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The Cost of Periodic Intensification of Routine Immunization and Mobile Health and Nutrition Teams in the Afar and Somali regions in Ethiopia

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Introduction

Ethiopia is home to over 1.1 million zero-dose children

- To close the gap, the Ministry of Health developed the *"Accelerated Action plan to address zero-dose, and under-vaccinated children in Ethiopia 2023-2025"*
- Includes several strategies to reach zero-dose children, but the cost of these are not known

Purpose of this study: to estimate the effectiveness and cost of immunization delivery strategies aimed at reaching zero-dose children in rural remote areas

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Methods

Quantitative analysis:

- Activity-based, bottom-up micro-costing study from a health systems perspective
- Cost represent volume weighted averages in 2024 USD
- Sample: 6 woredas (districts), 17 health centers, 32 health posts covering Dec 2023 to Nov 2024

Qualitative analysis:

- Conducted 16 key informant interviews across all system levels (from national level MOH to health extension workers) to contextualize cost findings and understand operational and financial enablers and bottlenecks

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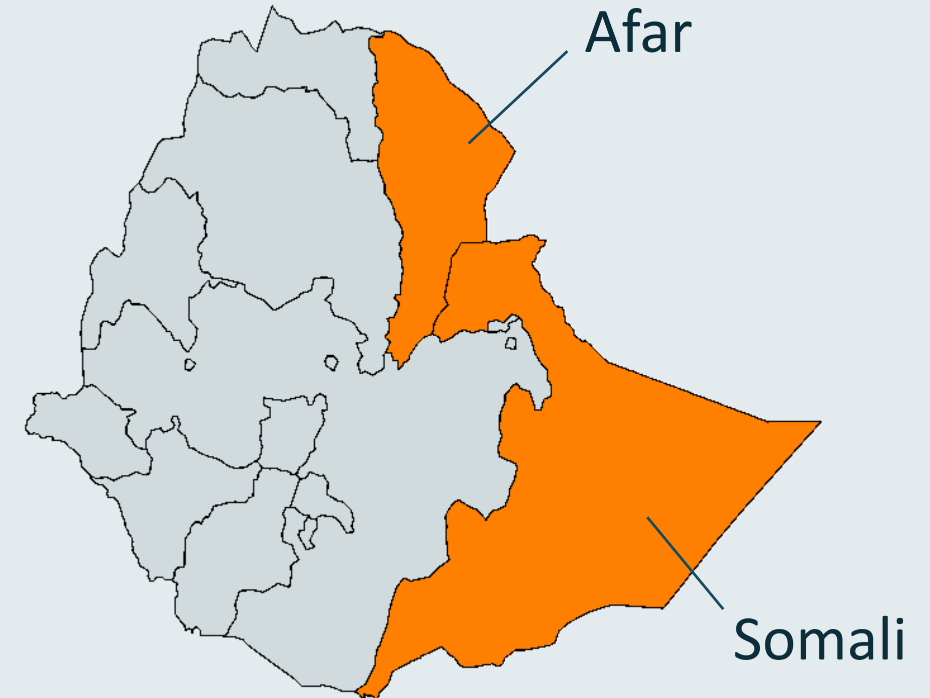
Geographic scope:



Rural regions with **nomadic pastoralist** populations, **conflict-affected** areas, among the **most marginalized**, with limited access to basic healthcare, the lowest immunization coverage, and the **highest rates of zero-dose children**

Immunization strategies

1. Routine immunization and regular outreach (RI/RO)

- Implemented by health centers and health posts (each health center oversees up to 5 health posts)
- Health centres provide facility-based services five days a week and conduct regular monthly outreach, while health posts primarily focus on outreach activities.

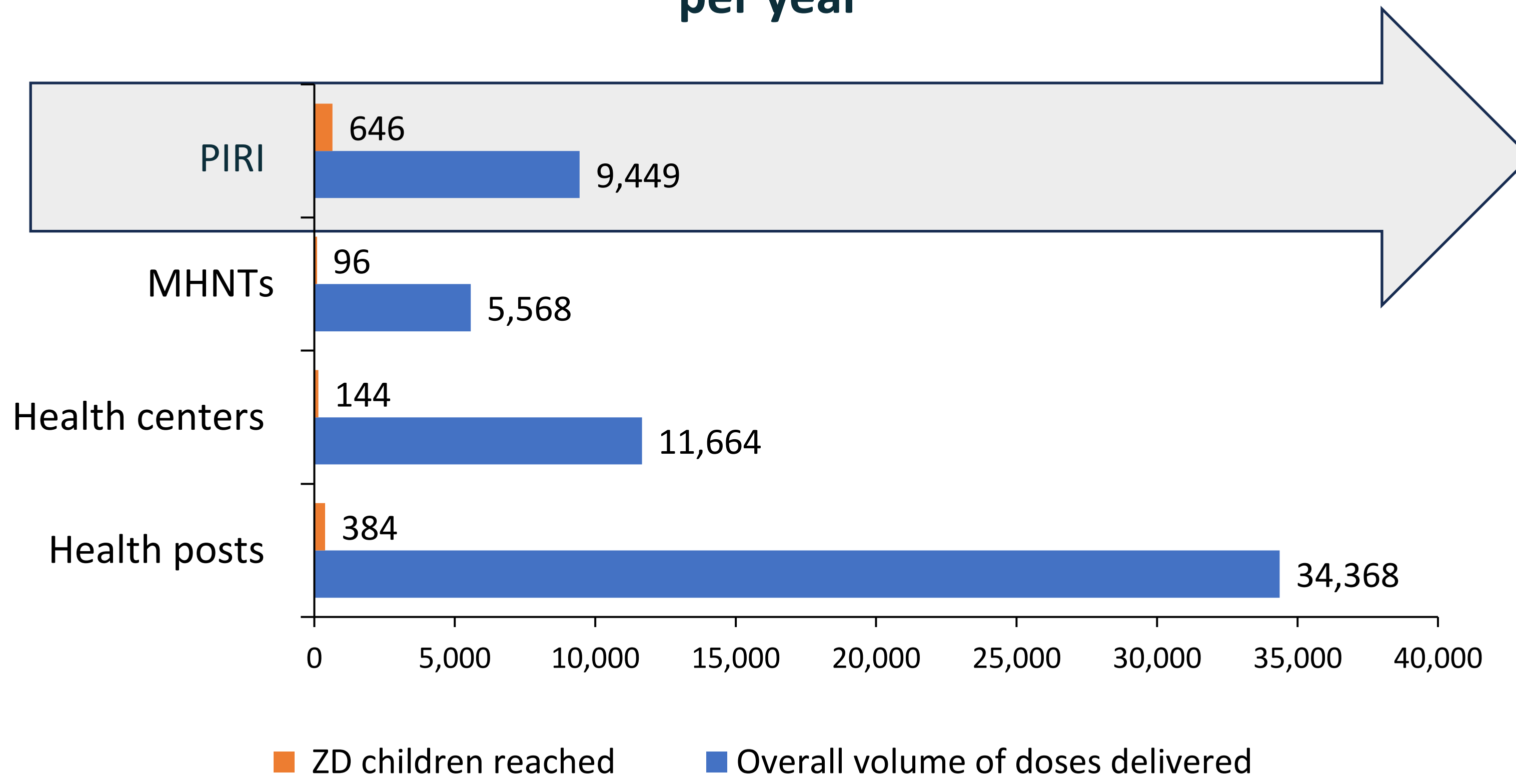
2. Mobile Health and Nutrition Teams (MHNT)

- Mobile teams primarily delivering maternal, nutrition, and immunization services in hard-to-reach areas
- Operates 6 days per week, one dedicated day per kebele, a kebele ‘graduates’ when key indicators (such as stunting) have sufficiently improved
- Dedicated staff and vehicles funded by UNICEF

3. Periodic intensification of routine immunization (PIRI)

- Campaign-style approach implemented from woreda (district) level, with strong community involvement
- Per policy should be implemented 4x per year, in reality 2-3 times per year, dependent on when Gavi funding for it is made available

Health posts deliver the majority of all vaccine doses but PIRI sessions are most effective at reaching zero-dose children



Even though only conducted a few times per year, PIRI reaches more ZD children (646) than all health centers and health posts in a woreda combined (528)

MHNTs reach fewer ZD children though there is only one such team per woreda, and they operate in a highly targeted manner, delivering a full package of services before they continue to the next kebele

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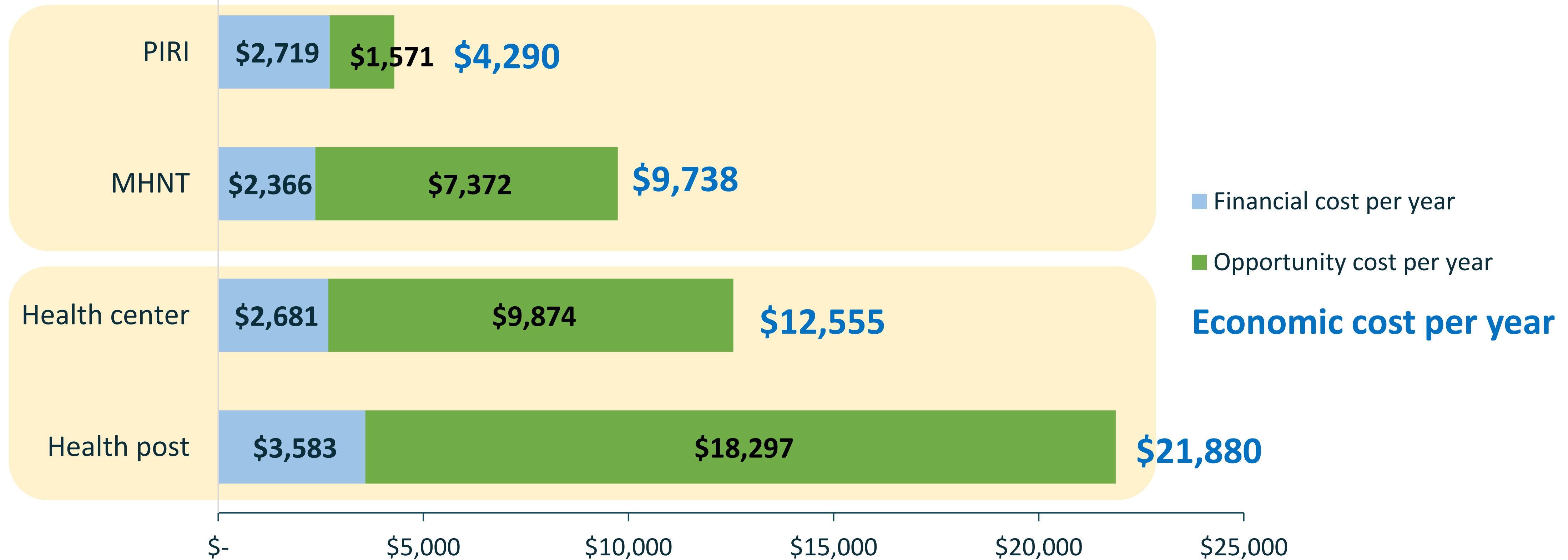
** Monthly data and per session data extrapolated over a year. Considering 16 health posts, 3 health centers, and 1 mobile health and nutrition team per woreda, and PIRI sessions conducted 2.67 per year*

Total annual delivery costs of zero dose strategies are lower than routine delivery



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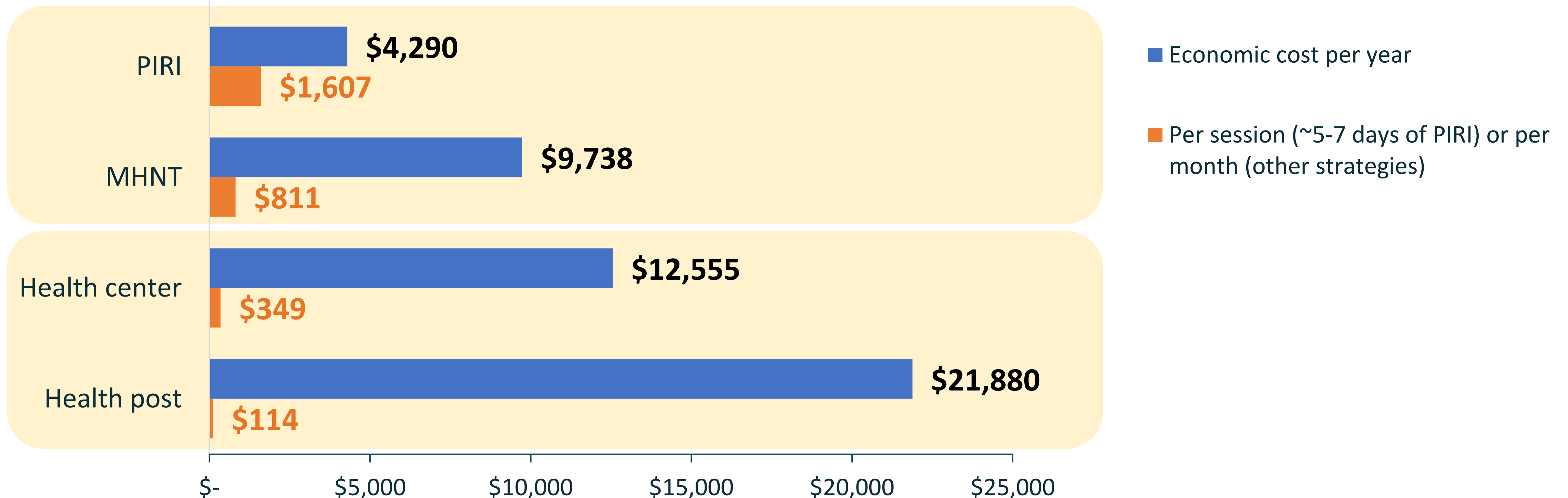
Though per session/per month zero-dose strategies cost more than routine delivery



