Estimating the cost of immunizing zero-dose children through outreach in Nigeria

Study report

THINK WELL

Acknowledgments:

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ACRONYMS

AEFI	Adverse events following immunization
AFENET	African Field Epidemiology Network
CHAI	Clinton Health Access Initiative
CHIPS	Community Health Influencers, promoters and Services
CRoWN	Community Re-orientation Women Network
DPT	Diphtheria, pertussis, and tetanus vaccine
EPI	Expanded Program on Immunization
GIS	Geographic Information System
IDCC	Immunization Delivery Cost Catalogue
IEC	Information, education and communication
IEV	Identify, enumerate, vaccinate
LCDA	Local Council Development Area
LGA	Local Government Area
MICS	Multiple Indicator Cluster Survey
NGN	Nigerian Naira
NICS	National immunization coverage
NPHCDA	National Primary Health Care Development Agency
NSIPSS	Nigeria Strategy for Immunization and PHC system strengthening
PHC	Primary Health Care
SCIDaR	Solina Centre for International Development and Research
SPHCDA	State Primary Healthcare Development Agency
UNICEF	United Nations Children's Fund
USD	United States Dollar
WHO	World Health Organization
ZDROP	Zero-Dose Reduction Plan
ZD	Zero-dose

EXECUTIVE SUMMARY

Introduction

Nigeria has the largest population of zero-dose (ZD) children globally—an estimated 2.1 million in 2023—with prevalence disproportionately high in the northern states due to insecurity, poverty, maternal education gaps, and health system weaknesses. To address this challenge, Nigeria has developed ambitious strategies, including the Zero-Dose Immunization Recovery Plan (2023–2028) and the Zero-Dose Reduction Plan (ZDROP), which aim to cut zero-dose prevalence by 80% by 2028. Outreach delivery—defined as taking immunization services beyond facility walls—is central to these efforts, yet limited evidence has existed on its costs in Nigeria. This study aimed to estimate the costs of reaching zero-dose children through outreach delivery in three states in Nigeria, with a focus on ZDROP implementation.

Methods

This study used a retrospective bottom-up costing approach in three states, Jigawa, Kaduna, and Lagos. In total, 57 health facilities were sampled across 8 LGAs, selected to represent different zero-dose prevalence and geographic contexts. Costs were assessed from the health sector payer perspective, capturing both financial outlays and economic costs. Data were collected at sites between December 2024 and March 2025, including cost data incurred within the prior month and doses delivered within the prior 12 months. Unit costs were calculated as volume-weighted averages, and findings were disaggregated by delivery strategy, state, and ZDROP participation. All costs are presented as 2024 USD. The main unit cost estimated is the cost per Penta1 dose delivered to all children, due to limited data on Penta1 doses delivered to zero-dose children (aged 12-23 months). A qualitative assessment was also conducted alongside the costing to capture providers' perspectives on the key barriers to vaccinating zero-dose children as well as their recommendations to reduce zero-dose prevalence in their areas.

Results

An increase in vaccine delivery volume was seen during ZDROP implementation at facilities implementing which were part of ZDROP compared to non-ZDROP facilities. During the implementation period, facilities delivered more doses of Penta1 vaccines, with outreach proving to be the main driver of these increases.

However, the cost-efficiency of expanding outreach delivery varied substantially across contexts. In Jigawa state, additional outreach sessions proved cost-efficient. Despite higher per-session costs, these facilities delivered more Penta1 doses to children at lower unit costs, with a financial cost of $7.57 per Penta1 dose through outreach compared to $13.20 at facilities which did not implement additional outreach sessions. In Kaduna, implementing multiple zero-dose initiatives simultaneously showed diminishing returns. Facilities running only ZDROP reached 57 Penta1 doses monthly at a financial cost of $2.47 per dose, while those implementing both ZDROP and other initiatives delivered 46 doses at $3.70 per dose. In Lagos, where zero-dose prevalence was lower and demand-side barriers more prominent, ZDROP-specific outreach sessions cost substantially more per Penta1 dose delivered ($8.73) compared to regular outreach ($1.48), despite reaching slightly more zero-dose children per session.

Key takeaways

- ZDROP facilities reached more children with Penta1 as well as with other antigens, particularly through outreach. This was true both in settings where caregivers received financial incentives for immunization, and where they did not.
- Increasing outreach delivery proved cost-efficient in settings where drivers of zero-dose prevalence can effectively be tackled by strengthening service delivery. In Jigawa, expanding outreach addressed

awareness-related barriers, resulting in more children being reached and lower unit costs despite higher per-session expenditures.

- When multiple initiatives tackle the same drivers of zero-dose prevalence while failing to address other key barriers to immunization, diminishing returns are observed. In Kaduna, implementing ZDROP concurrently with other zero-dose reduction initiatives did not yield cost-efficiencies as all interventions targeted similar supply-side issues while demand-side barriers remained unaddressed. Lower unit costs were observed where only one initiative was implemented.
- Reaching zero-dose children in lower prevalence settings likely requires more resources. In Lagos, while the zero-dose targeted additional ZDROP outreach vaccinated more zero-dose children than regular outreach, it did so at a higher cost per Penta1 delivered.
- Only investing in strengthening service delivery may not be cost-efficient in settings where demand-side barriers are prominent. In Lagos, ZDROP outreach sessions reached more zero-dose children per session but at much higher unit costs, suggesting both the need for interventions better tailored to local drivers of zero-dose prevalence.
- What is cost-efficient in one setting may not be in another. Because root causes of zero-dose prevalence differ across contexts, aligning intervention strategies with context-specific barriers improves cost-efficiency by enabling interventions to reach more children at lower unit cost.

1. INTRODUCTION

2.1 OVERVIEW

Nigeria is home to the world's largest population of zero-dose (ZD) children—those who have not received a single dose of diphtheria-tetanus-pertussis containing vaccine (DTP). In 2023, an estimated 2.1 million Nigerian children were zero-dose, with prevalence concentrated in the northern states, where insecurity, poverty, low maternal education, and weak health systems intersect to create deep inequities in access to immunization services.[1, 2, 3, 4, 5] Reducing the zero-dose burden is a central focus of Nigeria's immunization agenda, aligned with the global Immunization Agenda 2030 and Gavi's 5.0 priority to reach missed communities. National plans, including the updated Nigeria Strategy for Immunization and Primary Health Care System Strengthening (NSIPSS 2.0), the Zero-Dose Immunization Recovery Plan (2023–2028), and the Zero-Dose Reduction Plan (ZDROP), set ambitious targets to reduce zero-dose prevalence by 80% by 2028.

Box 1 – Definition of the zero-dose child

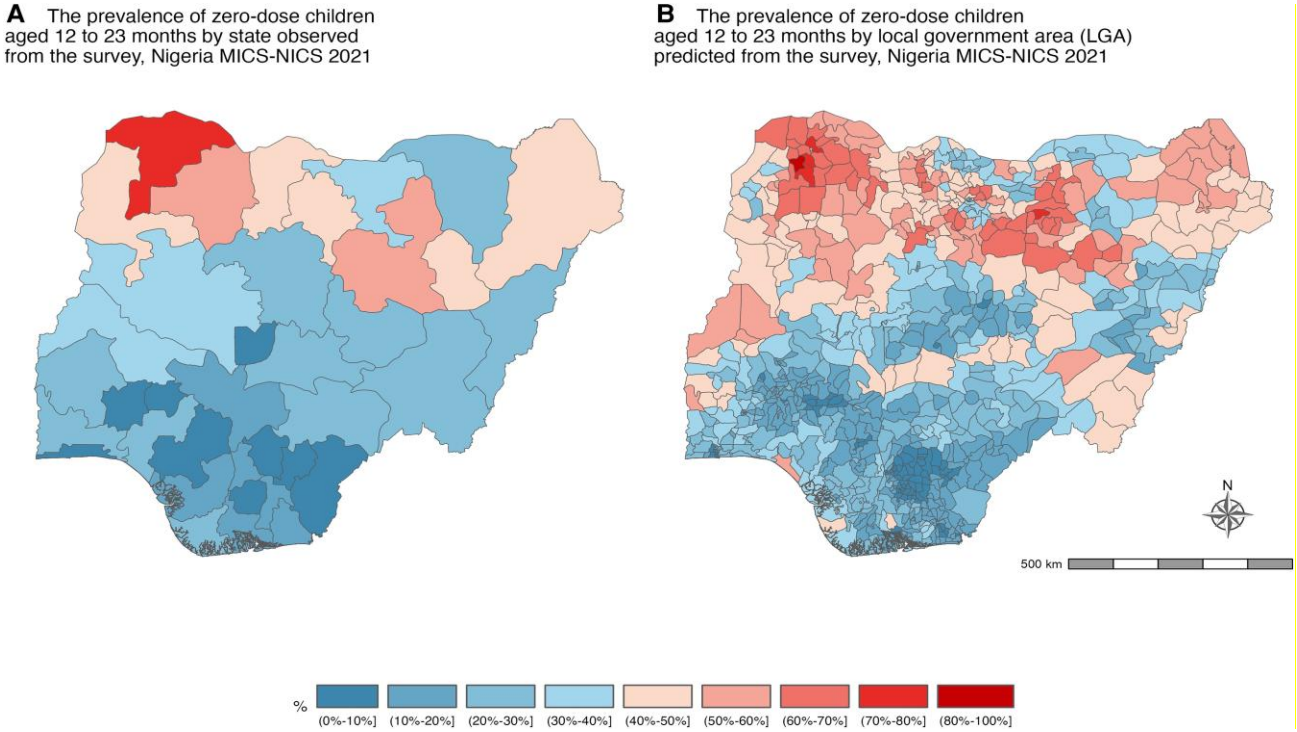
For operational purposes, Gavi defines zero-dose children as those who lack the first dose of first dose of diphtheria-tetanus-pertussis containing vaccine (DTP1). Global definitions consider children 'zero dose' when they have not received a single dose of DTP aged between 18 weeks and 23 months.[1] In Nigeria, zero-dose children are children who have not received a single dose of the Penta vaccine, with some states already classifying a child as zero-dose as soon as they have not received Penta1 by 6 weeks of age.

Despite these commitments, critical evidence gaps remain around the costs and resource requirements for reaching zero-dose children. Outreach—defined as the delivery of immunization services by health workers outside facility walls—is a cornerstone strategy for extending coverage, particularly in underserved and high-zero-dose burden areas. Yet little is known about the delivering vaccines through outreach in Nigeria. To address this gap, ThinkWell and Nnamdi Azikiwe University, in collaboration with the National Primary Health Care Development Agency (NPHCDA) and with support from the Gates Foundation, conducted a bottom-up costing study of outreach and other routine delivery strategies. By estimating financial and economic costs and examining operational realities, the study provides evidence to inform more efficient budgeting, planning, and prioritization of strategies to reach zero-dose children. These insights will be vital as Nigeria seeks to accelerate immunization gains, strengthen primary health care delivery, and prepare for the transition to increased domestic financing in the coming years.

