- Vaccine
- Doses administered (by age and gender)
- Vials opened (used)

Transfer of data to electronic systems introduces errors:

- Lack of timely reporting
- Transcribing
- Math and counting errors

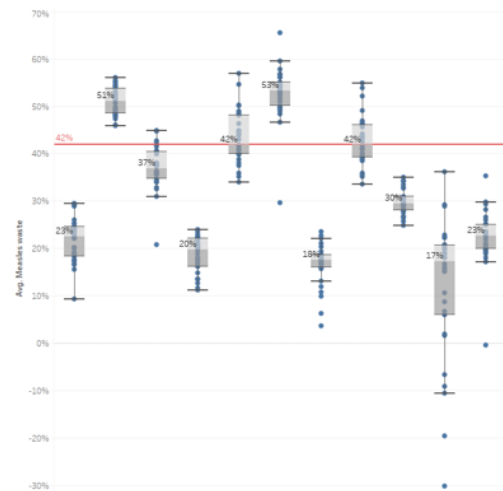
Stronger data available on doses administered

STRONG Health information management systems

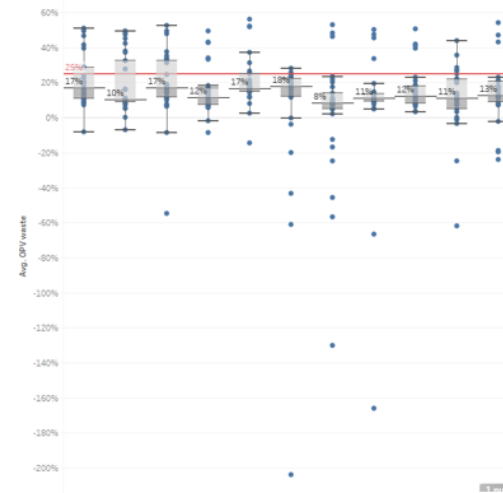
- Doses Administered } Coverage
- Vials opened } opened but not administered => wastage

Wastage results

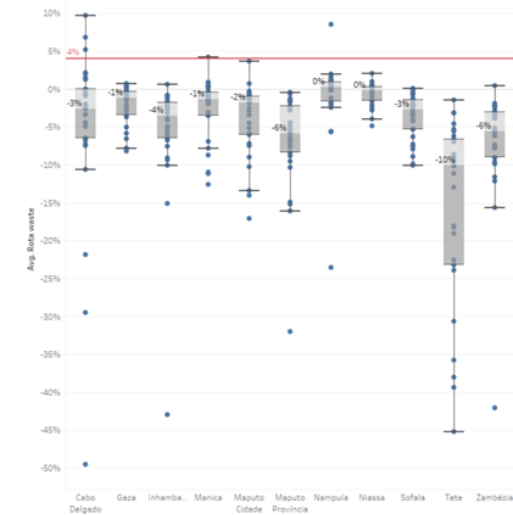
Measles (10 dose vial)



OPV (20 dose vial)



Rota (1 dose vial)



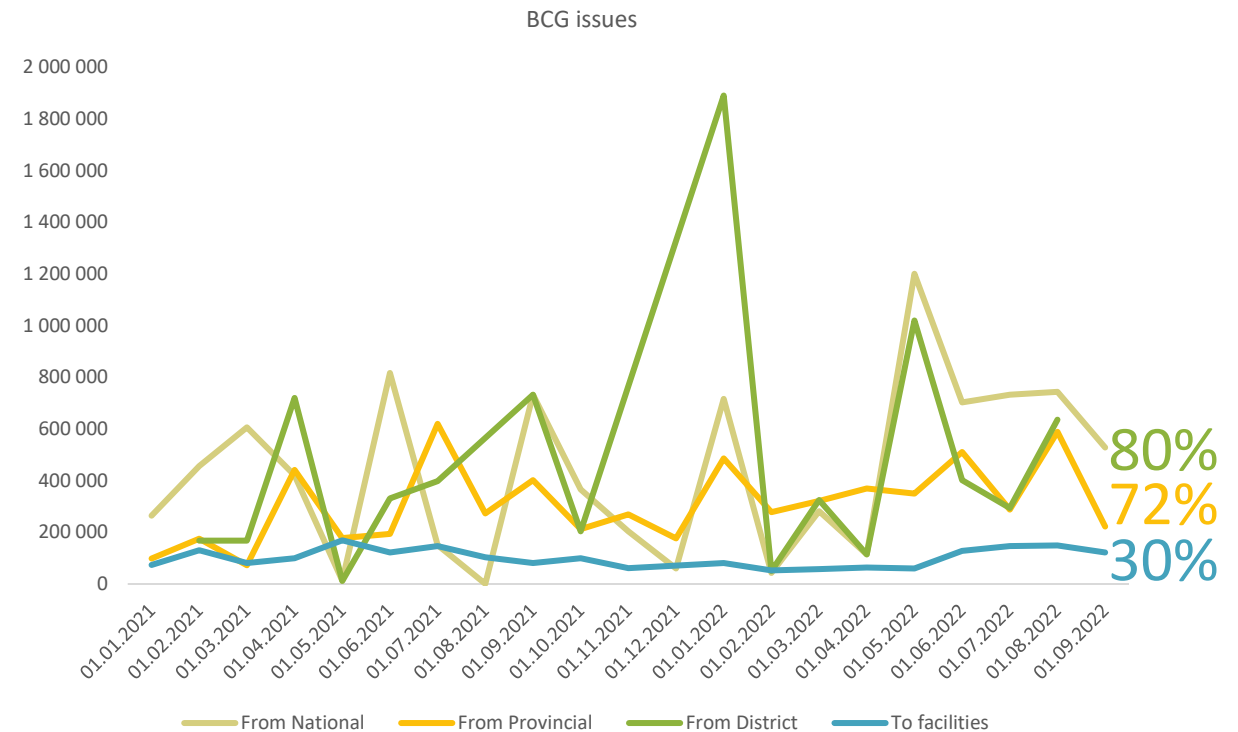
Limited quality supply chain data available for forecasting