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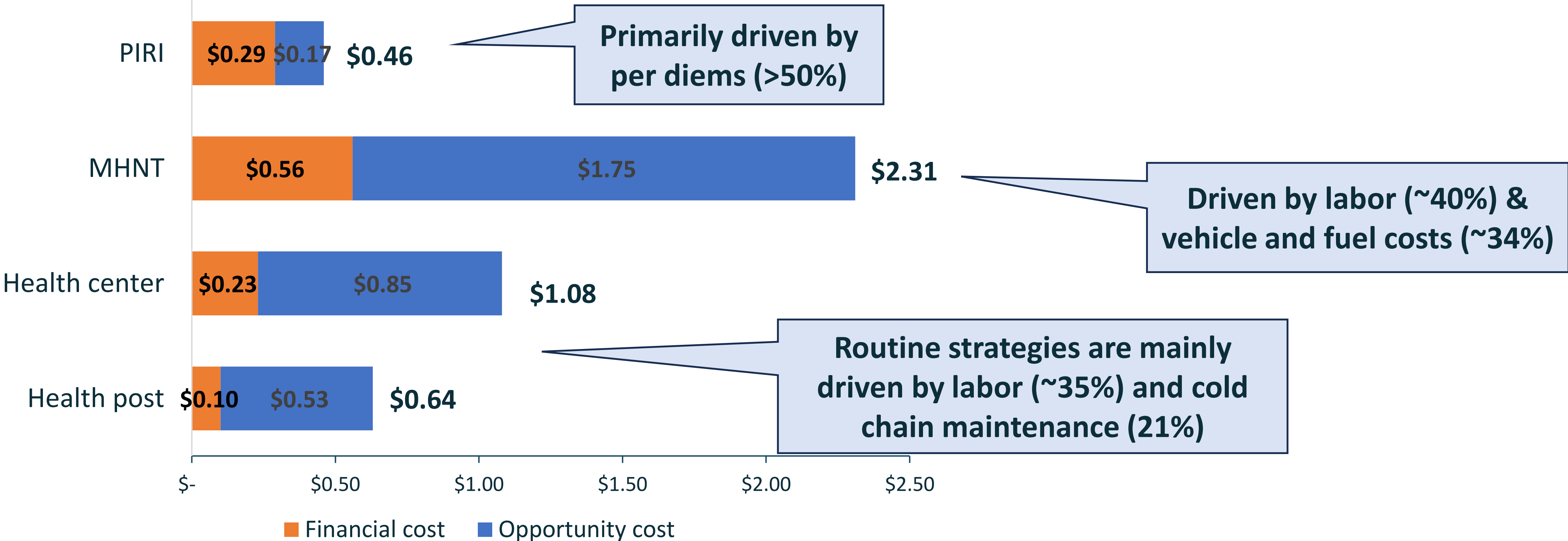
Cost per dose of PIRI is driven by per diems while other strategies are mainly driven by the cost of labor



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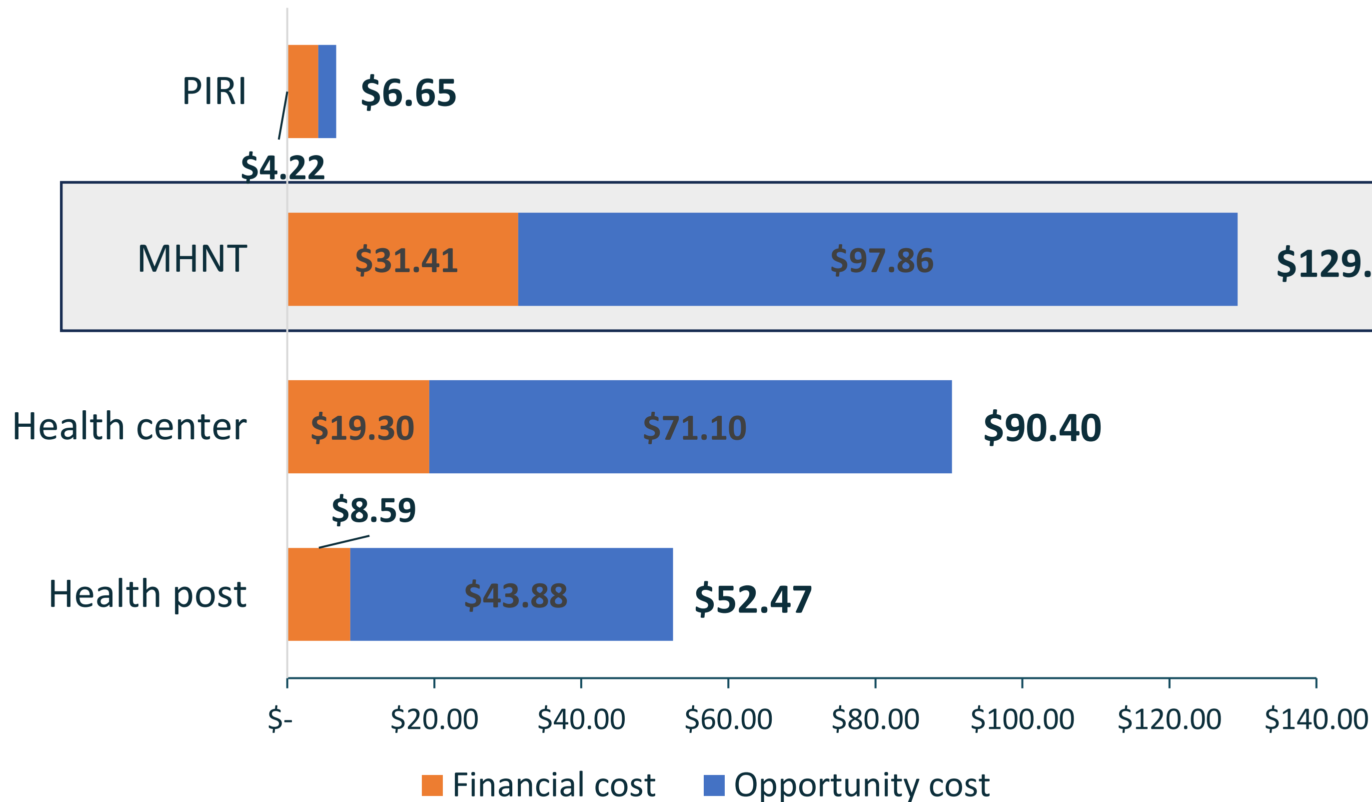
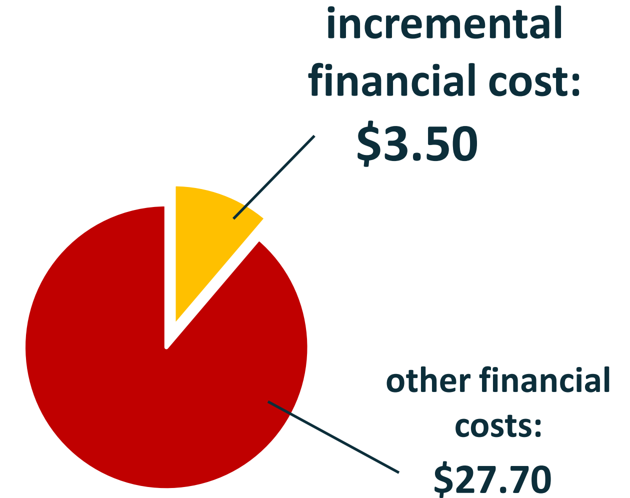
Per zero-dose child reached PIRI seems the most cost-efficient delivery strategy at first…





…though only a really small portion of the financial cost per dose for MHNTs is incremental/immunization-specific as it delivers many other services

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Conclusions

Both **MHNT and PIRI are effective** at filling operational challenges and resource gaps in the routine system by reaching missed children among mobile communities in hard-to-reach areas

Strategies must complement, not replace each other, as simultaneous MHNT and PIRI may cause **resource overlap** and **reduced effectiveness**.

PIRI is most effective and cost-efficient at reaching zero-dose children, though as it is implemented only 2-3 times per year, children remain permanently behind on schedule unless they are linked up with the routine system

Referral linkages with routine have been weak, resulting in **dropouts**, and reportedly parents have **postponed vaccination visits** to wait for an upcoming PIRI campaigns. Furthermore, if the frequency of PIRI were to increase, its cost-efficiency would drop.

The immunization-specific financial cost of **MHNT** delivery is low, and it offers a more **comprehensive, consistent, targeted, integrated approach** to reaching vulnerable communities

Moreover, integration with other highly demanded services such as nutrition has **increased uptake** of immunization compared to standalone delivery.

Thank you!

To see our qualitative analysis report, and receive our full, detailed cost analysis once this is finalized, go to this link
& sign up for the newsletter

https://immunizationeconomics.org/cost-of-reaching-zerodose-children/

Acknowledgements

We would like to thank the Ministry of Health, UNICEF, Afar and Somali regional health bureau, and Elidar, Mille, Ewa, Babili, Erer, and Yahob district EPI coordinators for their vital contributions to this work.

Cost Efficiency Analysis of Drone-Based Last Mile Vaccine Delivery to Remote Island Health Facilities in Buvuma District, Uganda

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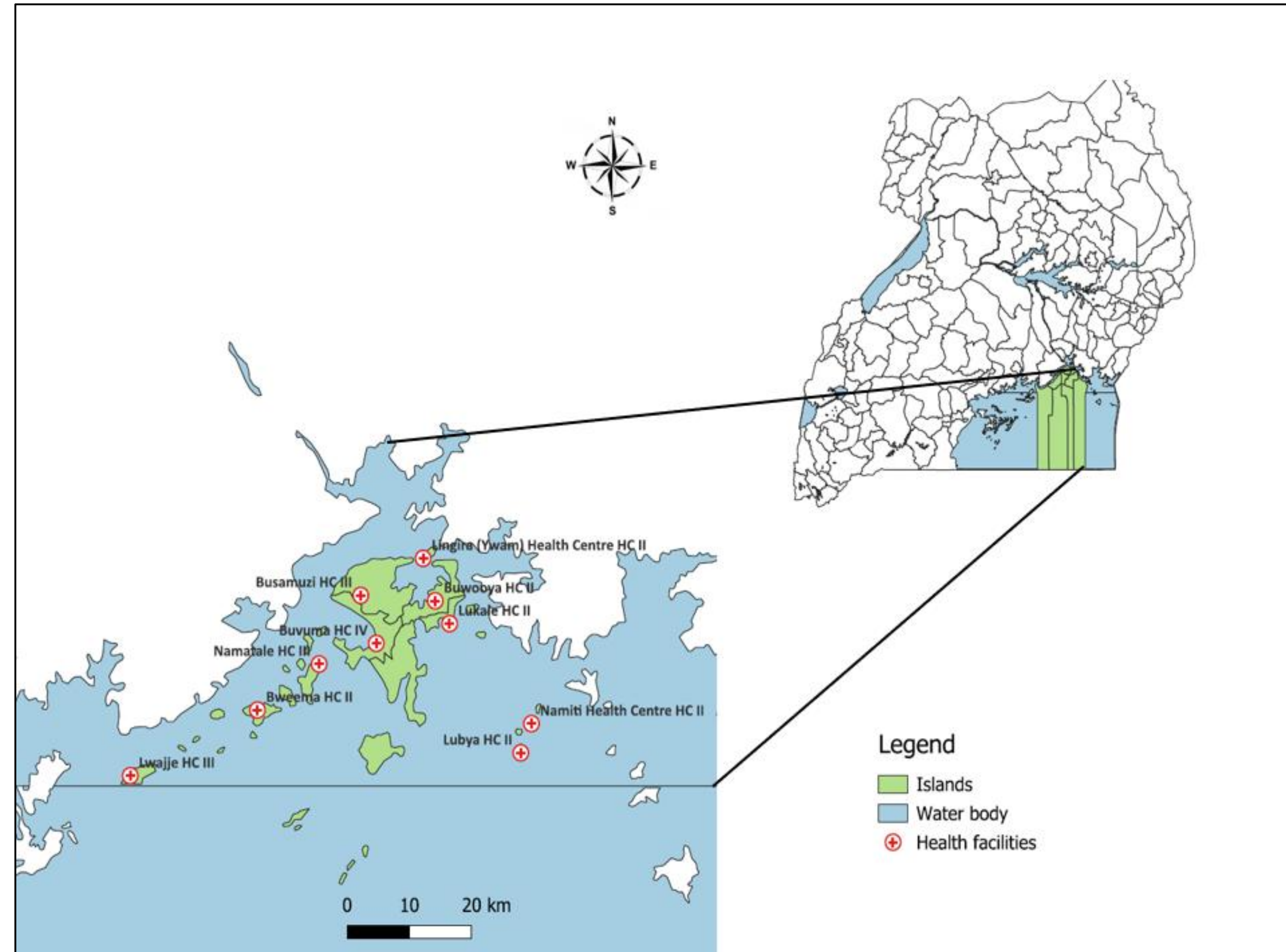
Last Mile Vaccine Delivery in Uganda

- **Last mile vaccine delivery**
  - Final stage in vaccine supply chain
  - Most challenging and costly
- **Multimodal**
  - Refrigerated trucks, motorcycles
- **Challenges**
  - Difficult terrains
  - Maintaining the cold chain
  - Infrastructure gaps
  - Funding gaps

Buvuma District

- **52 inhabitable islands**
  - 9 administrative units
  - 13 health facilities
- **Logistical challenges**
  - Delayed last mile delivery
  - Constant stockouts
- **Poor performance**
  - DPT1-3 dropout rate of 32%
  - Approximately 6,000 zero dose children