2.2 BACKGROUND

Zero-dose prevalence in Nigeria is driven by multiple socioeconomic and contextual factors.[1] Zero-dose prevalence is disproportionately concentrated in northern Nigeria, particularly in the northwest, where 45% of children remain unvaccinated according to the 2021 Multiple Indicator Cluster Survey/National Immunization Coverage Survey (MICS/NICS) (Figure 1).[2] The states of Sokoto, Bauchi, and Zamfara recorded the highest proportions of zero-dose children at 72%, 58%, and 56% respectively, compared to southern states where prevalence was as low as 1%.[2] Several studies have found that zero-dose status in Nigeria is strongly associated with lower maternal education, household poverty, and rural residence.[2] Insecurity has further compounded these barriers: a 2020 study found that children living within 5 km of a conflict event had 24% lower odds of being vaccinated compared to children outside conflict areas.[4] Additional risk factors include younger maternal age, larger family size, and persistent fears or misconceptions about vaccine safety and efficacy.[5]

Figure 1. Prevalence of ZD children by state and LGA in Nigeria[2]



To address these challenges, the Nigerian government has developed and updated a series of national immunization strategies. The Nigeria Strategy for Immunization and Primary Health Care System Strengthening (NSIPSS) 2018–2028 was revised in 2021 to reverse coverage declines from the COVID-19 pandemic and set ambitious objectives to reduce the number of zero-dose children through routine immunization—by 30% by 2025 and 80% by 2028.[6] Nigeria also joined *The Big Catch Up*, a global initiative to recover from coverage backsliding due to the COVID-19 pandemic, and developed the Zero-Dose Immunization Recovery Plan (2023–2028), which prioritizes interventions in the 100 local government areas (LGAs) with the highest zero-dose burden before scaling up nationwide.[7,8] To identify these priority LGAs, the University of Southampton and NPHCDA produced LGA-level zero-dose prevalence estimates and categorized LGAs into three tiers, with tier 1 LGAs spanning 18 states and accounting for more than 1.5 million zero-dose and under-immunized children.[9]

Building on these efforts, the National Primary Health Care Development Agency (NPHCDA) introduced the Zero-Dose Reduction Plan (ZDROP) in 2023 to operationalize the Recovery Plan in tier 1 LGAs. ZDROP aims to strengthen routine immunization through enhanced leadership and coordination, improved service delivery, demand generation, stronger data systems, and vaccine logistics. Complementary initiatives such as the Identify, Enumerate, and Vaccinate (IEV) strategy—which applies GIS mapping and census methods to locate zero-dose children—were also rolled out. In addition to government-led programs, partner-led initiatives such as the Community Reorientation Women Network (CRoWN), the Community Health Influencers, Promoters and Services (CHIPS) program, and RAISE4Sahel are testing innovative approaches to expand immunization reach, particularly in underserved and fragile contexts.

2.3 RATIONALE FOR THE STUDY

While Nigeria has developed comprehensive plans to reduce the zero-dose burden, critical evidence gaps remain on the cost of reaching these children through routine strategies. Outreach, in its various forms, is and will remain a cornerstone strategy to extend immunization services to underserved populations, yet there is limited published data on the financial and resource requirements for implementing routine outreach in Nigeria. Of the 119 studies in the Immunization Delivery Cost Catalogue[10], only three include primary data from Nigeria, with two limited to campaign delivery and one focused on measles outreach in a single state.[11,12,13] As Nigeria prepares to transition from Gavi support after 2028, the need for accurate budgeting and planning becomes increasingly urgent, as the country will rely predominantly on domestic resources to finance immunization. Achieving national objectives to reduce zero-dose prevalence will therefore depend on the availability of robust cost evidence to guide financial planning, inform resource allocation, and enable the sustainable scale-up of strategies to reach the most underserved children.

2.4 SELECTION OF INTERVENTION

Consultations identified reaching zero-dose children through routine outreach as the most critical intervention to cost for this study. Between December 2023 and August 2024, consultations were conducted to map ongoing and planned interventions to reach zero-dose children across Gavi's Identify, Reach, Measure, Monitor, and Advocate (IRMMA) framework. Partners engaged in this process included Gavi, the Vaccine Alliance; the United Nations Children's Fund (UNICEF); the Clinton Health Access Initiative (CHAI); the Solina Centre for International Development and Research (SCIDaR); and the African Field Epidemiology Network (AFENET). Several interventions were highlighted, including delivery strategy modifications (e.g., periodic intensification of routine immunization or integration with other services), changes in planning and reporting (e.g., more nuanced microplanning), demand-side interventions (e.g., enhanced social mobilization and engagement of religious leaders), and systems improvements (e.g., strengthened tracking and reporting systems). Following this mapping exercise, and in collaboration with the NPHCDA, outreach delivery was confirmed as a cornerstone strategy for reaching zero-dose children. The implementation of ZDROP in 2024 which sought to improve routine services and enable more zero-dose children was flagged as a key intervention to assess during the study. To enable comparison with non–zero-dose–focused strategies, routine delivery through fixed sites was also selected for assessment.

2.5 STUDY OBJECTIVES

The primary objective of this study is to estimate the costs of reaching zero-dose children through outreach delivery in different states in Nigeria. Sub-objectives include:

- To estimate the financial and economic costs of reaching a zero-dose child through outreach delivery in Nigeria
- To identify the main cost drivers of reaching zero-dose children through outreach
- To evaluate how the costs and cost drivers of delivering vaccines vary by state
- To examine how ZDROP implementation impacted the number of zero-dose children reached and the cost of delivery
- To assess the challenges and enabling factors faced by providers in reaching zero-dose children

2. METHODS

3.1 STUDY DESIGN

This was a retrospective costing study that captured the full financial and economic costs of immunization delivery for a typical month from the payer perspective. The study estimated immunization delivery costs, defined as the costs associated with delivering immunizations to target populations, exclusive of vaccine and vaccination supplies costs. Costs were collected from LGA, LCDA, ward and facility level. The study took a health sector payer perspective, including costs incurred by both health service providers and development partners when vaccinating the target populations; costs incurred by other sectors and government entities, or by the beneficiaries were not included.

The study also includes a qualitative component to evaluate the operational challenges and lessons learned from immunizing zero-dose children. To contextualize cost findings, we documented health workers' perspectives on the root causes of zero-dose prevalence and barriers to reaching zero-dose children, as well as their perspectives on potential strategies for reducing zero-dose prevalence.

3.2 SAMPLING STRATEGY

The study was conducted in three states, selected to include various settings with high zero-dose prevalence, and local government areas were selected in collaboration with the state governments. Of the 18 states that contain tier 1 zero-dose priority LGAs, namely the LGAs with the highest prevalence of zero-dose children, three were chosen to represent different geographic settings and levels of zero-dose prevalence, with guidance from the NPHCDA. Two states, Jigawa and Kaduna, are situated in the north and are largely rural, while Lagos is located in the south and presents a predominantly urban setting (see Table 1). At state level, we purposively selected the only two priority LGAs in Lagos, two priority LGAs in Jigawa state and four priority LGAs in Kaduna state, in collaboration with the SPHCDA in each state. We then worked with the SPHCDA to purposively select wards or LCDAs within each state, and all facilities within a selected ward or LCDA were included in the study.

Across the three states, we included a total of 57 health facilities, in 17 wards and LCDAs across 8 LGAs. Our sample includes 57 health facilities across the three states (Table 1). In Jigawa, the sample contains 12 facilities across 4 wards, in Kaduna 31 health facilities from 9 wards, and in Lagos 14 facilities from 4 LCDAs. Due to some health facilities in Lagos being located close to the LGA office, only two of these areas had an LCDA level office.

Table 1. Study states, characteristics and sample sizes

State	ZD prevalence	# LGAs included	# LCDA or wards included	# Sampled facilities			
				Total	# Rural	# Semi urban	# Urban
Jigawa	38.6%	2	4	12	9	2	1
Kaduna	29.2%	4	9	31	24	2	5
Lagos	7.6%	2	4	14	6	0	8
Total	**30.1%**	**8**	**17**	**57**	**39**	**4**	**14**

3.3 METHODOLOGY

This costing study used a bottom-up micro-costing (or ingredients-based) approach. Immunization delivery activities (defined in annex 1) at each administrative level were costed by measuring the quantity of the inputs (resource types defined in annex 2) used to implement these activities, which were then multiplied by a price for each of these inputs (unit cost) to calculate the cost of each resource type under each activity.

We estimated the financial and economic costs of vaccine delivery. The costs included in the study captured financial costs, defined as the financial outlays related to immunization delivery (such as per diems and transport costs). We also estimated economic costs, which are the sum of financial costs and opportunity cost of using existing or donated resources (such as capital costs, a share of government health worker salaries, and donated equipment), to account for the fact that when these resources are used for immunization delivery they are then unavailable for other purposes (opportunity cost).

Shared resources were allocated to immunization based on health staff reporting, and across delivery strategies based on volume delivered. Resources that are shared with the wider health system, like health workers' time, were allocated to immunization delivery based on reported time spent on immunization services. Similarly, capital costs for equipment and vehicles that are also used for other health services were allocated to immunization based on the reported use for immunization services. When necessary, costs for resources shared across multiple delivery strategies such as general immunization meetings, cold chain space and energy, were allocated to strategies on the basis of the proportion of doses delivered at that site.

Capital costs were annualized and discounted, and allocated to immunization using the number of days used or proportion used for immunization as a share of the useful life of the equipment. A straight-line depreciation of capital items was included using the number of immunization days as a share of the estimated useful life of the vehicle or equipment item. When calculating the economic costs, capital costs were discounted at the standard rate of 3%. The economic costs also include volunteer time, which was valued at an equivalent of the salary grade. World Bank Official exchange rate (local currency unit per US$, period average) was used to convert 2024 NGN into USD (1,478.97 NGN to 1 USD). [14]

3.4 DATA COLLECTION

Data was collected through in-person interviews between December 2024 and March 2025 by a team of seven data collectors and one supervisor from Nnamdi Azikiwe University using questionnaires designed in Microsoft Excel. Tailored questionnaires for data collection at facility level were designed in Excel. The data collection team underwent two days of training and participated in two days of pilot testing of the study materials at four health facilities in Anambra state. Data collectors were paired with staff from the SPHCDA to administer the questionnaires in a team of two. In-person interviews were conducted at state level, LGAs, and health facilities; when needed, additional requests for information were made via phone and email.

Costs were collected for a typical recent month of immunization service delivery and volume delivered data were collected for up to 12 months prior. We collected costs incurred for immunization service delivery per session or per month for a typical recent month prior to the moment of data collection. The number of doses delivered of any antigen, Penta1 doses delivered to all children, and Penta1 doses delivered to children aged 12-23 months were collected where available for the 12 months prior to data collection.

Unit cost information was obtained from national and international publicly available sources. To cost health worker time, during in-person interviews we collected the salary grade or equivalent salary grade for unpaid health workers based on their education level, and used official salary scale information from each of

the three states to estimate hourly labor costs, as provided by each state SPHCDAs. Equipment and vehicle unit costs were collected from publicly available online sources.