Logistics management information system data:

- Doses issued from various levels of the system
- Beginning and ending stock
- Stock received
- Doses administered

Not available:

- Vials consumed (in either administration or loss)
- Days out of stock (summation, not granular, or average)

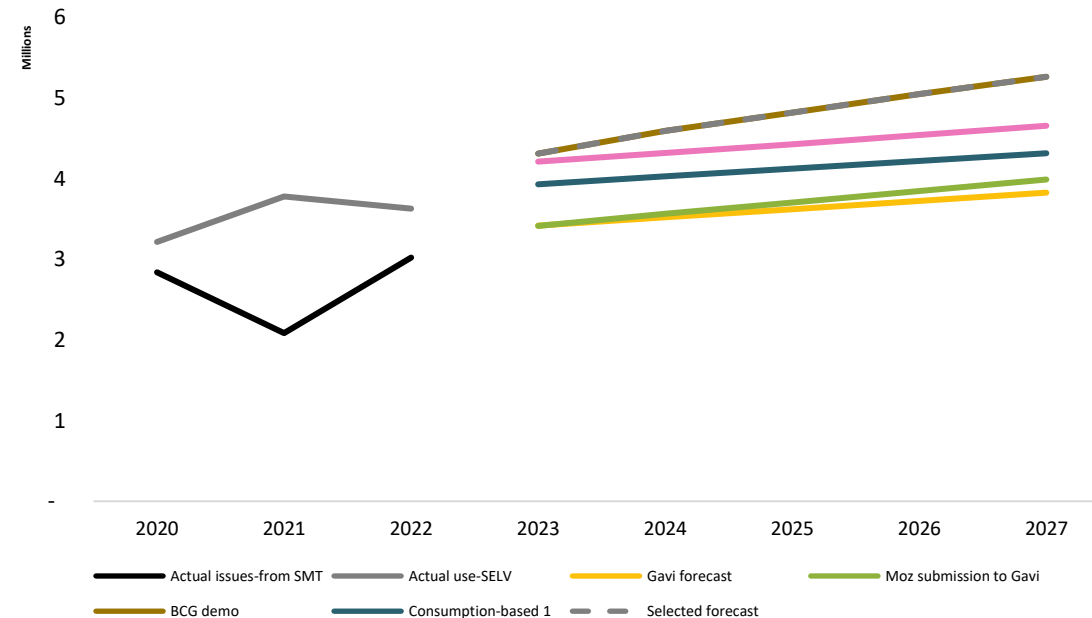


Forecast methods used

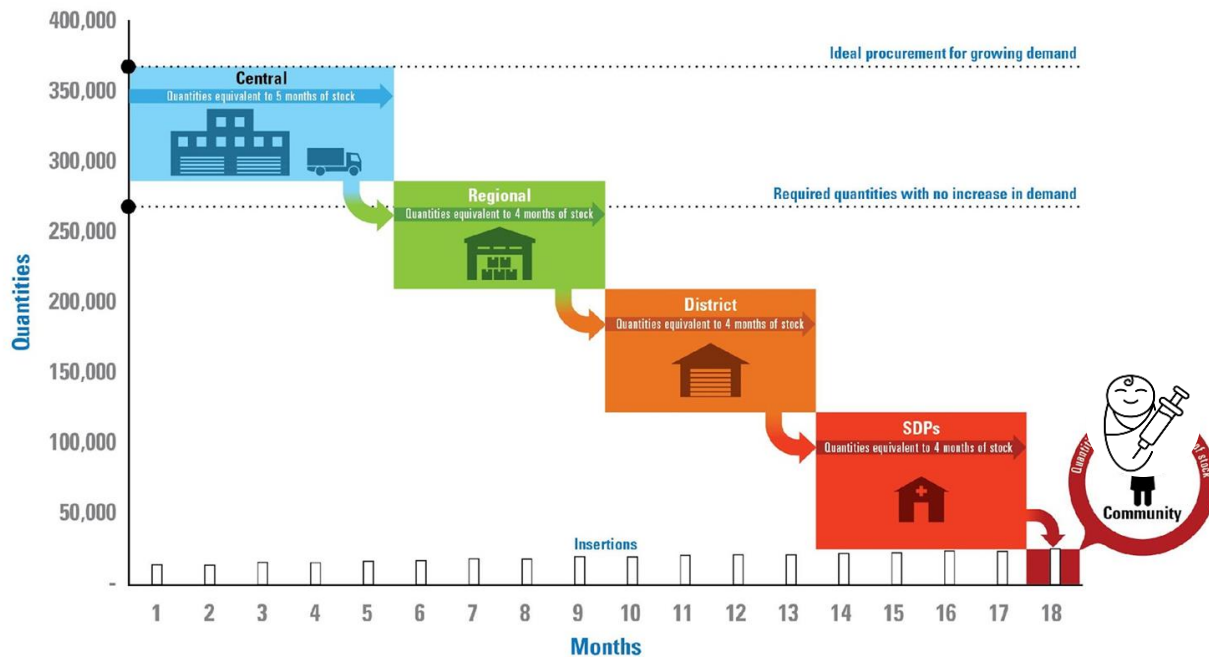
- Review and revise demographics data:
 - Provincial birth rates, BCG doses (given at birth)
- Trend: Doses used, adjusted to reporting rates
- Trend: Doses issued from various levels adjusted to reporting rates

Observations:

- Can not account for days out of stock
- Can not account for rationing
- Trends for doses used for products low in stock declines rather than increasing



Translating forecasts to plans for procurement



- Consider inventory policies and/or practices at each level of the system and calculate safety and order stock based on these policies
- 25% safety stock as a rule does not consider:
 - Forecast errors
 - Lead times and variability
 - Resupply policies and frequencies
 - Inventory management policies
- If the supply chain is experiencing frequent stock outs → not enough inventory
- Regardless of how accurate the demand forecast is, it will not be enough

How much is needed to fulfill demand in Mozambique?

If lead times are consistent and can be relied on, they do not need to be included in safety stock; but lead times at central-level are unpredictable, taking 3-6 or more months to arrive.

Level	Inventory policy	Practice	Resupply period	Lead time	Safety stock	Min (SS + LT)	Max (Min + RP)
Central	Continuous review	Procures annually for 12m + 25%	3m (not consistent)	3-6m (not consistent)	≥ of 3m	≥ 6-9m	≥ 9-12m