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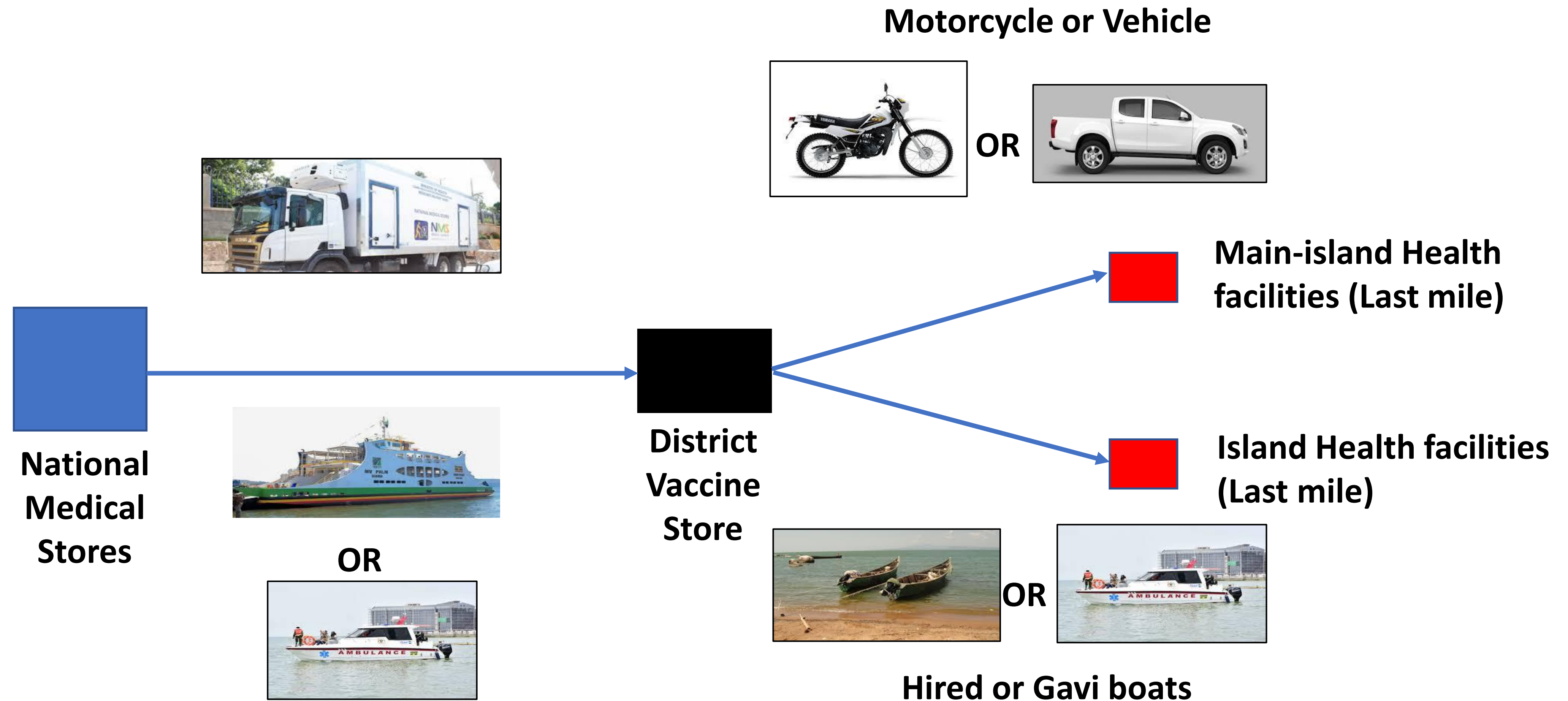
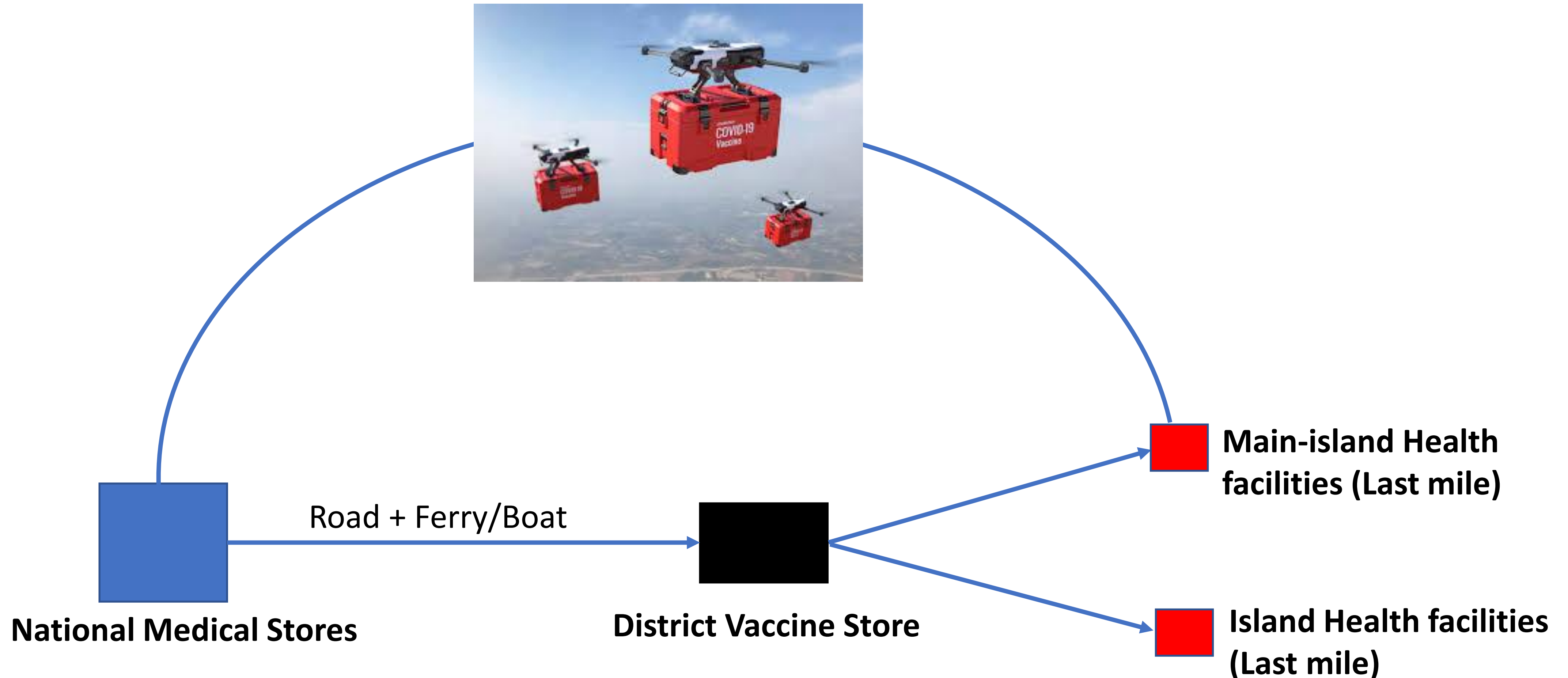
Last Mile Delivery in Buvuma (Traditional)



Proposed Drone Delivery



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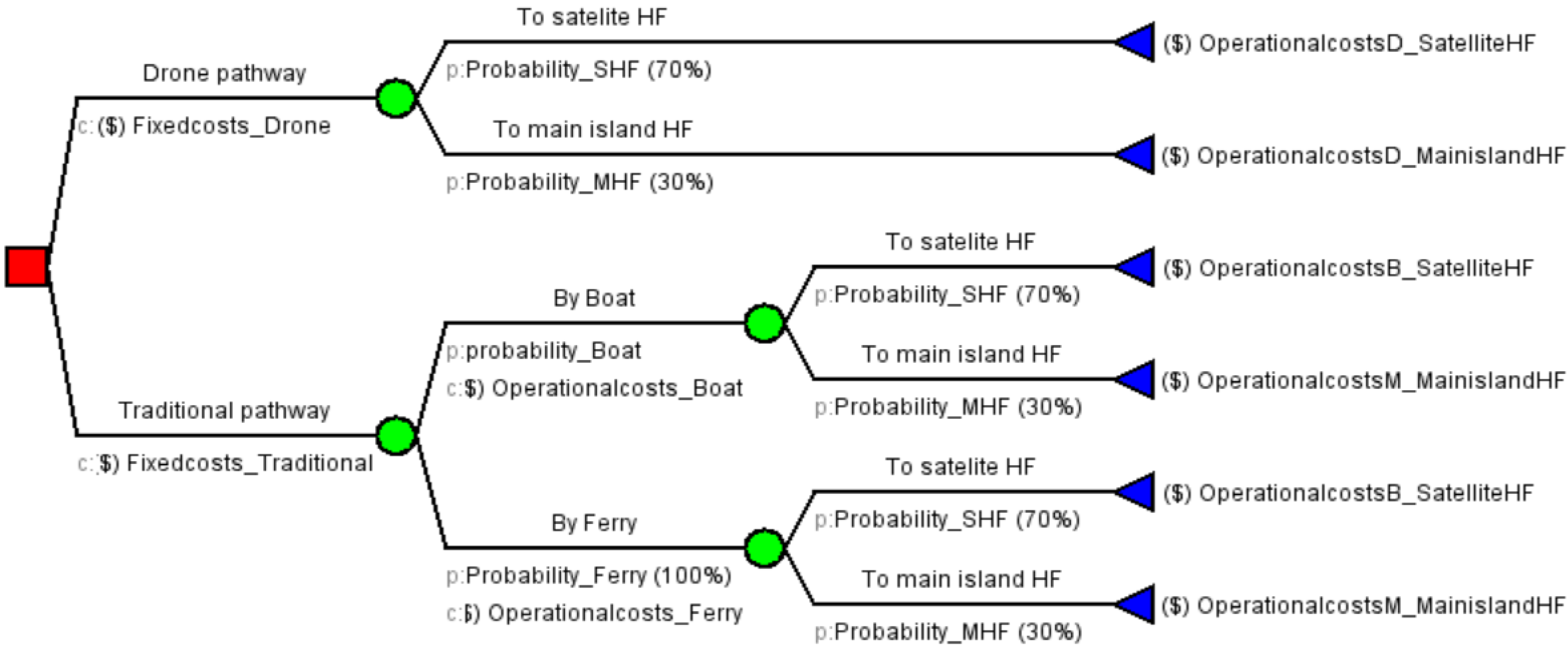
Objectives and Outcomes

- **Objectives**
  - To compare the cost efficiency of drone delivery to the traditional multimodal transport method in last mile delivery of vaccines in Buvuma District, Uganda
- **Outcomes**
  - Costs per vaccine delivered last mile
- **Perspective**
  - Government (Health sector)

Model Analysis

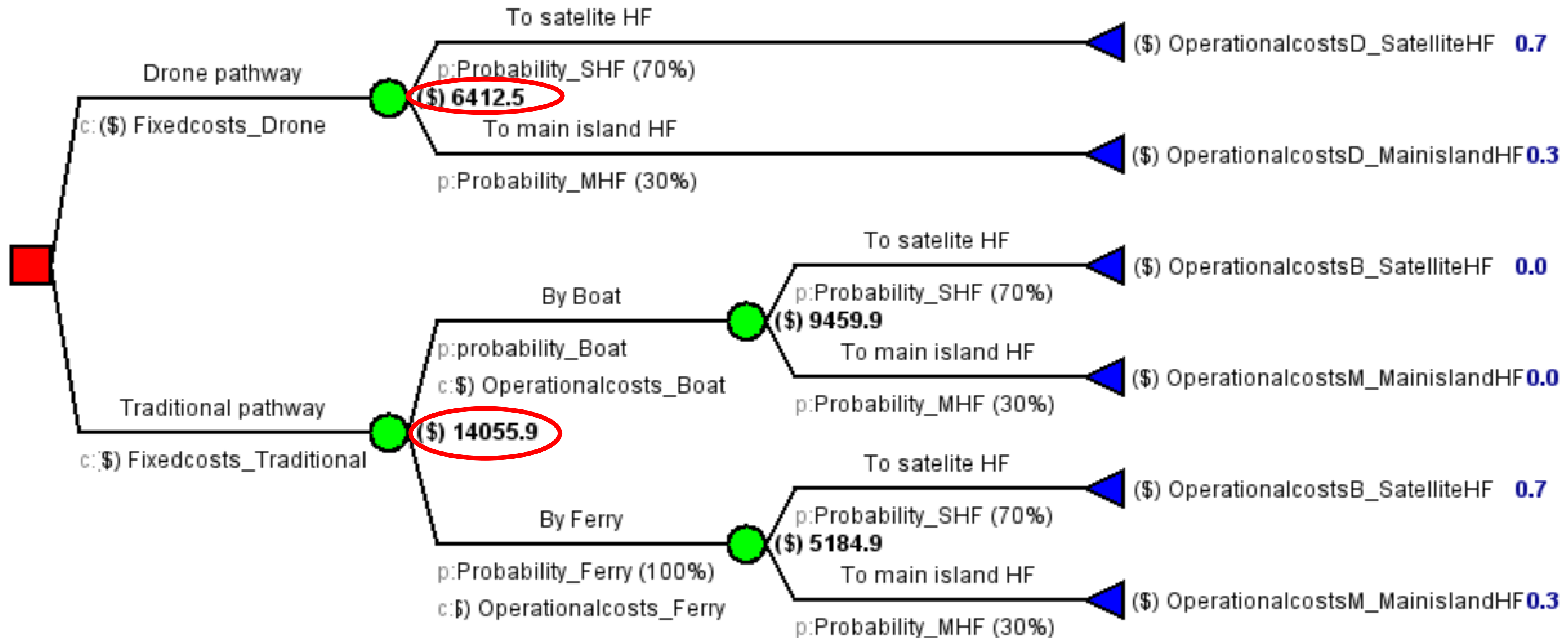


Cost Components and Sensitivity Analysis

- **Cost components**
  - Fixed + variable operational costs
  - Amortized to daily or quarter costs
- **Sensitivity analysis**
  - One-way sensitivity analysis
  - Tornado diagram