Where data was missing or unavailable, alternative sources were used, or assumptions were made to impute the data. Completed questionnaires were reviewed by the study team, and if data could not be retrieved after following up, alternative sources were employed, or assumptions were made to impute the missing data; these assumptions can be found in the Annex 3.

3.5 DATA ANALYSIS

Quantitative

To estimate the average unit costs at facility level, we calculated a volume weighted average in Microsoft Excel. Costs were calculated in Microsoft Excel for each cost type (financial/economic cost), delivery strategy (facility-based and outreach), and resource type. Unit costs were calculated using a volume-weighted average approach. The volume-weighted unit costs (per Penta1 dose delivered or per zero-dose child reached) at vaccination sites was calculated by dividing the total monthly cost incurred at the sites by the average number of doses administered at those sites per month, using the following formula:

$$unit\_cost_{vw} = \frac{\sum_{i=1}^{n} C_i}{\sum_{i=1}^{n} Q_i}$$

Where Ci represents the total cost of vaccine delivery at location i, Qi is the total quantity of doses delivered at location i, and n is the sample size for that level. All findings are shown for each of the three states individually.

Unit costs were estimated by dividing the average cost per month by the average number of doses delivered per month. The average cost per month for immunization delivery by strategy was divided by the number of doses delivered through that strategy. If facilities implemented ZDROP during the year, the average monthly volume delivered was calculated only considering ZDROP implementation months, while in facilities which did not implement ZDROP, the unit cost calculation used the average number of doses delivered for the 12 months prior to data collection. Therefore, at facilities which were part of ZDROP, the cost presented represents the average cost per dose over the months during which ZDROP was being implemented, while in non-ZDROP facilities, the cost per dose is shown for an average of doses delivered across 2024. For comparing volume delivery before and after ZDROP implementation at facilities which did not implement ZDROP, the average timepoint of ZDROP implementation in the ward (if available) or LGA was used.

In each state we disaggregated findings differently to reflect differences in context and implementation. Table 2 shows the unit costs calculated by strategy for each state, reflecting data availability and differing strategies and initiatives being implemented. Facilities were categorized depending on whether they implemented ZDROP or not, or whether they implemented ZDROP alongside other ongoing zero-dose reduction initiatives, or they only implemented other zero-dose reduction initiatives only (Kaduna only). For each category, we present the cost per Penta1 dose delivered at health facilities and through outreach. Where possible, we also estimated the cost per zero-dose child reached following the same breakdowns. As doses delivered through different forms of outreach and mobile delivery were combined, we combine these into a single cost per dose for outreach. The cost per immunization session is also shown for these breakdowns, calculated using a simple average.

Table 2. Cost breakdowns presented by state

<table>
<tr><th>Facility type</th><th>Strategy</th><th>Jigawa
All facilities part of New Incentives</th><th>Kaduna
Mixed participating in New Incentives across all breakdowns</th><th>Lagos
No facilities part of New Incentives</th></tr>
<tr><td rowspan="3">ZDROP facilities</td><td>Facility-based</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>Regular outreach</td><td rowspan="2">X
No additional outreach conducted in 1 LGA, doses were not separated by regular and additional outreach in the second LGA</td><td rowspan="2">X
Additional outreach conducted at some facilities - presented as single outreach cost as output data were often not available disaggregated, resulting in a very small sample group size</td><td>✓</td></tr>
<tr><td>Additional outreach</td><td>✓</td></tr>
<tr><td>All outreach (regular and additional)</td><td>✓</td><td>✓</td><td>X</td></tr>
<tr><td rowspan="2">Facilities participating in ZDROP and other ZD reduction initiatives</td><td>Facility-based</td><td rowspan="2">X
Not applicable - no other zero-dose reduction initiatives being implemented</td><td>✓</td><td rowspan="2">X
Not applicable - no other zero-dose reduction initiatives being implemented</td></tr>
<tr><td>All outreach (regular and additional)</td><td>✓</td></tr>
<tr><td rowspan="2">Facilities participating in other ZD reduction initiatives only</td><td>Facility-based</td><td rowspan="2">X
Not applicable - no other zero-dose reduction initiatives being implemented</td><td>✓</td><td rowspan="2">X
Not applicable - no other zero-dose reduction initiatives being implemented</td></tr>
<tr><td>All outreach (regular and additional)</td><td>✓</td></tr>
<tr><td rowspan="2">Facilities with no ZD-reduction initiatives</td><td>Facility-based</td><td>✓</td><td>✓</td><td>✓</td></tr>
<tr><td>Regular outreach</td><td>✓</td><td>✓</td><td>✓</td></tr>
</table>

✓= costs are estimated for this breakdown; **X**=costs are not estimated for this breakdown

Qualitative assessment

Qualitative data were categorized and assessed to generate insights on the root causes of zero-dose prevalence. Data were gathered through interviews with representatives from health facilities including ward focal points, facility managers and health care providers. With participants' consent, the sessions were audio-recorded, transcribed verbatim, and translated into English by local field staff. The English transcripts were reviewed to identify key themes. The emerging themes were then compared across the three states, to highlight similarities and variations.

3.6 LIMITATIONS

The study design, data limitations, contextual variations, and implementation differences constrain our ability to draw causal conclusions. First, we may not be able to attribute changes in volume delivery to whether or not ZDROP was being implemented as we do not compare the volume delivered during implementation to the volume delivered during the 12 months prior to that. Due to the differing start dates of ZDROP implementation across the sample, the number of months of ZDROP implementation and the time of the year during which ZDROP was implemented also varied. This may mean that changes in volume delivered across ZDROP facilities is also affected by seasonal changes in output, limiting our ability to make causal inferences on the changes in volume delivered before and after ZDROP implementation. Second, we obtained data on the number of zero-dose children reached from facility records, which frequently did not separate out recipients of Penta1 doses by age. For this reason, the number of zero-dose children reached was only available for a small subset of the sample. Therefore, the cost results are presented using the number of Penta1 doses delivered to all children under two years old, as a proxy for zero-dose children reached. Third, though we asked respondents about the most recent month of costs to minimize recall issues, this approach may not capture well potential seasonal variations. Fourth, activities implemented as part of ZDROP were not uniform, and at 50% of ZDROP facilities in Kaduna, other zero-dose reduction initiatives were also being implemented. In those settings, the impact of ZDROP is harder to infer and may not be comparable to facilities where ZDROP was the only zero-dose focused initiative being implemented. Finally, the barriers and drivers of zero-dose prevalence described in the qualitative findings reflect service provider perspectives and therefore may reflect caregivers' own experiences or priorities.

3.7 ETHICAL APPROVAL

Ethical approval for the study was granted by the National Health Research Ethics Committee. The study protocol, the data collection questionnaires and informed consent sheets for survey participants received ethical clearance from the National Health Research Ethics Committee for ethical clearance. The SPHCDA in each state also gave approval for the study.

3. QUALITATIVE FINDINGS

4.1 STRATEGY IMPLEMENTATION PER SETTING

Jigawa

In Jigawa, facilities implemented routine immunization through facility-based, outreach and mobile strategies. Regular outreach sessions were held weekly by all facilities, while 6 out of 12 facilities implemented regular mobile sessions which took place between 1 and 4 times per month. Outreach sessions were defined as being conducted at sites between a 2-5km distance from the facility, while mobile delivery was described as being implemented beyond 5km. Facility-based delivery was integrated with the provision of other services at all facilities in Jigawa, primarily with antenatal care services, with a few also offering minor illness treatment. Outreach and mobile immunization sessions were generally not integrated with other health services though some facilities in one LGA offered vitamin supplementation and antenatal care. During data collection, both LGAs sampled were part of the New Incentives program, which provided cash incentives to the caregivers of beneficiaries after each immunization visit and an additional incentive after six visits are completed. An overview of service delivery implementation can be found in Table 3.

All 12 facilities in the sample received funds for ZDROP efforts, with the facilities in Kafin Hausa LGA utilizing the funds to operate additional zero-dose focused outreach sessions, while the funding was used

for existing services in Dutse LGA. ZDROP implementation at sampled facilities started at varying points from July 2024 onward, with facilities in Kafin Hausa holding additional weekly zero-dose outreach sessions funded by ZDROP and facilities in Dutse using ZDROP funds for strengthening existing services. Across both LGAs, funds were used to provide additional incentives to health workers, cover transport costs and increase social mobilization efforts.

Table 3. Description of service delivery at facilities in Jigawa

	Total	Additional ZDROP outreach sessions	No additional ZDROP outreach sessions	No ZD initiatives
Facility overview				
# facilities	12	5	7	0
# facilities participating in ZDROP	12	5	7	0
# facilities where caregiver incentives were provided	12	5	7	0
Service delivery				
# conducting facility delivery (# integrated)	12 (12)	5 (5)	7 (7)	0
# conducting routine outreach (# integrated)	12 (6)	5 (0)	7 (6)	0
# conducting routine mobile (# integrated)	6 (1)	3 (0)	3 (1)	0
# implementing additional outreach sessions as part of ZDROP (# integrated)	5 (0)	5 (0)	0 (0)	0

Kaduna

Sampled sites in Kaduna also used facility-based, outreach, and mobile delivery. Routine immunization delivery outside of the facility was conducted through outreach and mobile strategies, with outreach covering sites within a 3km distance of the facilities and mobile delivery going beyond 3km. Both strategies aimed to reach marginalized populations, though mobile sessions are more resource-intensive and had a more targeted approach towards hard-to-reach areas. The integration of other health services varied across strategies and LGAs, with limited integration for outreach sessions in two LGAs and integration with services such as family planning, malaria services, and nutrition in the other two. Facility-based delivery was integrated with the provision of other services at all facilities in Kaduna, with the majority providing multiple services alongside immunization including antenatal care, malaria services and nutrition services. Two out of four LGAs in Kaduna (Ikara and Zaria) participated in the New Incentives program. Table 4 details service delivery information for facilities in Kaduna.

Of the 31 facilities in the sample, 18 were part of ZDROP, while another 8 implemented other zero-dose reduction initiatives. During the study period, 18 facilities were part of ZDROP in Kaduna, with 9 of these also implementing other zero-dose reduction initiatives, primarily UNICEF-funded integrated mobile outreach or outreach implemented by CHAN—the Christian Health Association of Nigeria—which began prior to 2024. A further 8 facilities implemented other zero-dose reduction initiatives only, such as UNICEF-funded integrated mobile outreach, CHAN-supported outreach or outreach supported by the New Incentives program, and the remaining 5 facilities in the sample did not implement any zero-dose reduction initiatives. Among the facilities which were part of ZDROP, at those facilities that were already implementing another zero-dose reduction initiative ZDROP funds were generally used for strengthening

existing services, including facility-based sessions and outreach. At ZDROP facilities that were not implementing other zero-dose focused initiatives ZDROP funds were generally used to implement additional outreach.