Province	Forced ordering	Orders quarterly 3m for 3m + 25%	3m	1m	≥ of 1m	≥ 1m	≥ 4m
District		Orders monthly for 1m + 25%	1m	1w	≥ of 1w	≥ 1w	≥ 1.5m
Health Facility		Orders monthly for 1m + 25%	1m	1w	≥ of 1w	≥ 1w	≥ 1.5m
System						≥ 8-11m	≥ 16m

Orders should be made prior to reaching minimum levels in order to reach maximum stock levels

System stock status is low, totals to be procured are higher than expected

Vaccine	Estimated MoS on hand at end of September in the system
Pentavalent	2.3
PCV	2.7
Rota	0.6
IPV	5.4
HPV	8.7
MR	4.4
BCG	39.7
bOPV	9.6
VAT/Td	12.9

Total to be procured:

- Demand for the year
- Inventory to fill the pipeline
- Catch-up/recovery vaccinations

These quantities are greater than Gavi's 2023 and 2024 allocations, even dipping into 2025, 2026, and 2027 allocations for some vaccines.

Several calls were needed to ensure all stakeholders were comfortable with the methods and results.

The World Bank stepped in to fund the additional quantities.

Next steps

Improve access to quality (supply chain) data

- Use the data
- Improve reporting rates
- Consider collecting data on total vials rather than total doses administered
- Calculate days out of stock
- Calculate actual wastage rates and factors

Monitor stock status and update supply Plans at least quarterly

- Calculate average monthly consumption (AMCs)
- Monitor System and level months of stock using Stock on Hand (SoH) and AMCs
- Determine if, when, and quantity of orders and shipments needed in advance of emergencies, stock outs, and overstocks.

Thank you!

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Q & A



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Thank You!

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