Name	Expression
Fixedcosts_Drone	2700
Fixedcosts_Traditional	8871
Probability_SHF	0.7
Probability_MHF	0.3
probability_Boat	0
Operationalcosts_Boat	5535
Probability_Ferry	1
Operationalcosts_Ferry	1260
Operationalcosts_MainislandHF	168
OperationalcostsD_SatelliteHF	4455
OperationalcostsD_MainislandHF	1980
OperationalcostsB_SatelliteHF	5535
OperationalcostsM_MainislandHF	168

Total Costs & Saving



- **Total Savings=14,055.9-6,412.5=$7,643.4**

Cost Per Vaccine Delivered & Saving

- **Cost per child =** Total Cost/Number of vaccines delivered

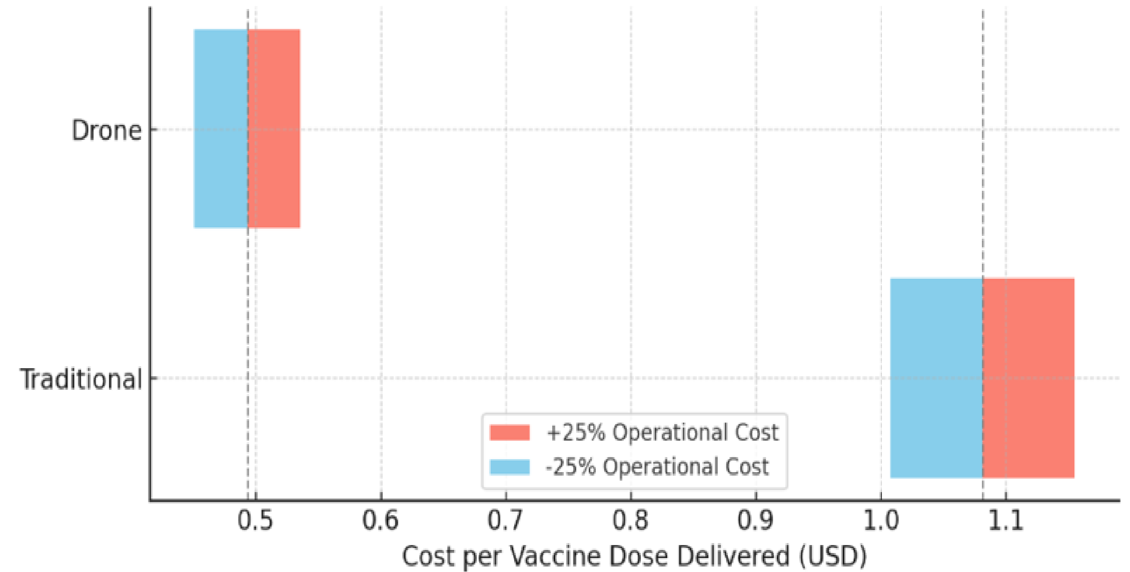
- **Traditional=**$\frac{14,055.9}{13,000}$=**$1.08 per dose**

- **Drone=**$\frac{6,412.5}{13,000}$=**$0.49 per dose**

- **Cost Saving per dose=**1.08-0.49=**$0.59**

Sensitivity Analysis

Strategy	Low Estimate	Base Case	High Estimate
Traditional	$1.01	$1.08	$1.16
Drone	$0.45	$0.49	$0.54



- **Drone delivery remained more cost-effective across all operational cost scenarios**

Study Limitations

- **Relied on modelled data**
  - Limits generalizability
- **Short analytic time horizon**
  - Not accounting for long term impact
  - Scalability & sustainability uncertain
- **Potential underestimation of indirect costs**
  - Non-monetized indirect savings

Conclusion and Recommendations

- **Conclusion**
  - Drone-based vaccine delivery offered a 54% reduction in costs
- **Recommendations**
  - Integrate drone technology into Uganda’s immunization supply chain
  - Further studies
    - Expand analysis to include health outcomes
    - Assess environmental impacts
    - Longer analytical time horizons

Acknowledgement

- **Ministry of Health, Uganda**
- **Makerere University School of Public Health**
- **US Centers for Disease Control and Prevention**
- **Buvuma District Local Government**
- **GAVI**

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The cost of immunizing zero-dose children through additional outreach sessions in Kaduna, Nigeria

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Introduction and objective

- With an estimated 2.1 million children who have never received a vaccine, Nigeria is the country with the highest number of *zero-dose children* in the world
- To address this, Nigeria developed the Zero-Dose Immunization Recovery Plan 2023-2028, and kicked off its **Zero-Dose Reduction Plan** (Z-DROP) in 100 priority local government areas (LGAs)
- Outreach is key element of this strategy

Zero dose children

- Children missing Penta1 between the ages of 12-23 months

This study estimated the cost and effectiveness of several outreach strategies at reaching zero-dose and under-immunized children

Design and methods

Scope	Estimating the **economic** and **financial** delivery cost of routine immunization delivery strategies
Perspective	Gov. entity responsible for implementation, and implementing partners (**payer**) (facility level costs included in these findings)
Design	**Bottom-up** retrospective costing
Sampling strategy	Purposive sampling of priority LGAs in collaboration with state MOH
Time horizon	Costs incurred during a typical month at point of data collection (January 2025)
Main output	Average **cost per dose delivered** (weighted by volume delivered, USD 2024)

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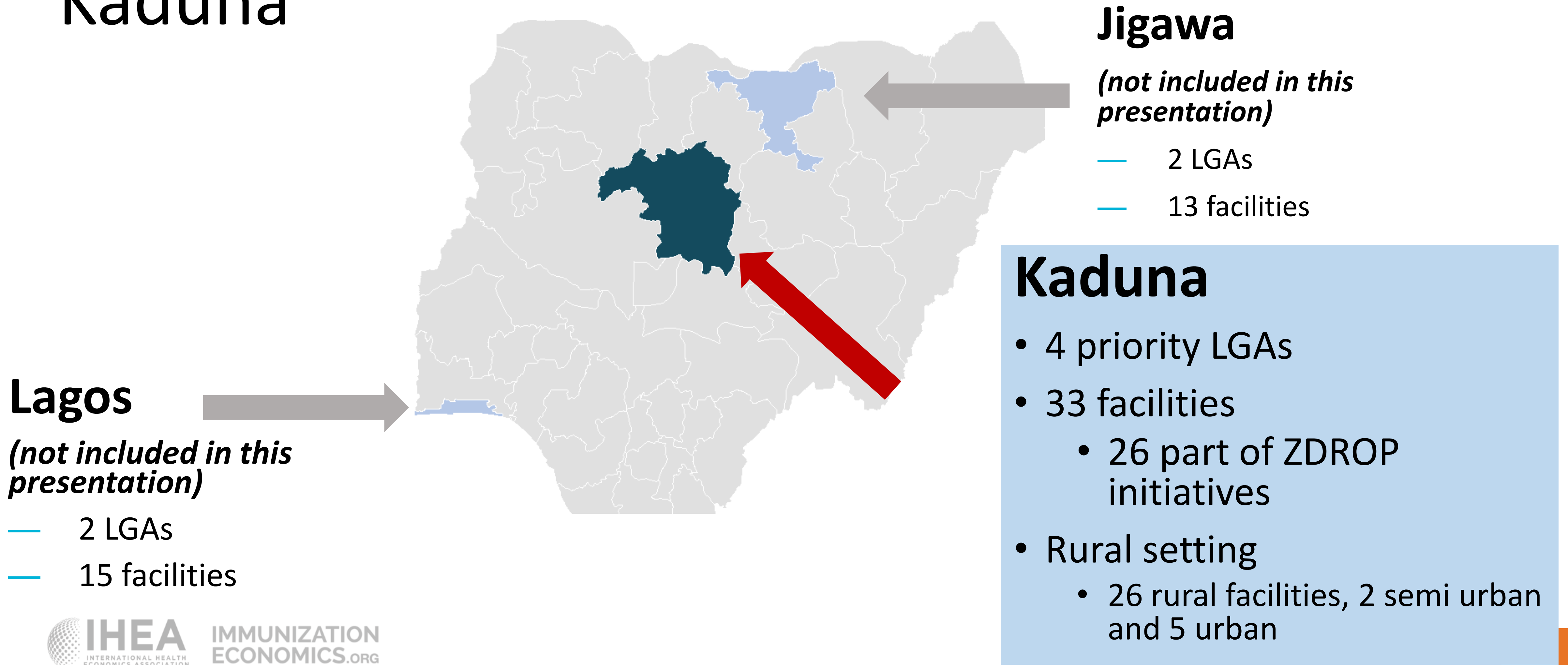
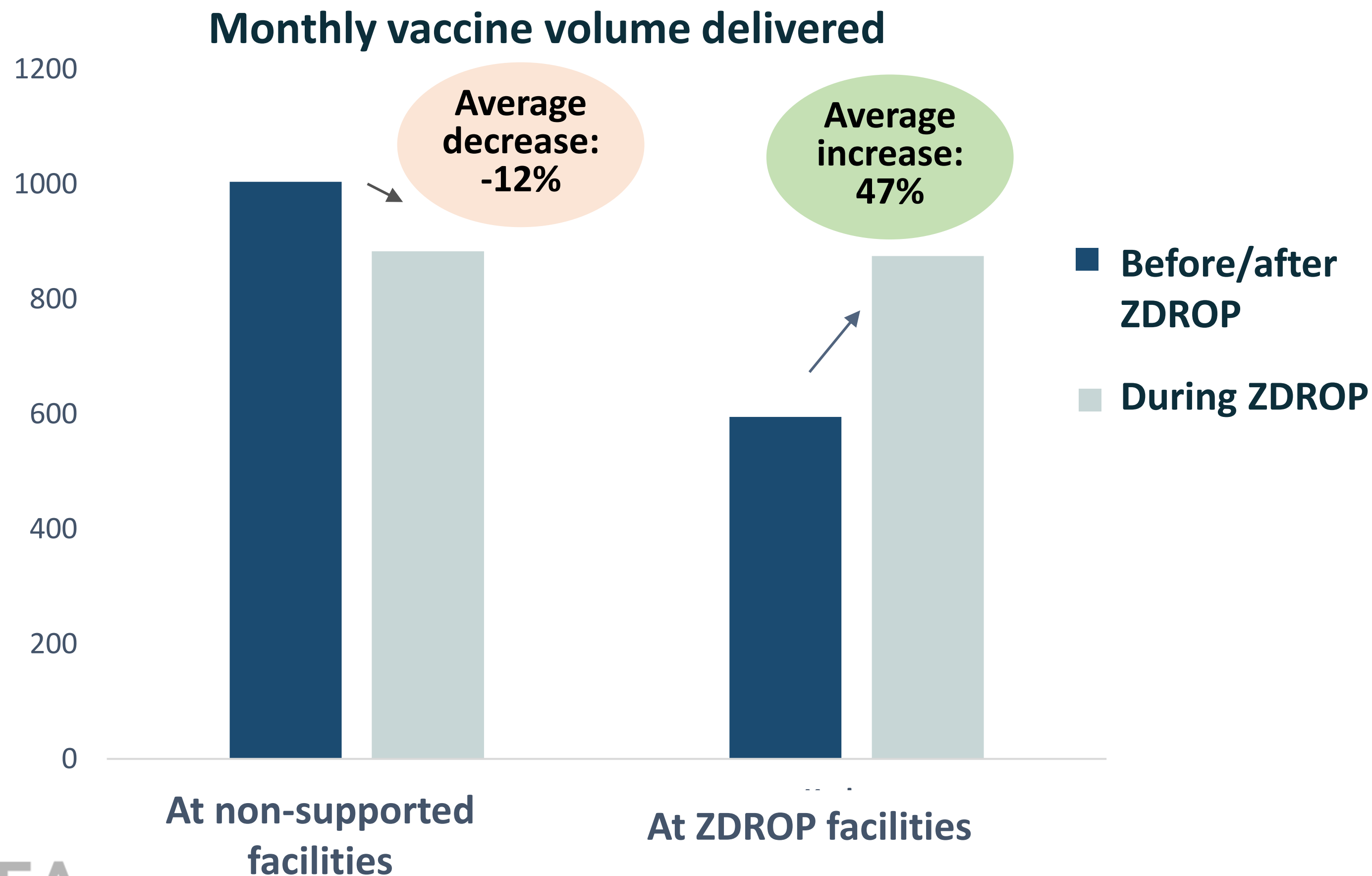
Our study included 33 facilities from 4 LGAs in Kaduna



When implementing ZDROP, facilities delivered more vaccine doses



- Implementation of ZDROP and zero-dose focused initiatives commenced in our sample between 2023-Q4 2024,
- Implementation of initiatives lasted for 2 to 12+ months