Table 4. Description of service delivery at facilities in Kaduna

	Total	ZDROP		ZDROP and other ZD initiative facilities		Other ZD initiatives only	No ZD initiatives
		Add. outreach	No add. outreach	Add. outreach	No add. outreach		
Facility overview							
# facilities	31	8	1	1	8	8	5
# facilities participating in ZDROP	18	8	1	1	8	0	0
# facilities where caregiver incentives were provided	11	4	0	1	3	4	1
Service delivery							
# conducting facility delivery (# integrated)	31 (31)	8 (8)	1 (1)	1 (1)	8 (8)	8 (8)	5 (5)
# conducting routine outreach (# integrated)	31 (21)	8 (4)	1 (0)	1 (1)	8 (7)	8 (5)	5 (4)
# conducting mobile (# integrated)	12 (10)	1 (1)	0 (0)	0 (0)	8 (8)	2 (1)	0 (0)
# implementing add. outreach sessions for ZDROP (#integrated)	9 (4)	8 (4)	0 (0)	1 (0)	0 (0)	-	-

Lagos

All facilities in Lagos operated facility-based and outreach routine immunization strategies. Facility-based sessions were held at least twice weekly, with some facilities offering immunization daily, while regular outreach took place usually once per week and doses were delivered at a mix of sites, including at churches and markets. In Lagos, facility-based delivery was integrated with the provision of other services at all facilities except one, with the majority providing multiple services alongside immunization including antenatal care, family planning and a general outpatient clinic. Regular outreach delivery was integrated with other health services at 10 of the 14 facilities. This was generally family planning or health education (n=8), with one facility also offering minor illness treatment, and one also including blood pressure estimation and nutrition services. The New Incentives program did not operate in Lagos, and no facilities reported providing cash incentives to beneficiaries or caregivers. Table 5 details service delivery information for facilities in Lagos.

In Lagos, 9 of the 14 sampled facilities were part of ZDROP, and of these, 8 implemented additional outreach sessions. ZDROP sessions were generally held twice per week in addition to regular outreach sessions held by facilities. ZDROP outreach sessions differed from regular outreach in that they targeted hard-to-reach areas, they included increased social mobilization efforts and also provided monthly incentives for health workers. ZDROP outreach was not integrated with other services at five of the

facilities, while the other three also offered family planning services, and one of these also offered minor illness services.

Table 5. Description of service delivery at facilities in Lagos

	Total	ZDROP facilities		No ZD initiatives
		Add. outreach	No add. outreach	
Facility overview				
# facilities	14	8	1	5
# facilities participating in ZDROP	9	8	1	5
# facilities where caregiver incentives were provided	0	0	0	0
Service delivery				
# conducting facility delivery (# integrated)	14 (13)	8 (7)	1 (1)	5 (5)
# conducting routine outreach (# integrated)	14	8 (5)	1 (1)	5 (4)
# implementing additional outreach sessions as part of ZDROP (# integrated)	9	8 (3)	0 (0)	-

4.2 ROOT CAUSES OF ZERO-DOSE PREVALENCE

According to facility-level providers, zero-dose prevalence was driven by a combination of demand-side barriers such as a lack of awareness and cultural beliefs, and supply-side structural challenges such as geographical remoteness and transport barriers. Facility-level providers across the three states, including facility managers, ward focal persons and service providers identified both demand-side barriers and supply-side challenges as key drivers of zero-dose prevalence. A lack of awareness of the importance of vaccination was the most consistently reported cause, while cultural beliefs were also a common factor reportedly driving zero-dose prevalence.

- In Jigawa, one LGA reported more issues with health system capacity and transport provision, while the other highlighted a lack of awareness on the benefits of vaccination and cultural beliefs as the main barriers.
- In Kaduna, lack of awareness was the most frequently driver of zero-dose prevalence, reported by 67-100% of facilities within each LGA, including at all facilities in the LGAs which included urban settings. Cultural or religious beliefs were also identified as barriers to vaccinating zero-dose children in almost all urban settings and most rural settings in Kaduna. In the two rural LGAs, the remoteness of communities was identified as key cause of zero-dose prevalence, reported by all facilities in one LGA and half of the facilities in the other.
- In Lagos, either a lack of awareness of the benefits of vaccination or cultural beliefs were the key root cause of zero-dose at all urban facilities, and were also prominent issues at rural facilities alongside challenges with relating to facility access and transport for beneficiaries.

4.3 ADDRESSING ZERO-DOSE PREVALENCE

To reduce zero-dose prevalence, providers highlighted the need for more resources to strengthen the demand and supply for vaccination, to address vaccine hesitancy and structural barriers to access to immunization services. A need for increased social mobilization to reduce zero-dose prevalence was commonly reported by providers, and increased incentives for both caregivers and healthcare workers plus improved transport to conduct outreach were also frequently flagged as being key in reaching zero-dose children.

- Most facilities in Jigawa (83%) reported a need for more social mobilization, generally those at which a lack of awareness of the benefits of vaccination was identified as a prominent root cause of zero-dose prevalence. At all facilities in Jigawa where migration contributed to zero-dose prevalence, improved transportation to conduct outreach was reported as being required to reduce zero-dose prevalence.
- In Kaduna, improving transport and providing caregiver incentives were the most frequent suggestions for increasing vaccination coverage among zero-dose children. In one of the two LGAs not implementing the New Incentives initiative most respondents flagged caregiver incentives (90%) or health worker incentives (70%) as being needed for reducing zero-dose prevalence; however, this was not in the case in the other LGA not part of the New Incentive initiatives, where only 10% of facilities suggested caregiver incentives and none mentioned additional health worker incentives as a key gap to be filled to help reduce zero-dose prevalence. The need for improved transport was consistently flagged across LGAs in Kaduna (50-80% of respondents).
- In Lagos, additional social mobilization was reported as being important for reducing zero-dose prevalence (reported at 86% of facilities in each LGA), followed by the provision of caregiver incentives which was flagged at 43% of the urban LGA facilities and 29% of those in the rural LGA.

4. QUANTITATIVE FINDINGS

4.1 JIGAWA

Volume delivered and zero-dose children reached

In Jigawa, the average number of doses delivered of all antigens and Penta1 doses was higher during ZDROP implementation compared to before. When comparing the average monthly doses delivered before and during ZDROP implementation in Jigawa—where all facilities participated in ZDROP and provided incentives to caregivers (Box 2)—the number of all antigens and Penta1 doses was higher during ZDROP implementation (Figure 2 and Figure 3). A greater increase was seen in the number of Penta1 doses delivered through outreach (+21%) compared to facility-based delivery (+1%). When comparing the two LGAs, the increase in Penta1 doses delivered was especially higher for outreach in the LGA where additional outreach sessions were held as part of ZDROP, with an increase of 10% and 22% respectively for facility-based delivery and outreach where additional outreach sessions were held, compared to a decrease of 2% for facility-based delivery and an increase of 19% for outreach were no additional sessions were implemented.

Box 2. Summary of zero-dose reduction initiatives in Jigawa sample during study period

- ZDROP implemented in all facilities
- ZDROP started at varying points from July 2024 onwards
- Incentives for caregivers were given in all facilities
- Additional outreach was conducted as part of ZDROP in one out of two LGAs (Kafin Hausa)

Figure 2. Average number of doses of all antigens delivered per month at facilities in Jigawa

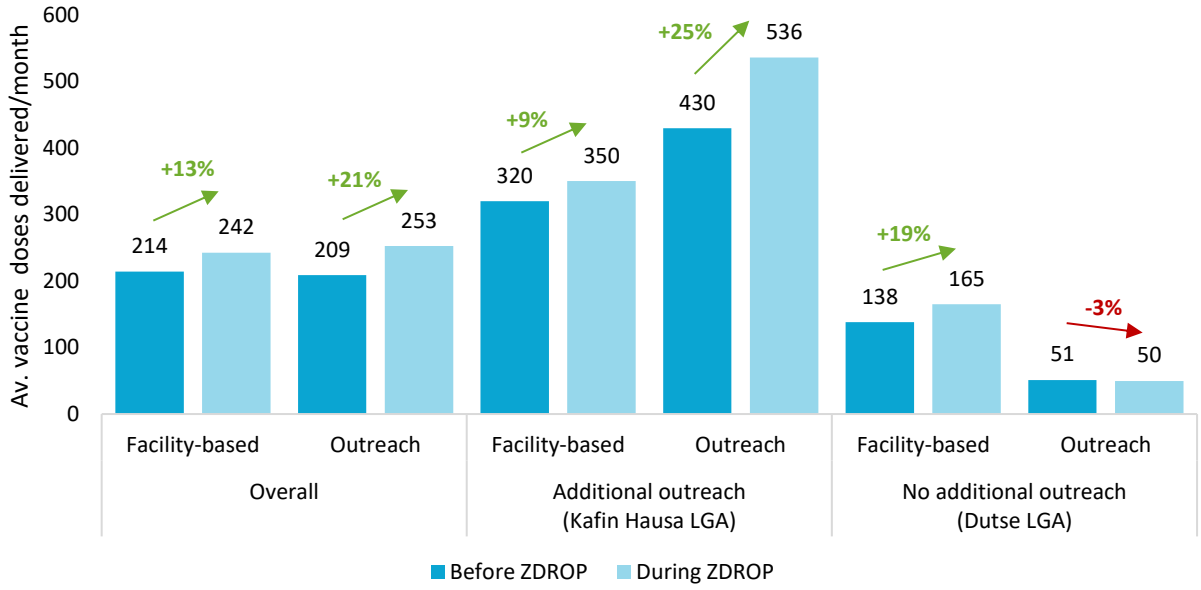
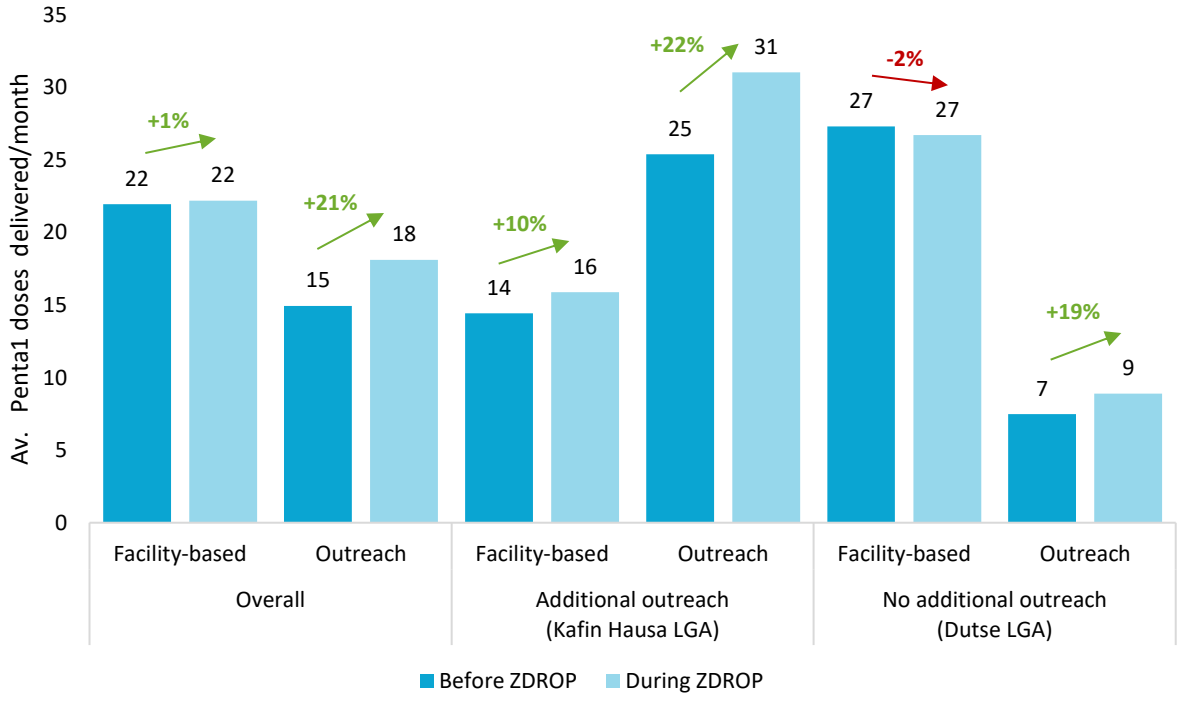


Figure 3. Average number of Penta1 doses delivered per month at facilities in Jigawa



While data on the number of zero-dose children reached was limited, a slight increase in the number reached per month was seen during ZDROP implementation in the one LGA where data was available. Records on the numbers of Penta1 doses delivered to zero-dose children were only available at 7 facilities (out of 12) in Dutse LGA, which did not implement additional outreach sessions as part of ZDROP. A small

change in the number of zero-dose children reached was observed, with the average per month at facilities increasing from 4 to 5 (Table 6). The proportion of zero-dose children reached a share of all Penta1 doses delivered increased during ZDROP implementation for outreach delivery (from 15% to 18%), while it decreased for facility-based delivery (from 20% to 16%).

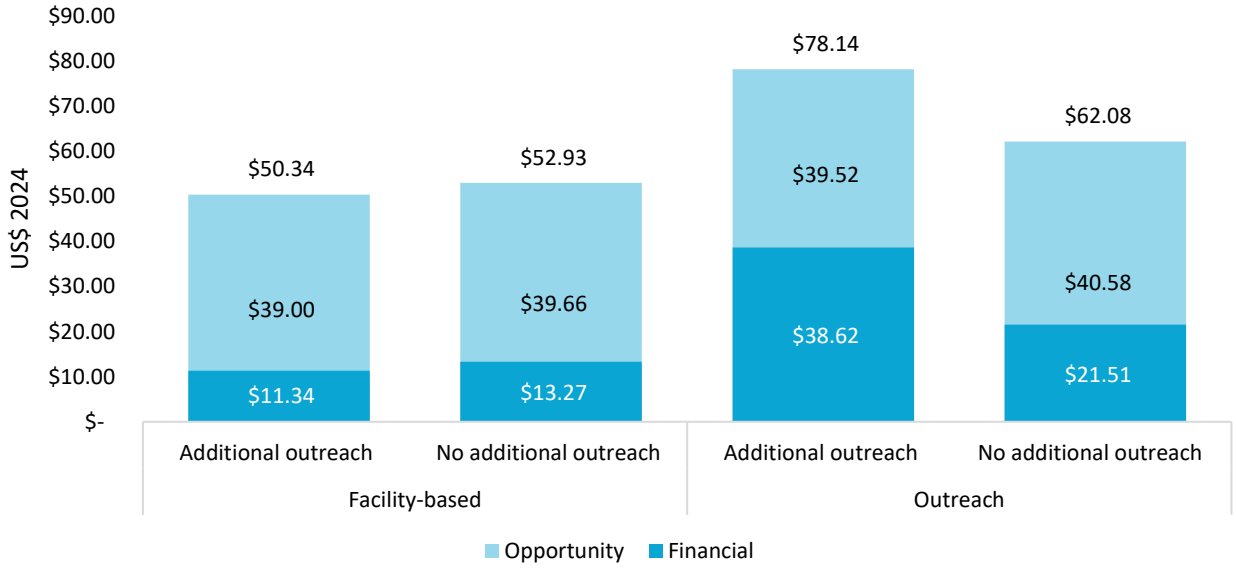
Table 6. Average number of Penta1 doses delivered to zero-dose children by strategy per facility per month

Strategy	Before ZDROP		During ZDROP	
	Number ZD reached	ZD reached as % of Penta1 doses delivered	Number ZD reached	ZD reached as % of Penta1 doses delivered
Facility-based (n=7)	13	20%	13	16%
Outreach (n=7)	4	15%	5	18%

Cost per immunization session

The cost per session varied across sites which held additional sessions and those which did not, and was higher for outreach sessions at sites that implemented additional outreach as part of ZDROP. When comparing the average cost per session, outreach delivery was more costly than facility-based delivery in both LGAs, and costlier per session at facilities in the LGA which held additional sessions as part of ZDROP (Figure 4). The average financial cost per session was estimated at $11.43-$13.27 for facility-based sessions across the two LGAs and $21.51-$38.62 for outreach sessions. Higher transport costs and incentives contributed to the increased cost for outreach compared to facility-based delivery.

Figure 4. Average cost per immunization session at facilities in Jigawa which did and did not implement additional sessions as part of ZDROP in Jigawa (facility level cost, US$ 2024)

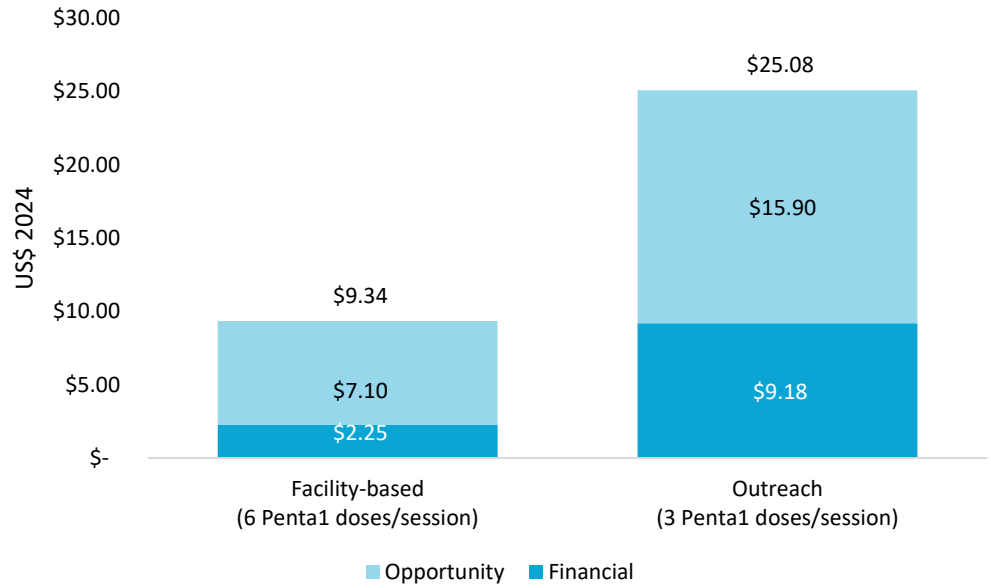


Cost per Penta1 dose delivered

Across sampled facilities in Jigawa, the financial cost of delivering a dose of Penta1 vaccine through outreach was $9.18 and the economic cost per dose was $25.08 (Figure 5). The financial cost of delivering

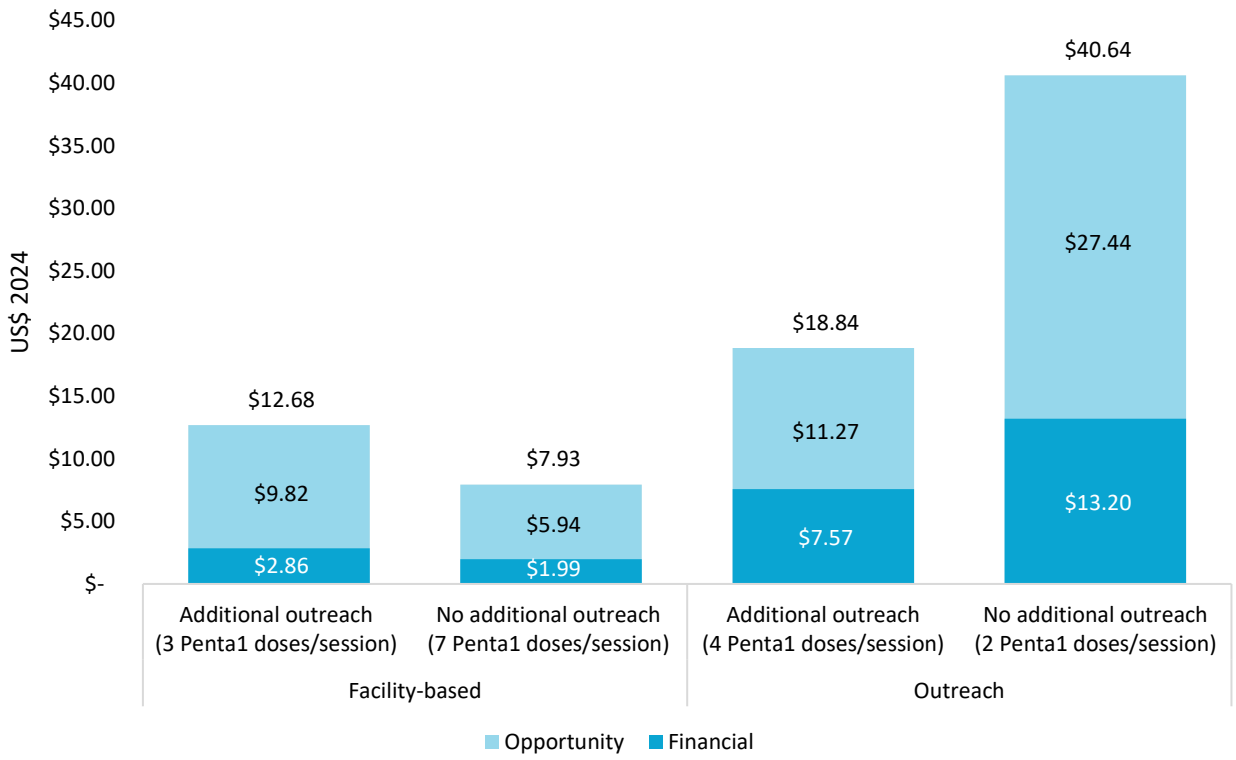
a Penta1 vaccine dose at sampled facilities in Jigawa varied from $2.25 through facility-based delivery to $9.18 through outreach. When incorporating the opportunity cost of labor and use of existing resources, the economic cost per Penta1 dose delivered was $9.34 for facility-based delivery and $25.08 through outreach.