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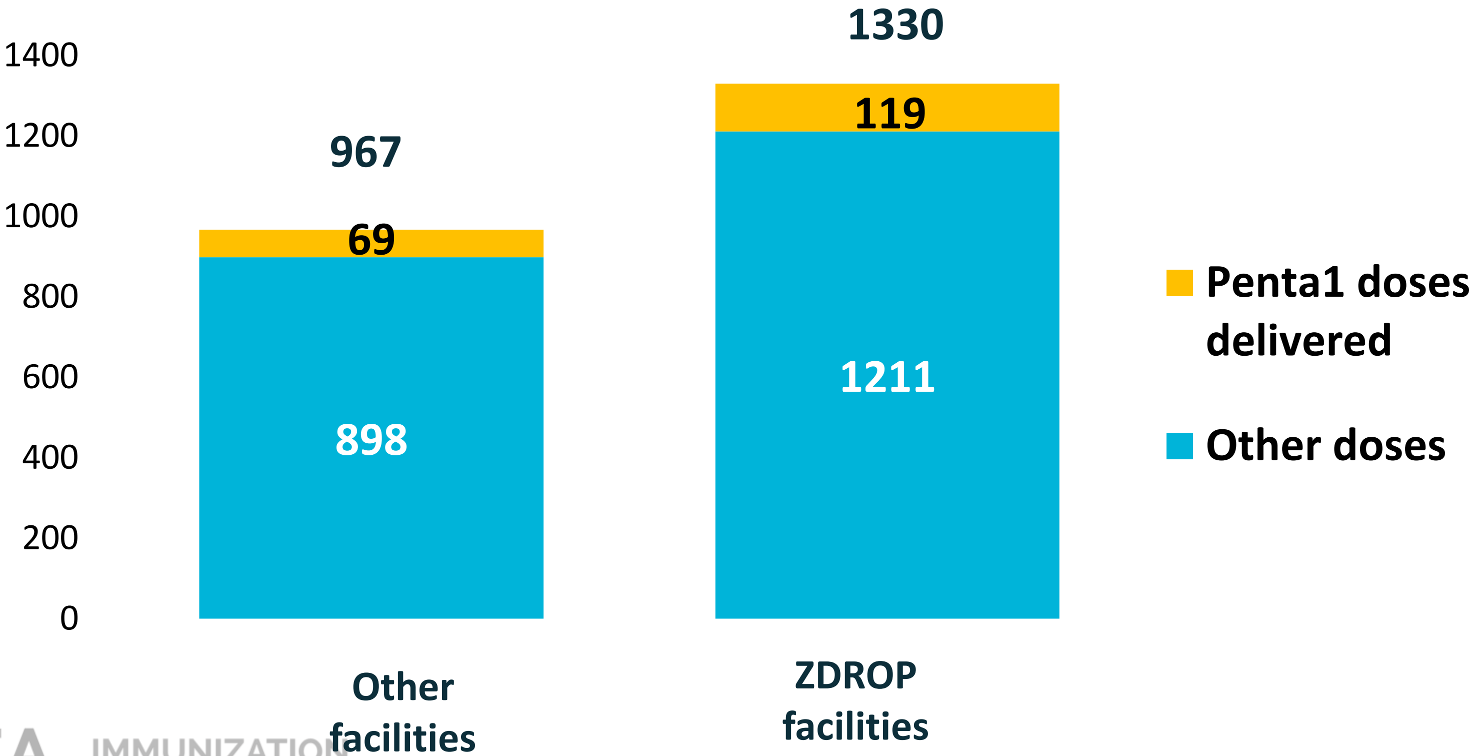
Note: includes a subset of facilities for which data was available for ZDROP time periods vs not

During ZDROP, supported facilities **delivered more doses** and **reached more new children** than other facilities



Every Penta1 dose delivered indicates an additional child had been reached, and although it includes children being reached on time, it is a strong indicator of additional zero-dose children reached

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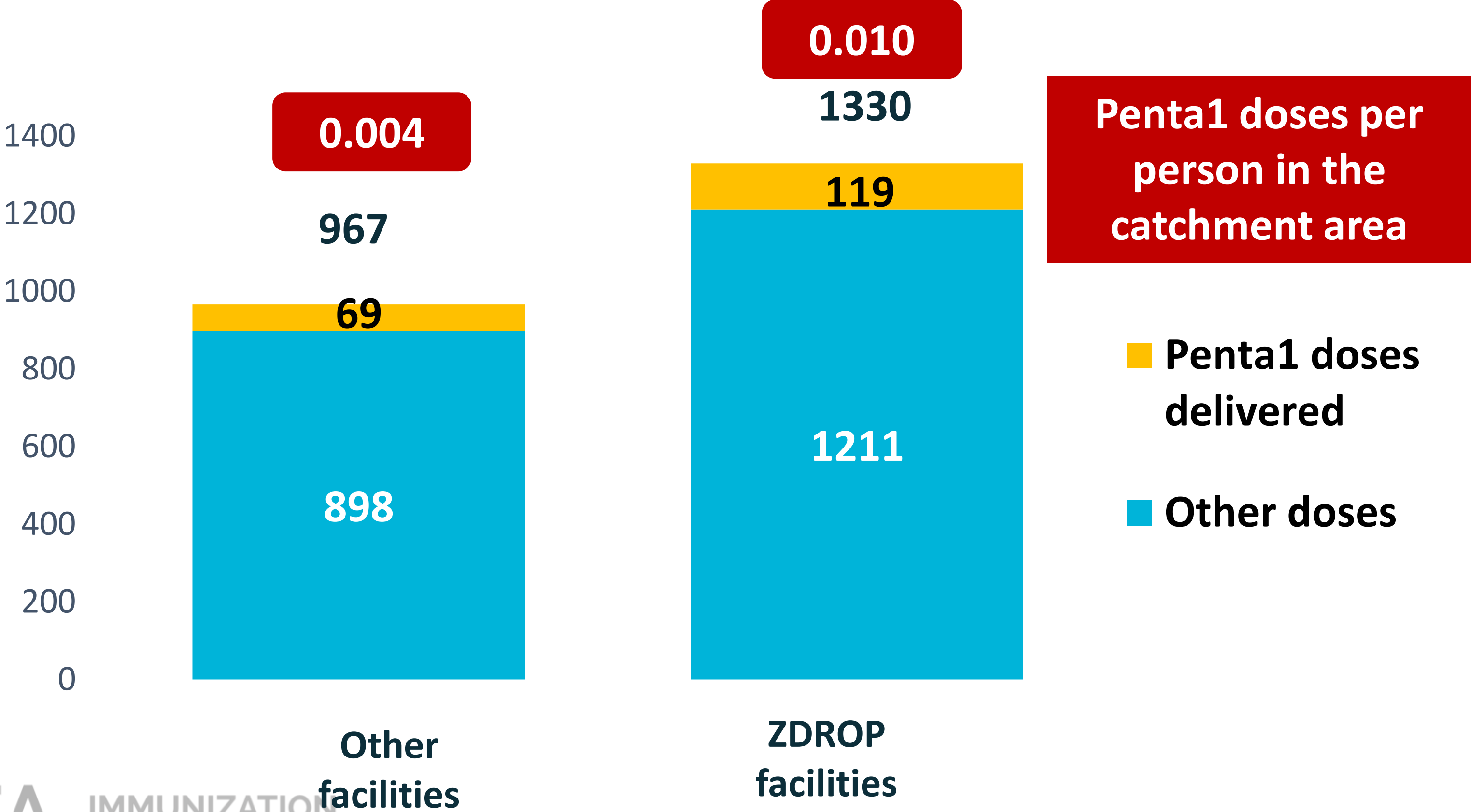
During ZDROP, supported facilities **delivered more doses** and **reached more new children** than other facilities



Relative to their catchment population, ZDROP facilities tended to outperform other facilities

Most of the additional children reached by ZDROP facilities were reached through outreach

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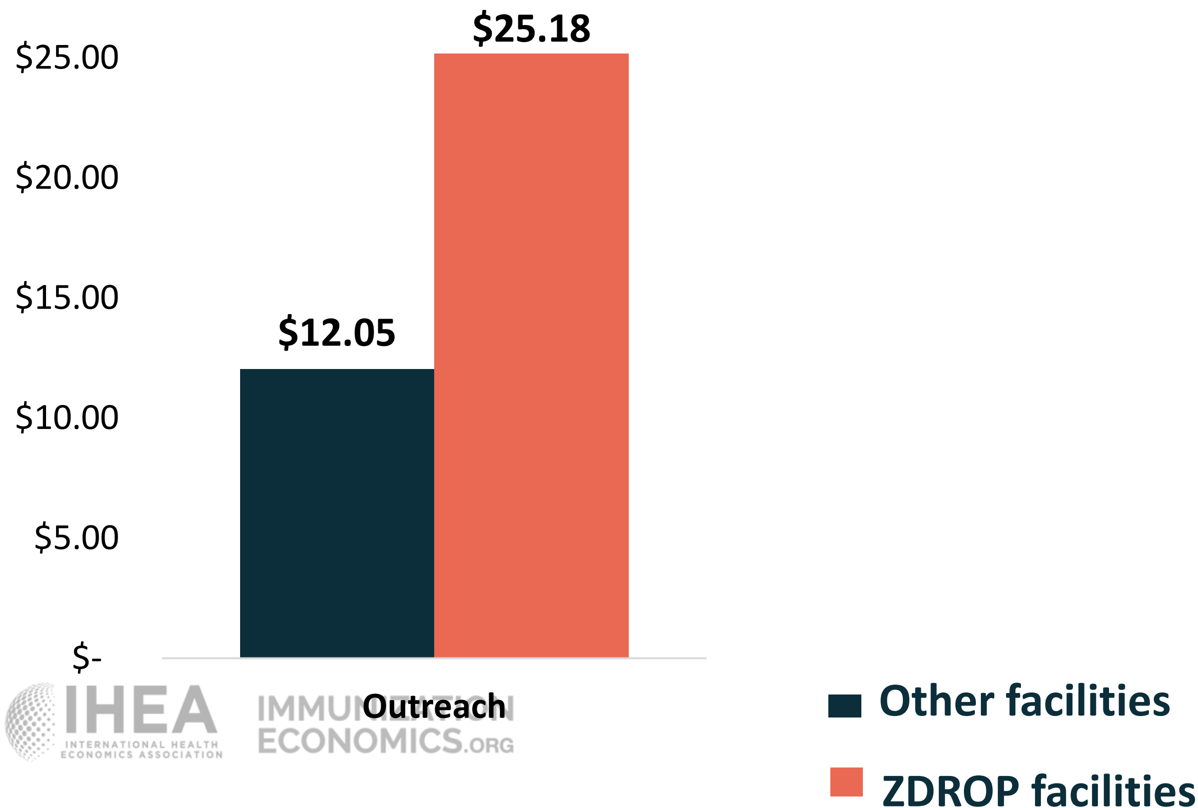
The average cost per outreach session was **higher at ZDROP facilities**, driven by staff incentives

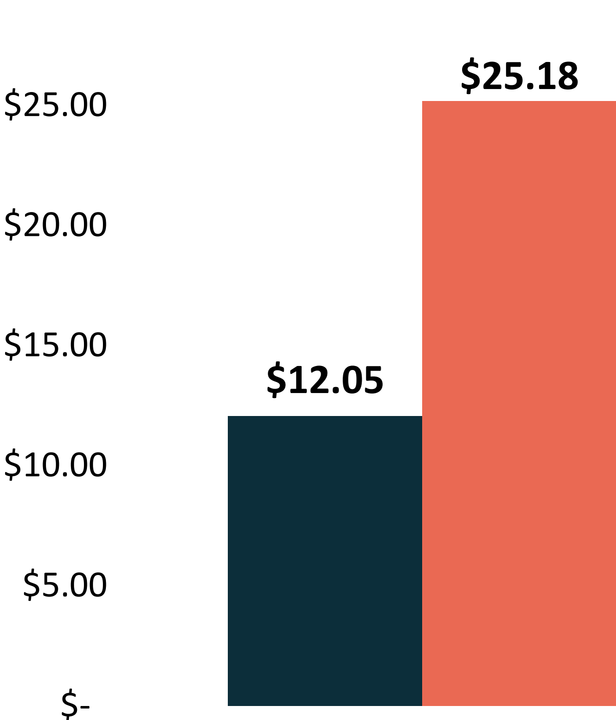


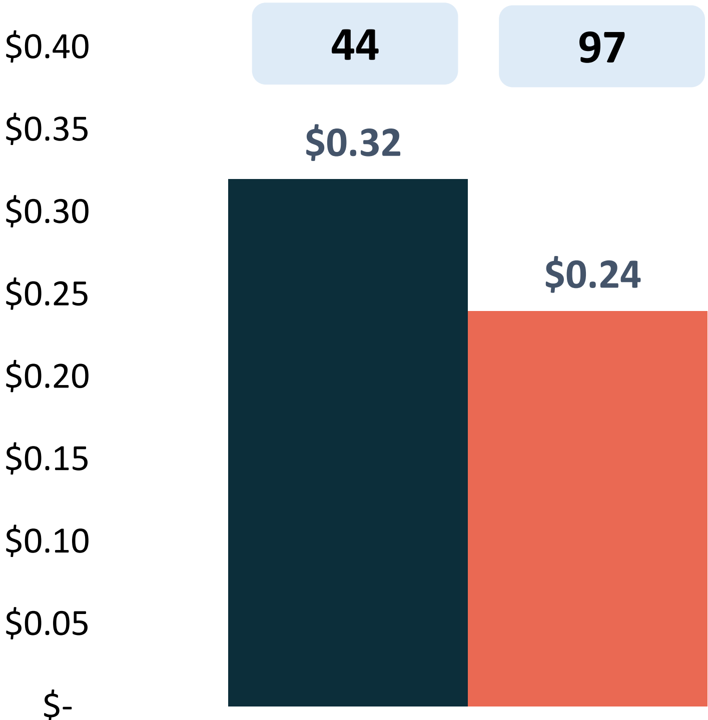
Other facilities

ZDROP facilities

Higher incentives were given for outreach at facilities supported by ZDROP

When accounting for the increased volume delivered, outreach at ZDROP supported facilities appears to be **more cost-efficient**