Figure 5. Cost per Penta1 dose delivered at facilities in Jigawa (facility level cost, US$ 2024)



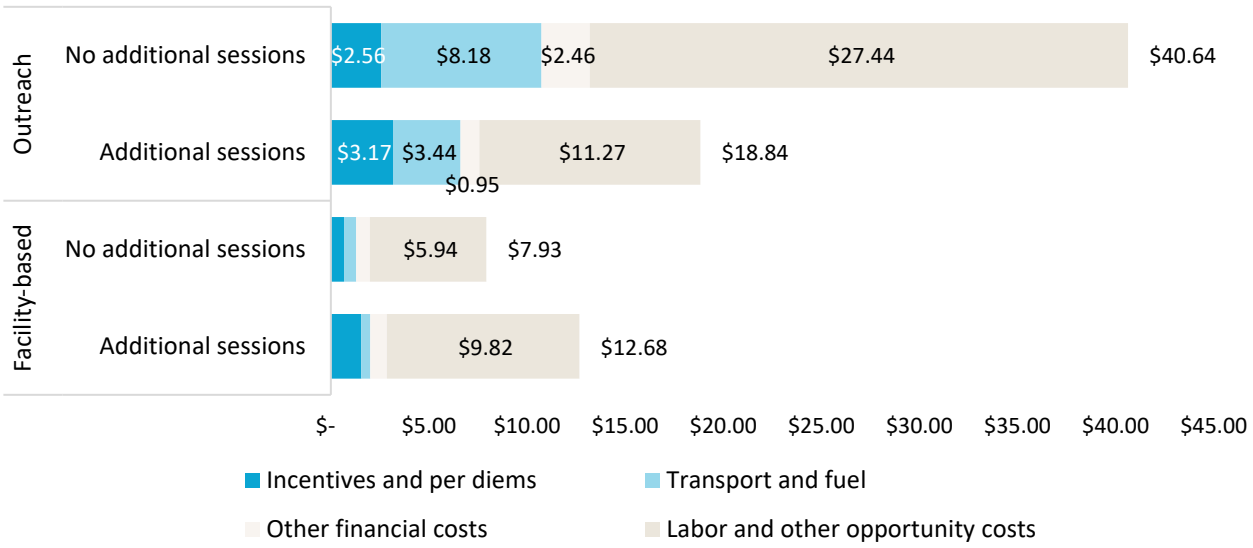
While all sites in Jigawa were part of ZDROP, the facilities which held additional outreach sessions delivered more Penta1 doses per month at lower financial and economic unit costs (Figure 6). All facilities in Jigawa were part of ZDROP and also provided incentives to caregivers. However, sites in one of the LGAs conducted additional outreach sessions as part of ZDROP, holding an average of 13 immunization sessions per month (9 of which were outreach) in total, compared to 9 in the other LGA, 6 of which were outreach. The financial cost of delivering Penta1 doses varied from $2.86 for facility-based and $7.57 through outreach at sites which held additional ZDROP sessions, and $1.99 for facility-based and $13.20 for outreach at sites which did not hold additional sessions (Figure 6). The monthly volume delivered at the sites with additional sessions was higher, particularly through outreach, where the average output was 31 Penta1 doses and 536 doses overall, compared to 9 Penta1 doses and 50 doses overall through outreach at facilities which did not operate additional sessions. On a per-session basis this corresponded to 4 Penta1 doses per outreach session in the LGA where additional sessions were held compared to 2 Penta1 doses per session in the other LGA. The cost per Penta1 was lower for outreach delivery at facilities which held additional sessions, partly due to the larger session sizes, while this was slightly higher for facility-based delivery, where sessions were smaller at facilities conducting additional outreach.

Figure 6. Cost per Penta1 dose delivered at facility level at sites in Jigawa which did or did not implement additional sessions as part of ZDROP (facility level cost, US$ 2024)



Labor was the primary cost driver across strategies for economic costs, with transport, incentives and per diems driving financial costs. The cost per Penta1 dose delivered for both outreach and facility-based delivery was driven by the opportunity cost of paid and volunteer labor, while other opportunity costs such as the use of cold chain equipment were minimal (Figure 7). Transport costs and incentives and per diems received for outreach delivery were the largest financial cost drivers for this strategy, with transport and fuel being a larger cost driver at facilities that did not hold additional outreach sessions. Other financial costs—which include cold chain repair and energy costs, printing costs, and workshop and meeting costs—were minor, ranging from $0.95 at facilities that conducted additional sessions to $2.46 at facilities that did not.

Figure 74. Average economic cost per Penta1 dose delivered at facilities in Jigawa which did and did not implement additional sessions as part of ZDROP, by resource type (facility level cost, US$ 2024)



Cost per zero-dose child reached

The financial cost of reaching zero-dose children through outreach was estimated at $25.67 per child while the economic cost was estimated at $79.06. In Jigawa, the only facilities that reported data on zero-dose children reached were facilities that did not implement additional sessions as part of ZDROP. At these sites, the financial cost of reaching a zero-dose child was $4.14 for facility-based delivery and $25.67 for outreach, while the economic unit costs were $16.51 and $79.06 respectively (Table 7).

Table 7. Cost to reach zero-dose child in Jigawa (US$ 2024)*

	ZD children reached per month (per session)	Financial cost	Economic cost
LGA in which sites did not implement additional sessions			
Facility-based	13 (3)	$ 4.14	$ 16.51
Outreach	5 (1)	$ 25.67	$ 79.06

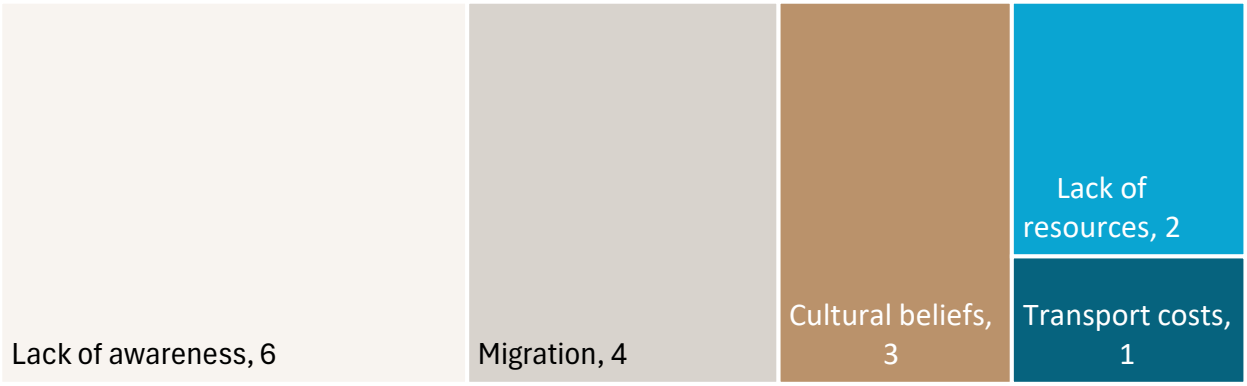
*For 7 facilities in Dutse LGA which reported data on number of zero-dose children reached

Drivers of zero-dose prevalence

Additional outreach sessions were cost-efficient in reaching beneficiaries who may have been missed by the health care system. At all facilities in Jigawa, lack of awareness on the benefits of vaccination was the most commonly reported cause of zero-dose prevalence—reported by 6 out of 12 facilities as key barrier to reaching zero-dose children—followed by population migration (reported by 4 facilities) (Figure 8). The additional outreach sessions, which normally included dedicated social mobilization, appear to have been cost-efficient in reaching these populations, with an average session size of 74 children (of which 4 reached with Penta1) and a financial cost per Penta1 dose delivered through outreach of $7.57, compared to 9 children reached (of which 2 with Penta1) and a cost of $13.20 per Penta1 at facilities which did not hold additional outreach sessions. As the key barriers in these areas could be effectively addressed by

strengthening the supply of immunization services, channeling more resources to conduct additional outreach sessions proved cost-efficient.

Figure 8. Root causes of zero-dose prevalence reported by facilities in Jigawa (n of facilities)



4.2 KADUNA

Volume delivered and zero-dose children reached

In Kaduna, the average number of doses delivered through outreach—for Penta1 doses and all antigens—was higher during ZDROP implementation compared to before. At facilities which implemented ZDROP—including those where ZDROP was the only zero-dose reduction initiative, as well as those where other initiatives were concurrently implemented (Box 3)—the average number Penta1 doses delivered through outreach increased during ZDROP implementation (+156% and +106%). At facilities only implementing ZDROP, the volume delivered at facilities decreased, both for all antigens and for Penta1 doses only (respectively -12% and -19%). The increase in Penta1 doses delivered through outreach coupled with the decrease in output at facilities suggests that there may have been a displacement effect of outreach, meaning that during ZDROP implementation some children vaccinated through outreach may have previously been vaccinated at health facilities. At facilities which did not implement any zero-dose reduction initiatives, the number of Penta1 doses delivered through outreach increased to a much lesser extent (+12%) and the number of vaccine doses delivered overall decreased slightly (-7%) (Figure 9 and Figure 10).

Box 3. Summary of zero-dose reduction initiatives in Kaduna sample during study period

- 9 facilities implemented ZDROP only, 9 implemented ZDROP and other initiatives, 8 implemented only other initiatives, 5 implemented no zero-dose reduction initiatives
- ZDROP implementation began at varying time points from July 2024 onwards
- Other initiatives varied in implementation and included UNICEF integrated mobile outreach and outreach implemented by CHAN
- Incentives for caregivers were given in 11 of 31 facilities (2 of 4 LGAs)
- At ZDROP only facilities, additional outreach was held as part of ZDROP in 8 of 9 facilities
- At facilities implementing ZDROP and other initiatives facilities, additional outreach was held as part of ZDROP in 1 of 9 facilities

Figure 95. Average number of doses of all antigens delivered per month per population at facilities in Kaduna