Doses delivered per session

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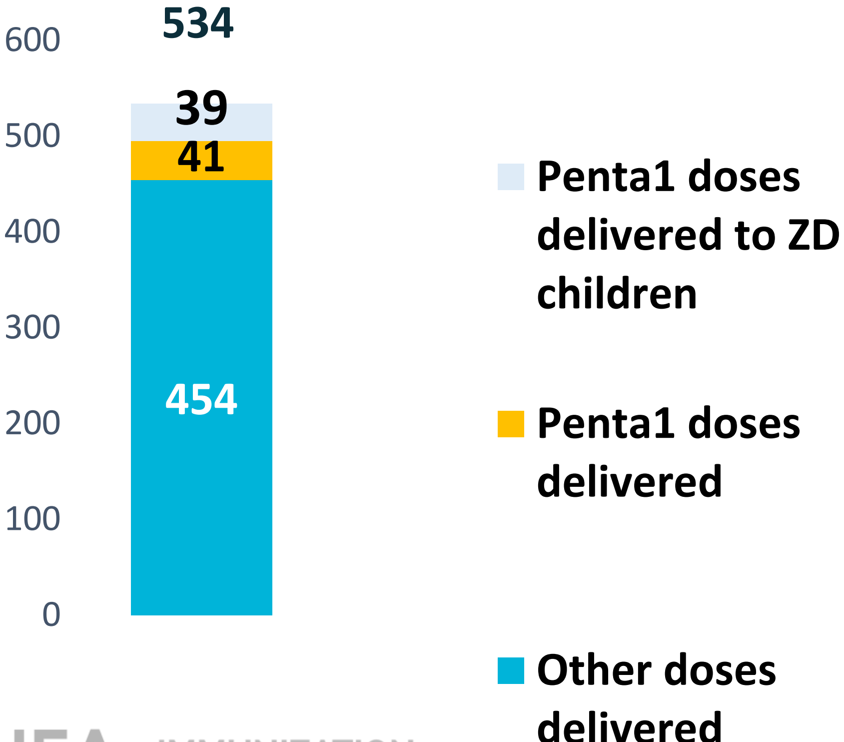
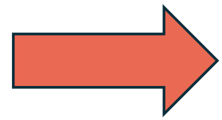
The financial cost per zero-dose child reached through outreach **ranged between $1.72-$8.24** but data was limited



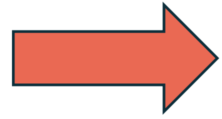
- **$3.39**: average financial cost per ZD child reached
- **49%** of Penta1 doses were given to ZD children, higher proportion at facilities which offered incentives for care givers
- Major root causes of zero-dose children varied across facilities

Note: includes data for 12 outreach strategies at 11 facilities, all supported by zero-dose reduction initiatives

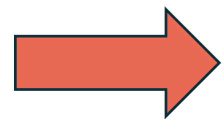
Key takeaways



ZDROP support increased the number of vaccines doses delivered, as well as the number of **additional children reached with Penta1**



If ZDROP facilities increase volume delivery without adding many more additional outreach sessions**, then cost efficiencies could be achieved, despite additional financial expenditures**



Recording of zero-dose dose children reached is heterogeneous, further analysis needed to determine the impact of funding and contextual factors

Thank you

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The cost of identifying and reaching zero dose children in Uganda

A case study of house-to-house registration and targeted outreaches

Carol Kamya

Zero Dose Learning Hub, Uganda

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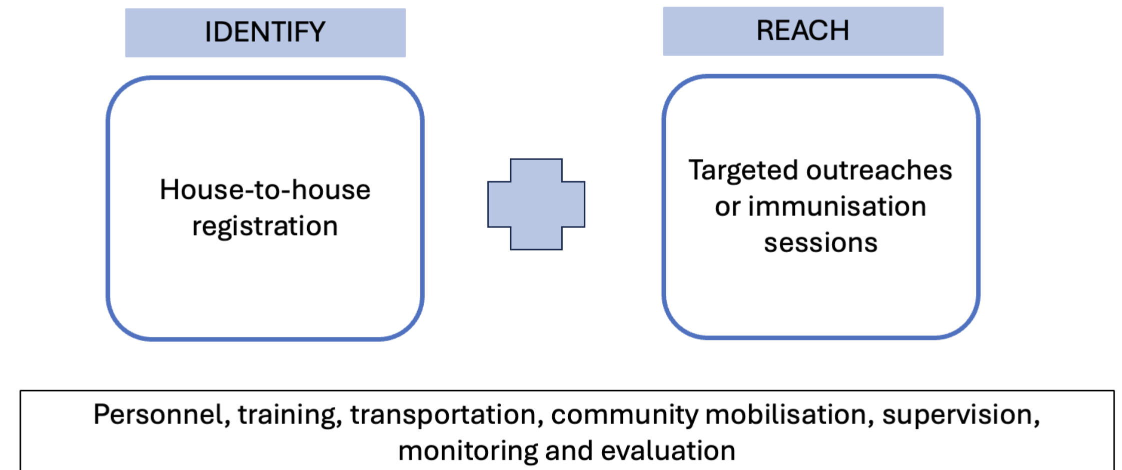
Introduction

- Significant progress has been made in improving immunization coverage in Uganda
- Despite this there is an increasing number of outbreaks, low coverage for some antigens and accumulation of Zero Dose (ZD) and Under Immunised (UI) children.
- Immunisation program conducted the “Big catch-up campaign” in November 2024.
  - Aimed to reach 297,687 ZDC and 676,712 UI children

Rationale and Objective

- Previous costing exercises or studies have mainly focused on estimating the costs of routine immunisation and mapping financing flows for routine immunisation.
- Limited evidence on the costs of identifying and reaching ZD children.
- Findings will inform country and global level planning, budgeting and future guidelines.

Objective
To estimate the incremental costs of identifying and reaching ZD and UI children through the selected interventions implemented as part of the "Big Catch-up campaign."



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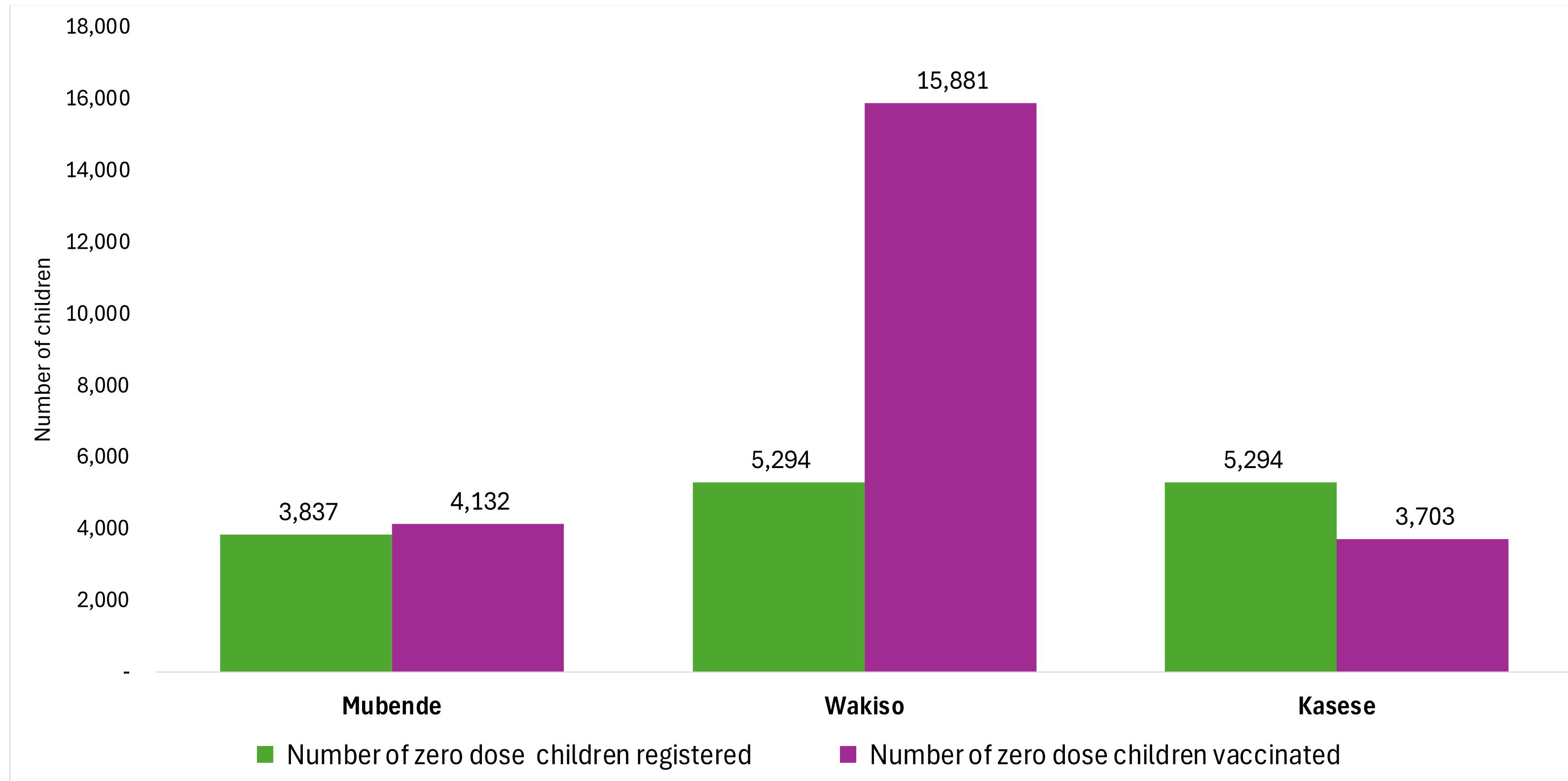
Methods

Design	Retrospective costing study
Costing approach	Ingredients costing using bottom-up approaches. (Both financial and economic costs)
Study sites	• Mubende district: Underserved, hard to reach and pastoral communities • Wakiso district: Urban, peri-urban, and island communities. • Kasese District: Hilly, sparsely populated, with a presence of fishing and border communities.
Study population	Children <5 years (Defined by UNEPI)
Perspective	Payer perspective- costs of delivering the intervention.
Outcome	Primary outcome: Cost per ZD child vaccinated

Results

Number of ZD children registered and vaccinated



119,156 ZD children were registered, 8% (14,425) were zero-dose children

23,716 ZD children were vaccinated

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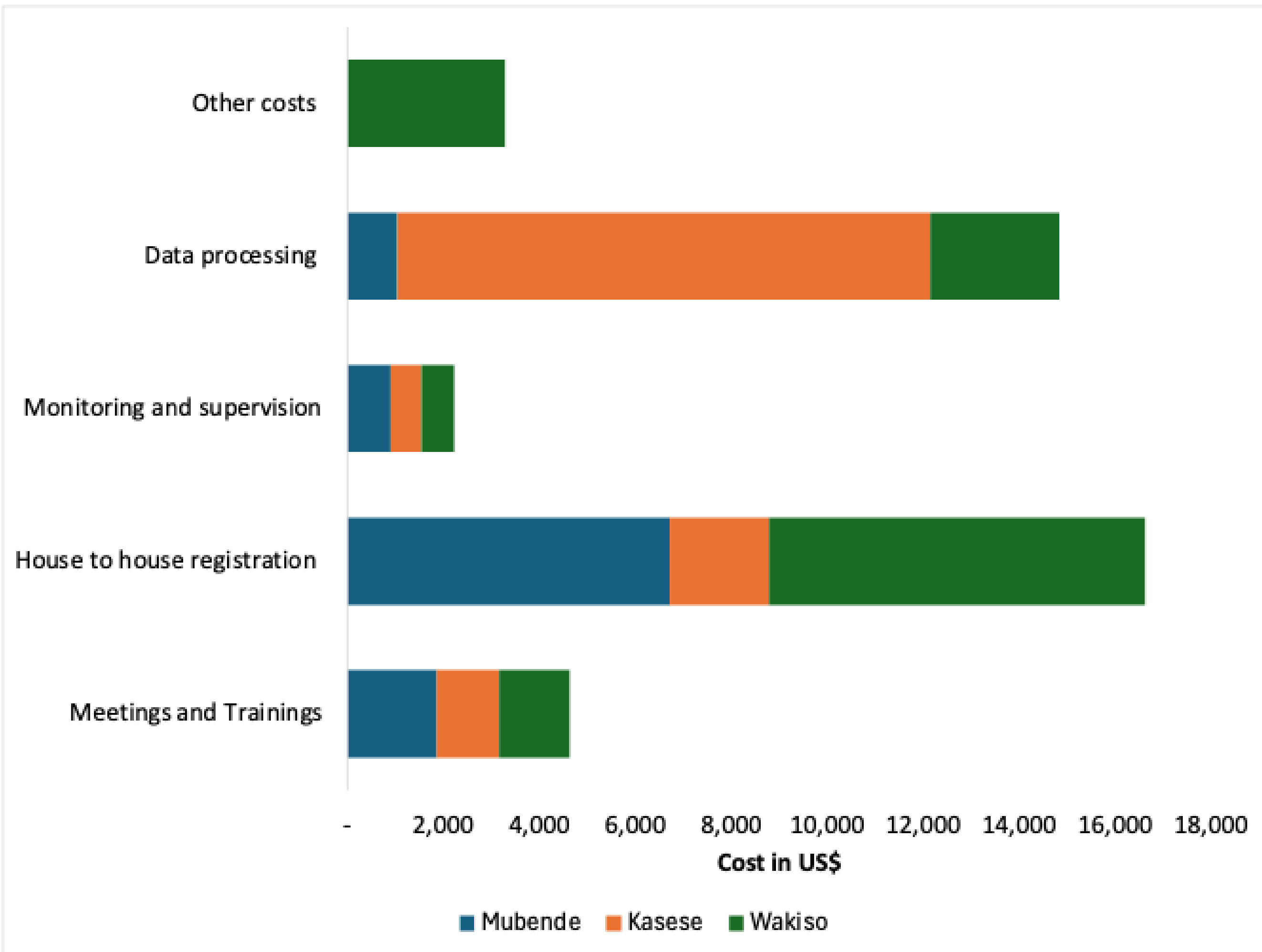
Registration costs



$3.07
Cost per ZD child identified

	Mubende	Kasese	Wakiso
Total costs attributed to DPT1	$2,258	$2,963	$1,396
Number of ZD children identified	587	515	1053
Costs per child identified (Zero Dose Child)	$3.85	$5.75	$1.33

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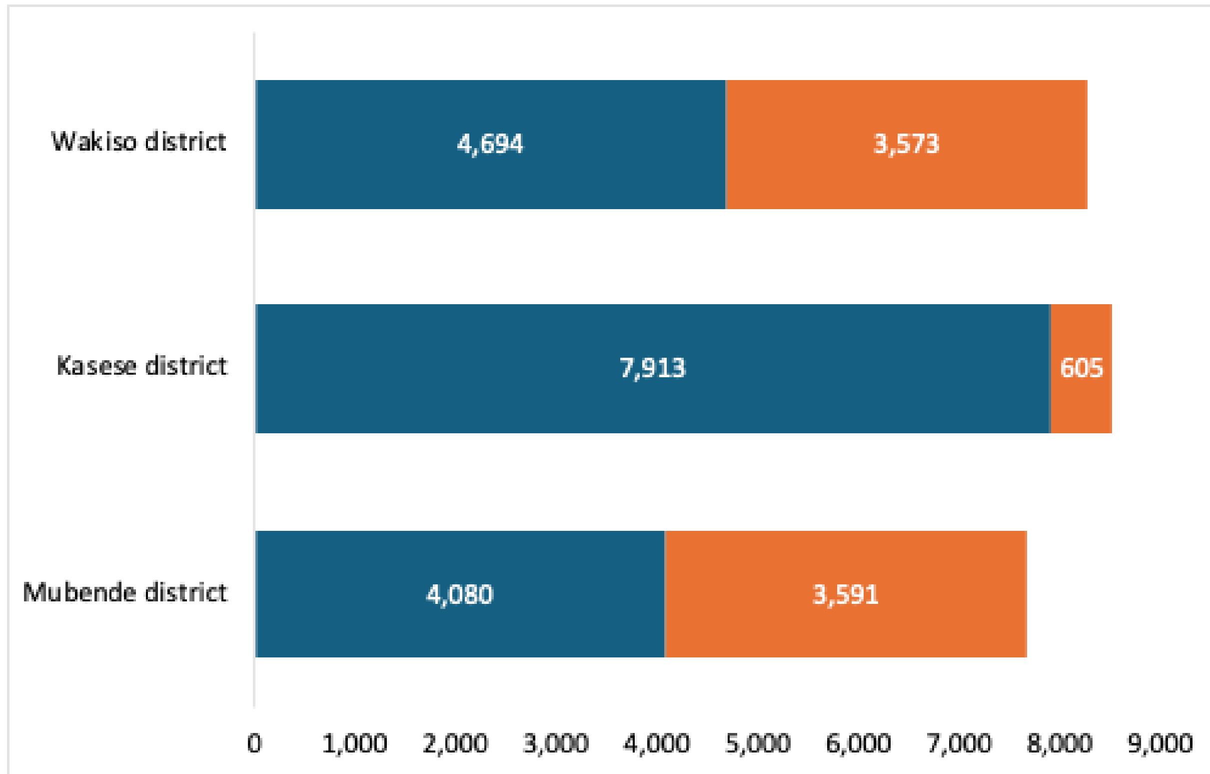
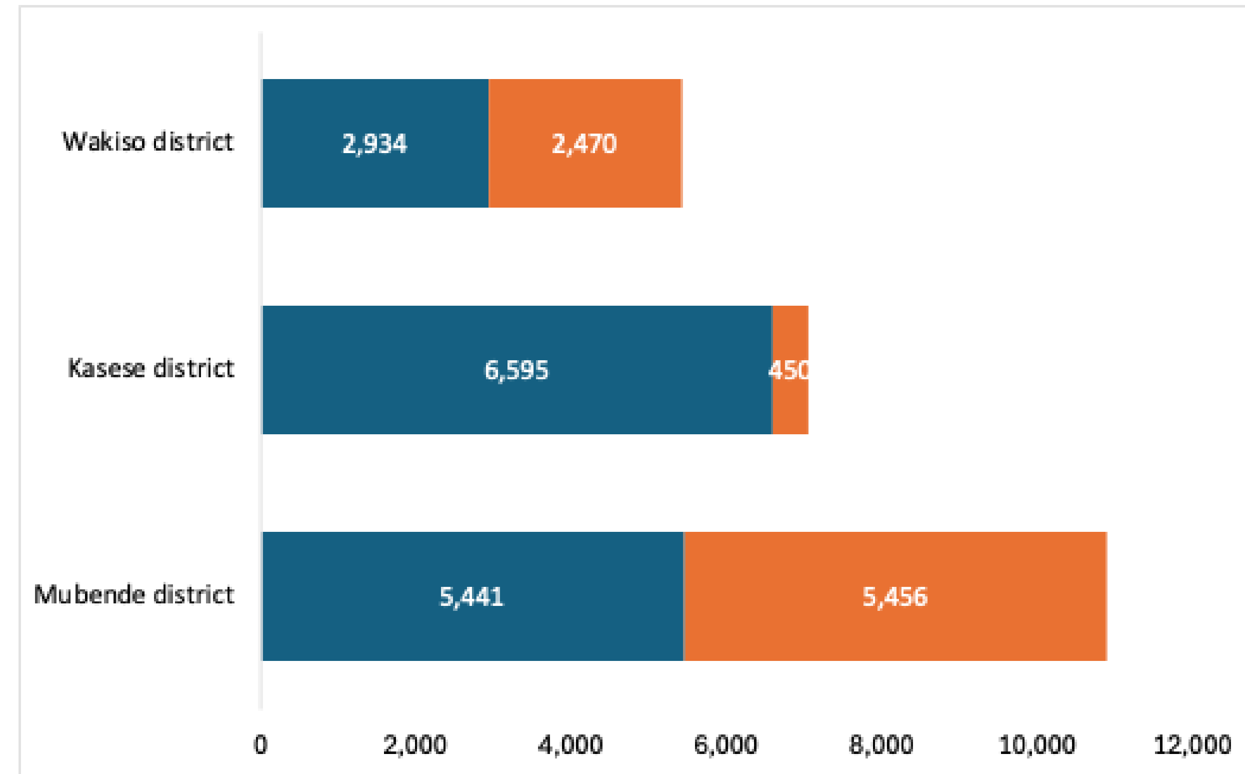
Vaccination related costs

DPT1



DPT3



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Cost per child vaccinated

	Mubende	Kasese	Wakiso	Total
Total costs attributed to DPT1 vaccination	8,031	8,518	8,267	24,816
Number of children vaccinated with DPT1	966	124	889	1,979
Cost per child vaccinated with DPT1	**$8.3**	**$68.7**	**$9.3**	
Total costs attributed to DPT3 vaccination	10,897	7,045	5,404	23,346
Number of children vaccinated with DPT3	1,334	110	604	2,048
Costs per child vaccinated with DPT3	**$8.2**	**$64.0**	**$8.9**	

$12.53 ($8.3-$68.7) Cost per ZD child vaccinated

$11.4 ($8.2-$64) Cost per UI child vaccinated

Implementation challenges

House to house Registration

- Increased workload for VHTs with insufficient incentives or rewards, affecting their motivation and overall effectiveness
- Inadequate training of VHTs, which led to confusion about their tasks and a rushed implementation
- Inadequate logistics, such as registration forms.
- Only one VHT was involved per village (some villages have >2 VHTs)

Vaccination

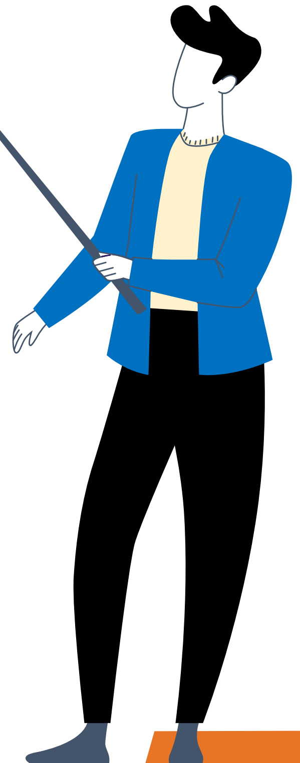
- Vaccination was not linked to registration due to short timelines for implementation.
- Staffing shortages affected outreach efforts
- Resistance towards vaccination. (Myths and misconceptions, Knowledge gaps about immunisation)

Discussion

- Considerable financial investment is required to identify and reach ZD children
  - Additional resources are invested in identifying these children for purposes of targeting.
- Costs are dynamic and responsive to changes in: i) the number of ZD children identified and vaccinated, and ii) the number of administrative units.
- Integrating additional antigens into campaign-based outreaches can offer significant cost-saving opportunities.
- House-to-house registration identified ZD and UI children; its sustainability and cost-effectiveness are unclear.

Learnings

1. Village Health Teams/Community Health workers are key players in the identification of ZDC and UIC at community level. (Many caregivers give birth at home or with TBAs)
2. Identifying ZD, UI children and missed communities requires a data capture system that collects data at the community level and facilitates real-time data use at all levels.
3. The ZD burden is a moving target that requires routine assessments to align interventions as the situation changes. The health system must be adaptable to changing situations to reach ZDC.
4. Barriers to uptake of immunisation services differ by context and therefore require tailored approaches to address them.



What does this mean for policy?

1. Leverage localised data and accelerate the digitisation of immunisation systems to identify and reach ZD children
   - Reduce data processing costs, improve data quality and enhance use (data-driven outreaches, sustain the identification of ZD and UI children)

2. Leverage Existing Health Platforms for Integrated Identification and Vaccination Efforts
   - Other immunisation programs include Child Health Days, the introduction of new vaccines, and other campaigns.
   - Malaria, HIV and TB programs

3. For future efforts, it is necessary to allocate resources based on local district-specific challenges and involve local stakeholders in the planning process.
   - Planning and budgeting should account for context-specific challenges such as geographic barriers and high travel costs.

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Cost-effectiveness analysis of routine catch-up and campaign strategies zero-dose measles vaccine in selected conflict affected district of Ethiopia: a modeling study

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Outline

1. Background
2. Methods
    a. Study Setting
    b. Cost effectiveness model
    c. Outcome analysis
3. Preliminary Results and Interpretations
4. Conclusion

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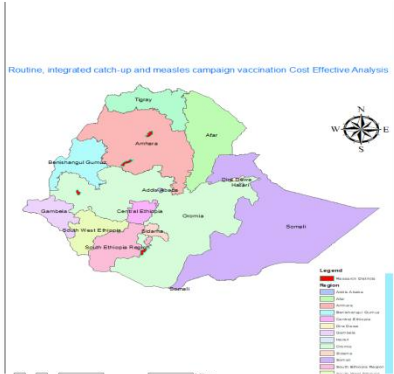
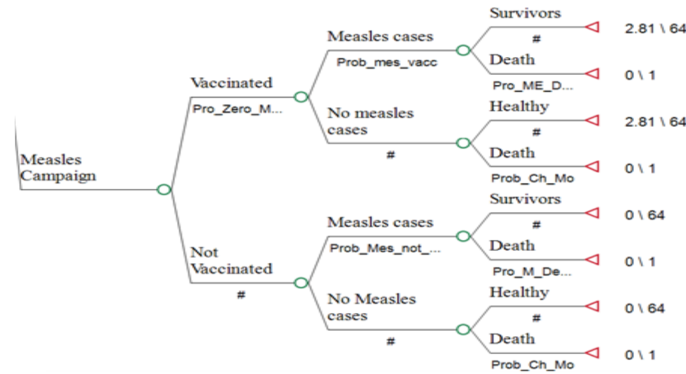
Background

- Addressing "zero doses" is **critical to Global Goals** such as "Leaving no child behind with immunization"
- Vaccination is a highly **cost-effective intervention** that reduces poverty, lowers treatment costs, prevents disability and death, and promotes long-term health and productivity
- **Measles remains a major vaccine-preventable cause of child illness and death**, particularly in low- and middle-income countries like Ethiopia.
- Many children in Ethiopia, especially in remote, conflict-affected, and underserved areas, are "zero-dose"
- There is a recognized **need for economic evidence** to support policy and investment decisions for reaching these children, especially in conflict-affected areas, which this study aims to address

Methods





Four districts most affected by conflict was selected

- A full economic evaluation were applied
- Costing analysis framework from the **provider perspective**

A decision tree model was developed from primary and secondary data source

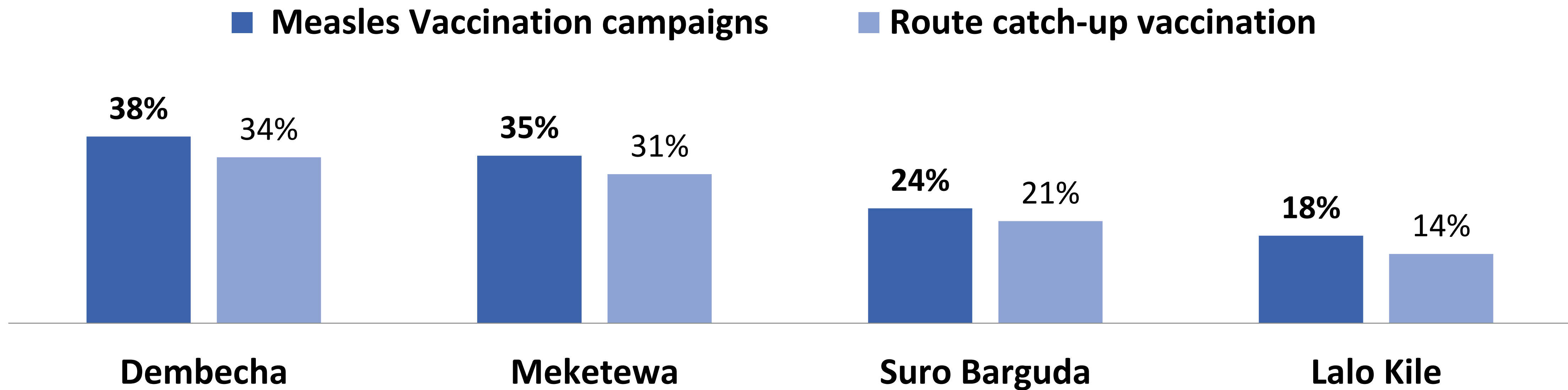
Comparators : Routine catch-ups :as a routine component of immunization

Measles campaigns: National immunization campaign

Health outcomes measured

- Incremental Cost-Effectiveness Ratios were reported in cost per DALYs averted
- DALYs averted combine Years of Life Lost (YLL) due to premature mortality and Years Lived with Disability (YLD)
- PSA and One-way SS were done

Coverage by strategy in conflict-affected Woredas for zero-dose measles vaccination



- Measles vaccination campaigns reached between 18% and 38% of the target population, which is slightly higher than the coverage achieved through routine catch-up immunization efforts which ranged from 14% to 34%.