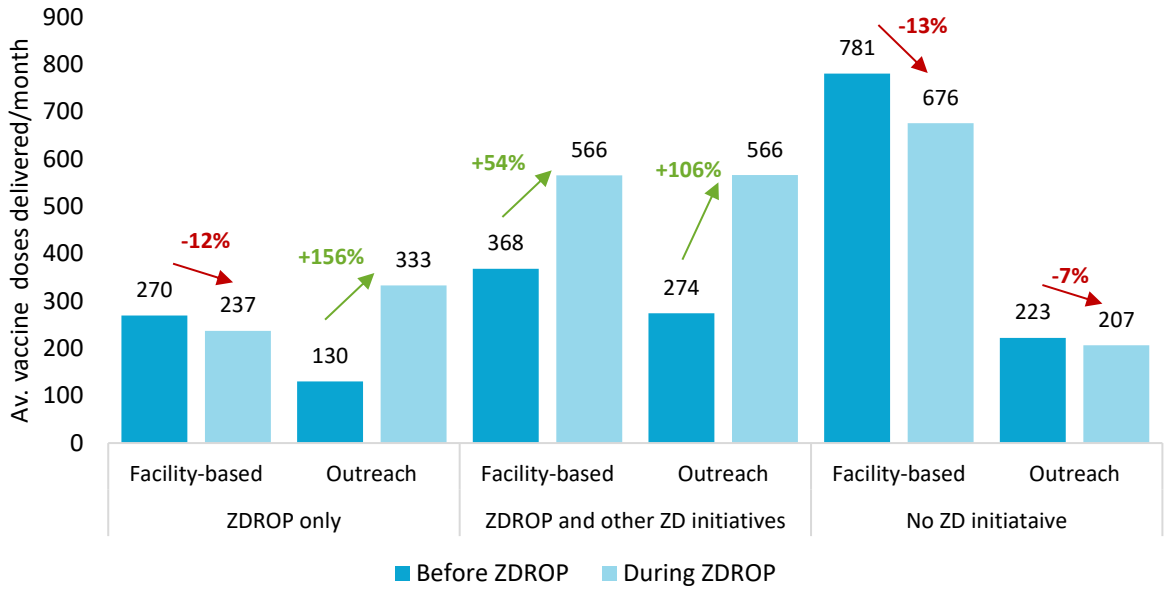
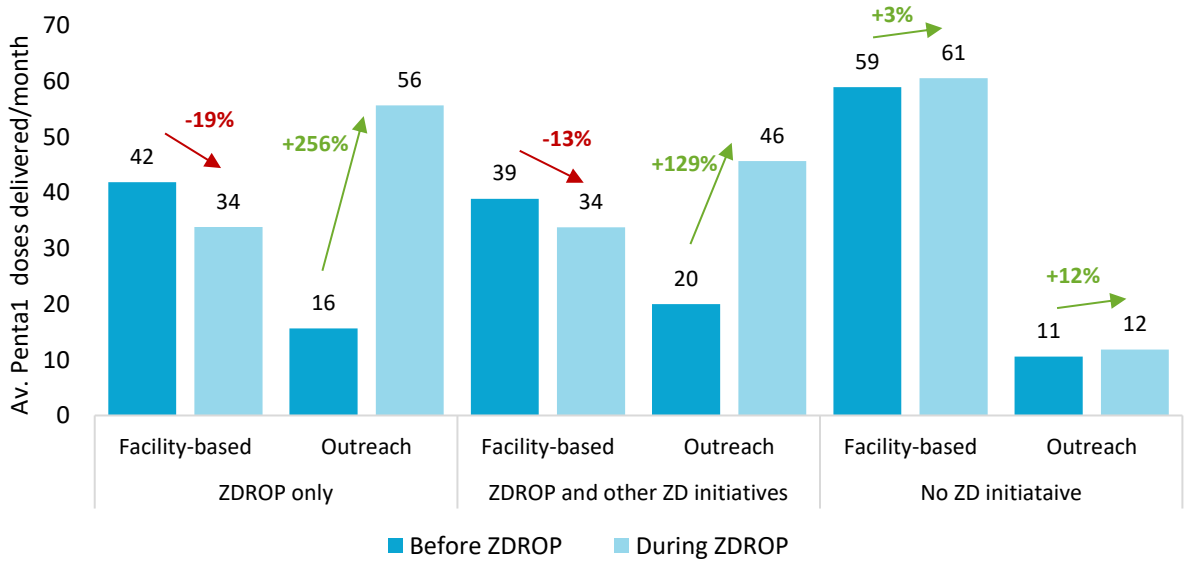


Figure 106. Average number of doses of all antigens delivered per month per population at facilities in Kaduna



Implementation of additional sessions as part of ZDROP reached an average of 18 zero-dose children per month across five facilities. Data on the number of zero-dose children reached was limited, particularly for facility-based delivery and regular outreach. At the five facilities where zero-dose data was available for additional outreach sessions held as part of ZDROP, an average of 18 zero-dose children per month were reached. At the single facility where data was available and which participated in ZDROP though did not implement additional outreach sessions, the average number of zero-dose children reached during ZDROP implementation increased from 10 to 15 per month overall (Table 8). At that facility, it can also be observed

that the percentage of zero-dose children reached as share of all Penta1 doses delivered increased slightly during ZDROP implementation.

Table 8. Average number of Penta1 doses delivered to zero-dose children, by strategy per facility per month

Strategy	Before ZDROP		During ZDROP	
	Number ZD reached	ZD reached as % of Penta1 doses delivered	Number ZD reached	ZD reached as % of Penta1 doses delivered
Facility-based (n=1)	6	17%	8	21%
Regular outreach (n=1)	4	9%	7	13%
Additional ZDROP outreach (n=5)	Not applicable		18	8%

Cost per immunization session

The average financial cost per outreach session was almost double at ZDROP-only facilities ($17.50) compared to facilities with no zero-dose reduction initiatives ($10.20), with the overall economic cost also higher at $43.76 vs. $34.77 per session (Figure 11). At all sites, outreach sessions incurred higher financial costs than facility-based delivery due to the cost of transportation and incentives for health workers. At ZDROP facilities, outreach was far more costly per session compared to non-ZDROP facilities, primarily due to the higher incentives provided to health workers as part of ZDROP. At facilities which also implemented other zero-dose initiatives, either in addition to ZDROP or not, the financial cost per outreach session was even higher, ranging from$19.41 to $31.55.

Figure 11. Average cost per facility-based immunization session in Kaduna (facility level cost, US$ 2024)

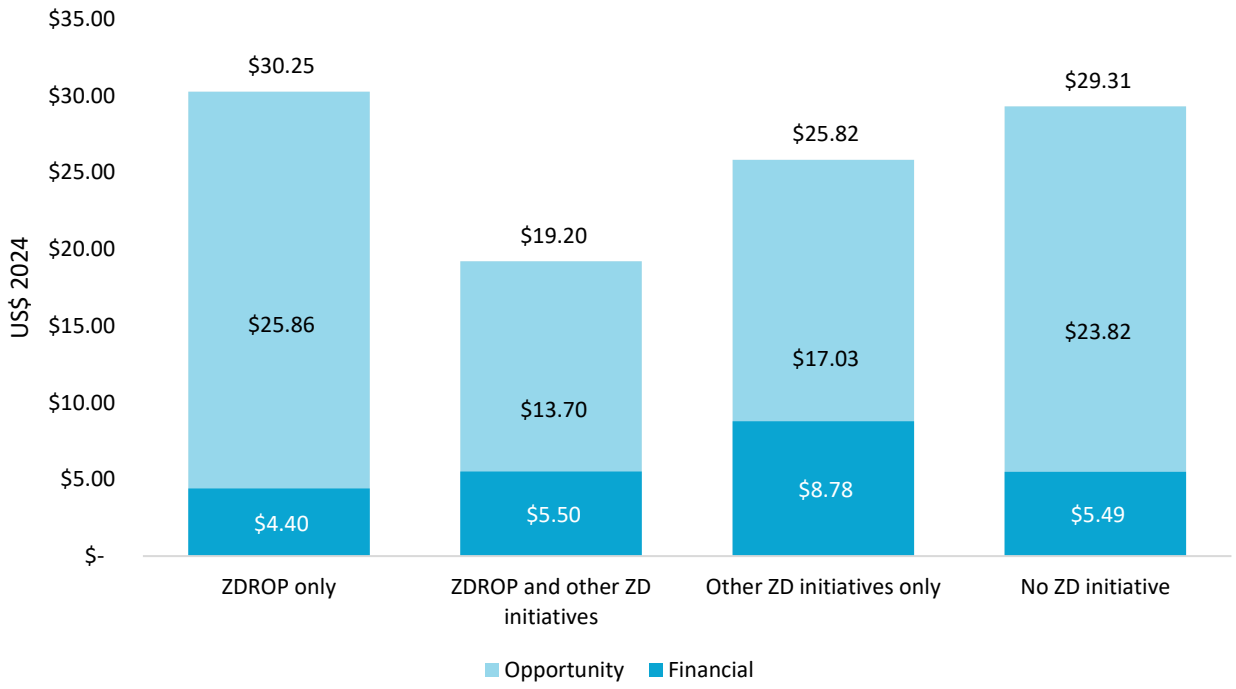
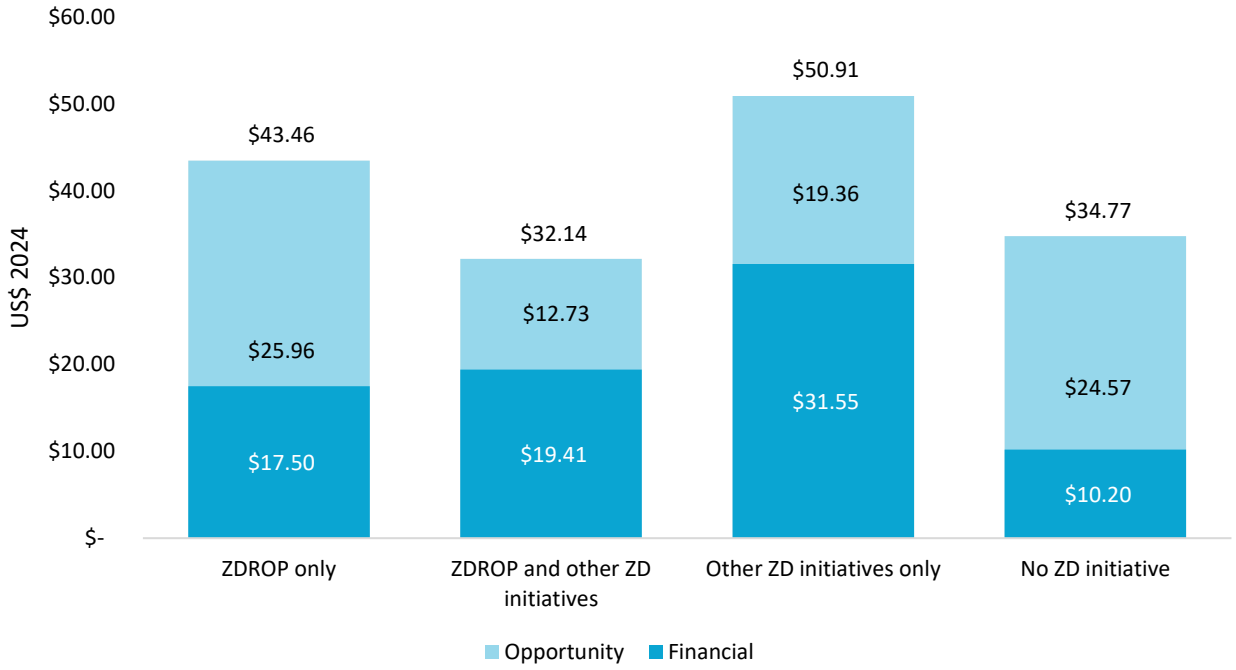


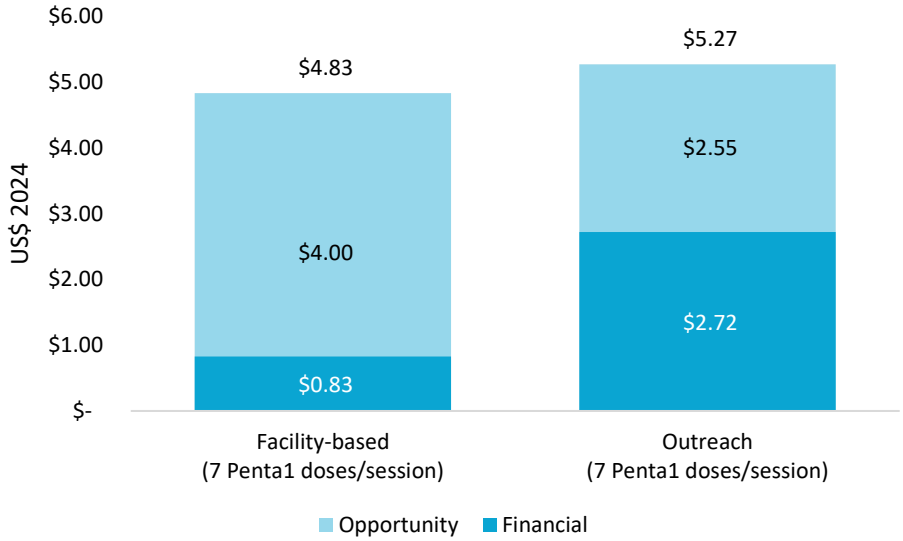
Figure 12. Average cost per outreach immunization session in Kaduna (facility level cost, US$ 2024)



Cost per Penta 1 dose delivered

In Kaduna, the financial cost of delivering a dose of Penta1 vaccine through outreach in sampled facilities was $2.72 and the economic cost per dose was $5.27 (Figure 13). The financial cost of delivering a Penta1 vaccine dose at sampled facilities in Kaduna varied from $0.83 through facility-based delivery to $2.72 through outreach. When incorporating the opportunity cost of labor and use of existing resources, the economic cost per Penta1 dose delivered was $4.83 for facility-based delivery and $5.27 through outreach.