Overview of Economic (including Financial) Costs by inputs for measles vaccination campaign in 2025 USD) at conflict-affected Woredas

Costs by inputs	**Financial**		**Economic**	
	Birr	1USD=135Birr	Birr	1USD=135Birr
Labor costs paid and Volunteer labor	2.7	0.02(2%)	98.07	0.73(42%)
Personnel costs	25.65	0.19(18%)	57.3	0.43(24%)
Distribution costs	5.4	0.04(4%)	47.25	0.35(20%)
Transport and fuel	10.8	0.08(7%)	10.13	0.08(4%)
Vaccine, Syringe and safety supplies	72.9	0.54(50%)	10.13	0.08(4%)
PPE & IPC and Social mobilization, communication	9.45	0.07(6%)	3.38	0.001(< 1%)
Workshops and meetings	5.4	0.04(3%)	3.38	0.03(1%)
Vehicle maintenance, incin- erator running costs	13.5	0.10(9%)	3.38	0.03(1%)
Cold chain repairs, energy costs	0.13	0.001(< 1%)	0.32	0.000(< 1%)
Capital costs (Cold chain equipment, other)	0.14	0.001(< 1%)	0	0.001(< 1%)
Total cost per vaccinated zero dose	145.8	**1.08**	**233.20**	**1.73**

Overview of Economic (including Financial) Costs by inputs for measles routine catch-up vaccination (2025 USD) at conflict-affected Woredas

Costs inputs	Financial		Economic	
	Birr	1USD=135Birr	Birr	1USD=135Birr
Labor costs paid and Volunteer labor	3.24	0.02(3%)	97.37	0.73(40%)
Distribution costs	5.4	0.19(4%)	55.69	0.41(23%)
Personnel costs	2.97	0.022(3%)	57.34	0.43(24%)
Transport and fuel	9.45	0.07(8%)	9.45	0.07(4%)
Vaccine, Syringe and safety supplies	72.9	0.54(61%)	10.13	0.08(4%)
Workshops and meetings	5.4	0.04(4%)	3.38	0.03(1%)
Printing materials, stationery supplies	6.75	0.05(5%)	2.84	0.02(1%)
Vehicle maintenance, incin- erator running costs	13.5	0.10(11%)	3.38	0.03(1%)
Cold chain repairs, energy costs	0.27	0.002(< 1%)	0.32	0.002(< 1%)
Capital costs (Cold chain equipment, other)	0.27	0.002(< 1%)	0.27	0.00(< 1%)
Total Cost per Dose	**119.61**	**0.89**	**240.69**	**1.78**

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Cost Breakdown (Financial and Economic) of Zero-Dose Measles Vaccination Strategies) at conflict-affected Woredas

Region	**Zone**	**Distracts affected by conflict**	**Zero dose Measles vaccination campaigns**			**Route Catch-up zero dose measles**		
			Number of vaccinated	Financial costs	Economic costs	Number of vaccinated	Financial costs	Economic costs
Amhara	West Gojjam	Dembecha	459	$495.67	$ 793.98	465	$ 413.85	$ 224.28
	South Gondor	Meketewa	126	$ 136.08	$ 224.28	126	$ 112.14	$ 827.70
Oromia	West Guji	Suro Barguda	139	$149.69	$ 258.97	123	$ 109.47	$ 218.94
	Kelem Walaga	Lalo Kile	85	$76.06	$ 135.39	76	$ 67.64	$ 135.28
Total			**809**	**$ 873.72**	**1,412.62**	**790**	**$ 703.10**	**$ 1,406.20**

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Incremental cost-effectiveness ratio per DALYs averted

Vaccination Strategy	Cost (USD)	Incremental Cost	Eff (DALYs)	Incremental Eff	ICER
Measles campaign	13.46		61		
Routine catch-up	33.45	19.99	64.09	3.1	6.45

- Routine catch-up strategy averted 64.09 DALYs at a cost of $33.45,offering an additional 3.10 DALYs averted
- The ICER of $6.45 per DALYs averted confirms the cost-effectiveness of the catch-up strategy. indicating that one DALY could be averted at a cost $6.45
- This suggests that the catch-up strategy is relatively cost-effective, falls below the Ethiopia GDP per capita.

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Sensitivity analysis

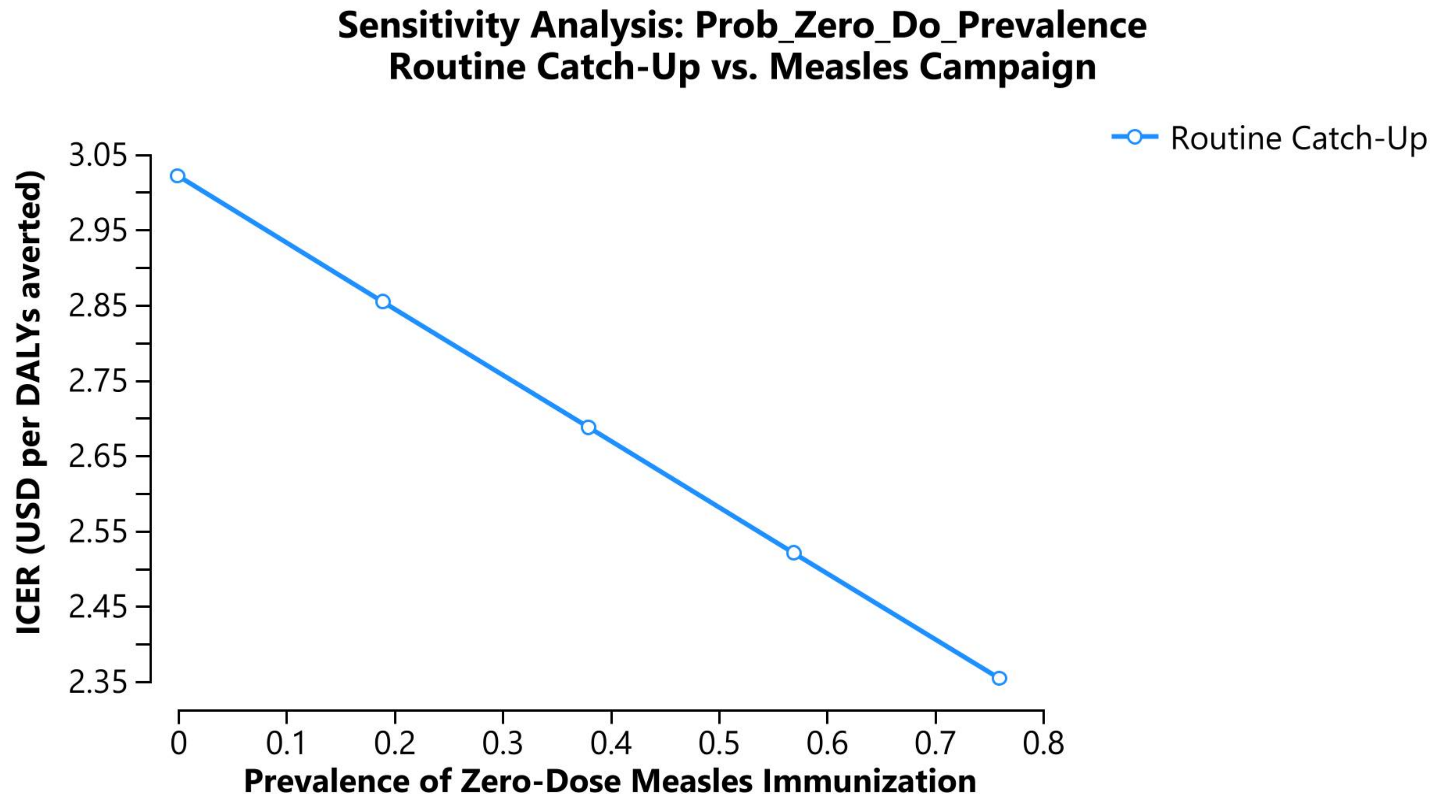

Figure 1 Prevalence of Measles zero dose

- An investment of just $3.05 for routine catch-up we averted approximately 77% of zero-dose measles prevalence.
  - Demonstrating that targeted, low-cost interventions can yield substantial impact (Figure 1)

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Sensitivity analysis

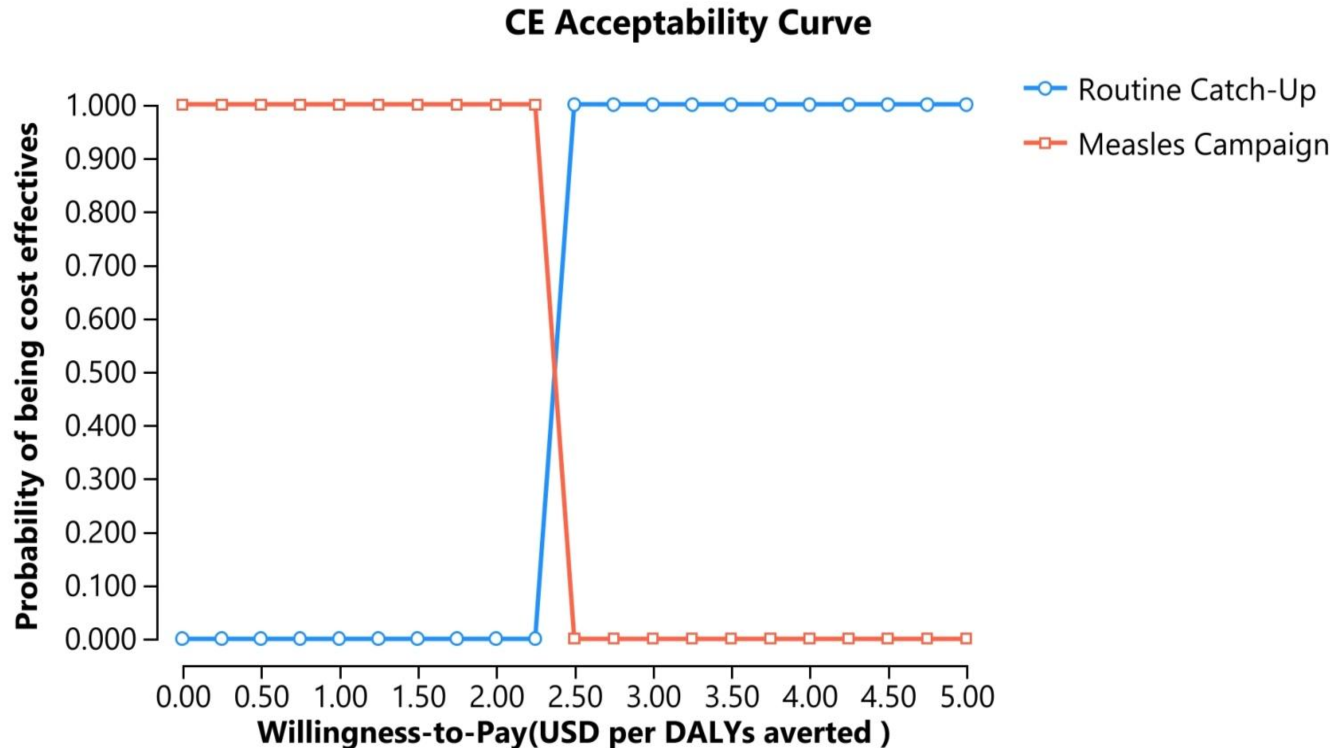

Figure 2 Cost-effectiveness acceptability curve for zero dose measles vaccination strategy

- At **$2.50 WTP**, there's a **50% chance** either strategy (routine catch-up and measles campaign.) is cost-effective indicating equal likelihood.
- **Above $2.50**, the measles campaign becomes **less cost-effective** compared to the **routine catch-up strategy**.
- The **catch-up strategy achieves** a **100% probability** of being cost-effective at a **$5 WTP**, making it the preferred option at more investment levels

Conclusion

- Ethiopia continues to face a high burden of zero-dose measles, especially in conflict-affected areas
- Routine catch-up vaccination is a cost-effective strategy, delivering better health outcomes at a lower cost than mass campaigns
- The cost per DALYs averted was below Ethiopia's GDP per capita, indicating strong value for money
- Additional studies are needed to capture client-side direct and indirect costs such as transportation, time, and income loss across different settings to better inform program design and resource allocation.
- Future evaluations should include underserved populations such as internally displaced , refugees, and pastoralist communities to improve the equity and comprehensiveness of cost-effectiveness analyses.

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Thank you

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