Figure 13. Cost per Penta1 dose delivered in at facilities in Kaduna (facility level cost, US$ 2024)



The financial cost per Penta 1 dose delivered in Kaduna through outreach was lower at facilities implementing either ZDROP only or other zero-dose reduction initiatives only. At facilities which were implementing ZDROP, the financial cost per Penta1 dose delivered was $0.69 for facility-based delivery, compared to $2.47 for outreach, while at facilities implementing both ZDROP and other zero-dose reduction initiatives only, this was higher at $0.81 for facility-based delivery and $3.69 for outreach (Figure 14 and Figure 15). At facilities which were not part of any zero-dose reduction initiatives, and which delivered the lowest number of Penta1 doses per month and per session, the financial unit cost was highest at $4.69 (Figure 15). The opportunity cost was also highest for outreach at facilities which were not part of any zero-dose reduction initiative ($9.92 per Penta1 dose) compared to those that were, as team sizes were slightly larger despite fewer doses being delivered.

Figure 14. Average cost per dose per Penta1 dose administered through facility-based delivery in Kaduna (facility level cost, US$ 2024)

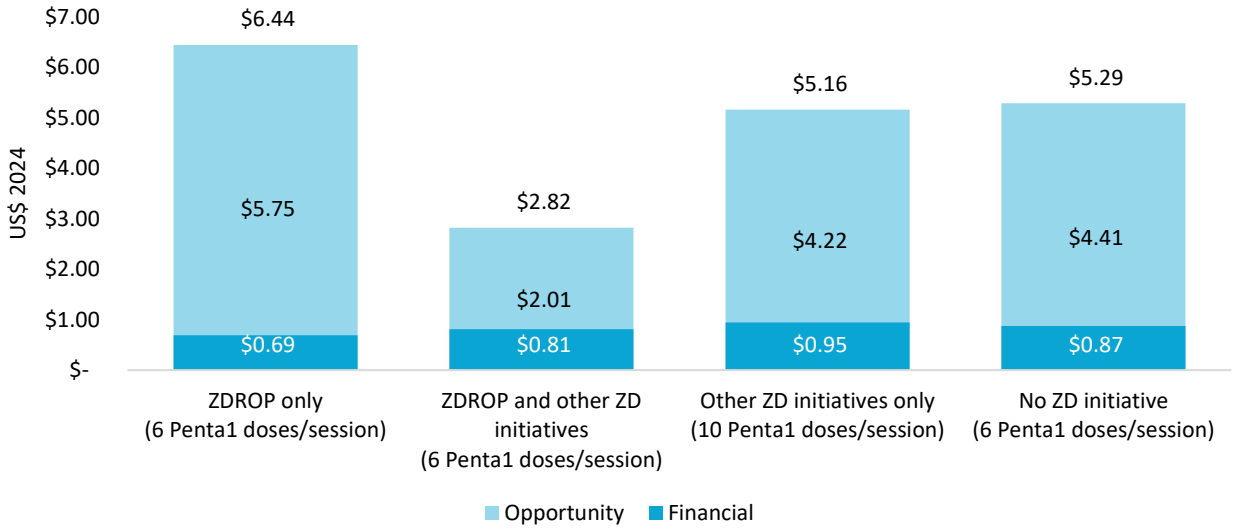
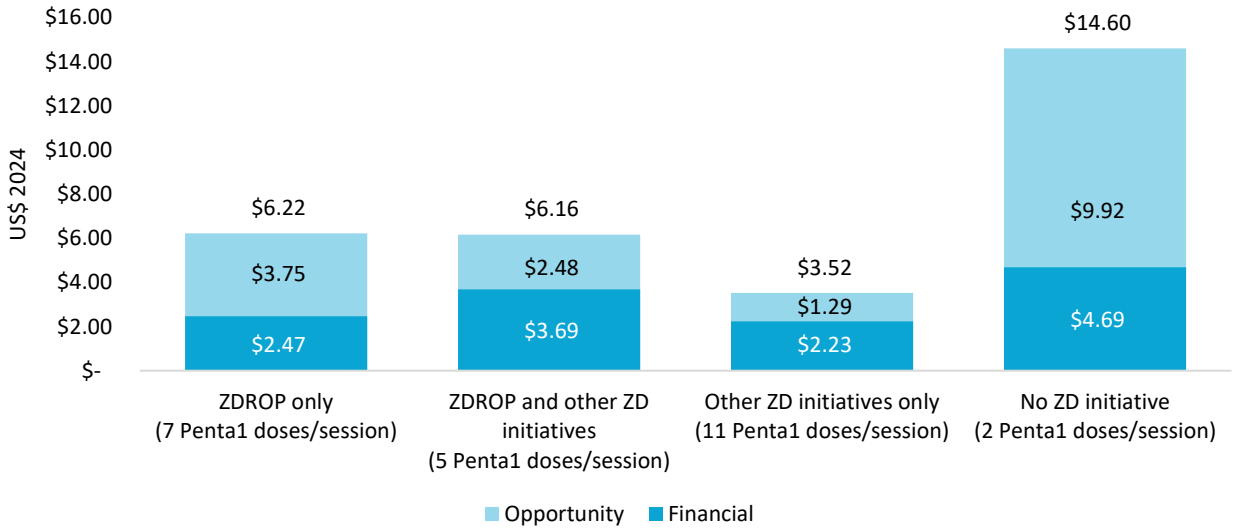
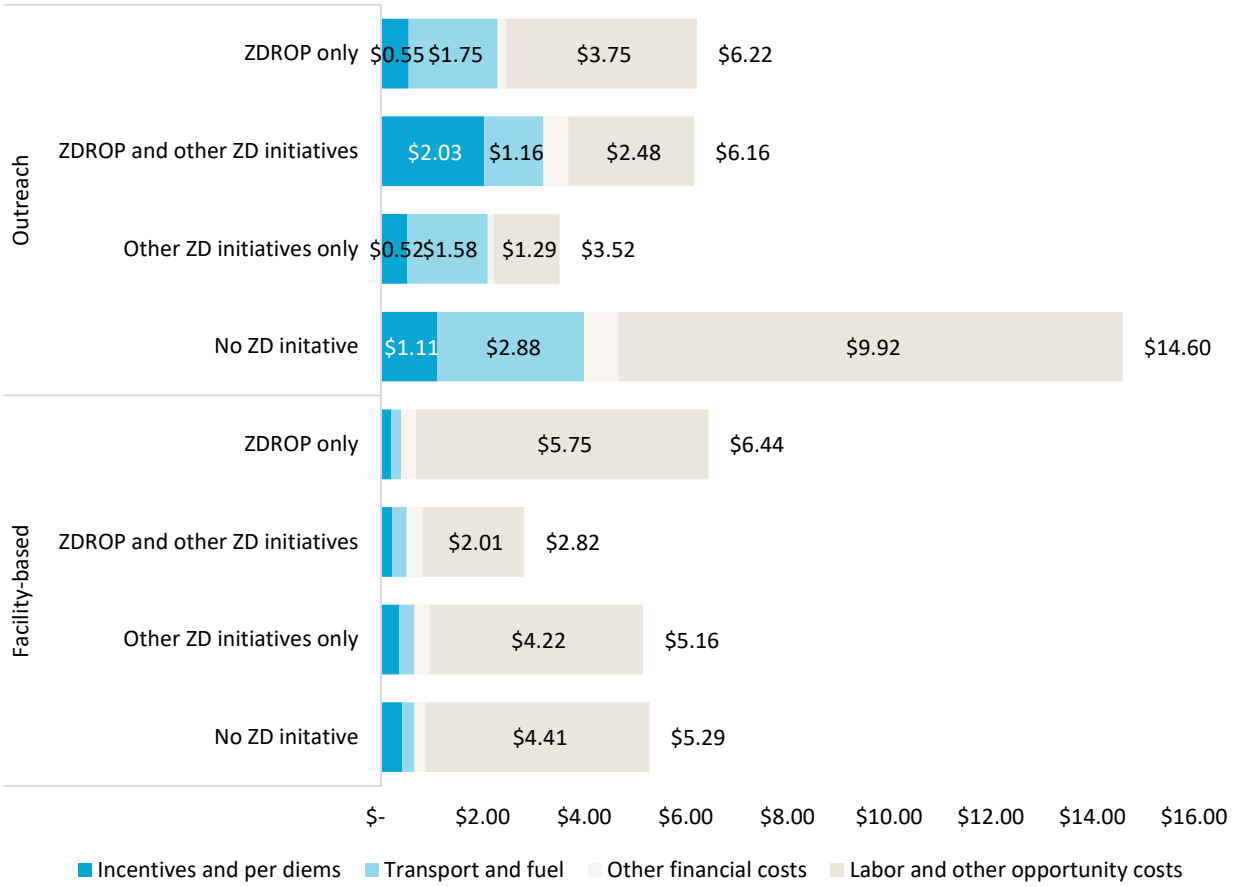


Figure 15. Average cost per dose per Penta1 dose administered through outreach delivery in Kaduna (facility level cost, US$ 2024)



Labor was the largest cost driver across facility-based and outreach delivery in Kaduna, with transport, incentives and per diems driving financial costs. Paid and volunteer labor accounted for the majority of the economic cost per dose across strategies in Kaduna (Figure 16). Transport costs were the largest financial cost driver for outreach, except at facilities which implemented both ZDROP and other ZD reduction initiatives, where health workers received per diems and additional incentives.

Figure 167. Average cost per Penta1 dose delivered, at facilities in Kaduna by resource type (facility level cost, US$ 2024)



Cost per zero-dose child reached

The financial cost of reaching a zero-dose child through outreach was lower at facilities that implemented additional ZDROP sessions, with a higher number of children reached through ZDROP outreach per month and per session (Table 9). There was a paucity of data on the number of zero-dose children reached. One facility in which ZDROP funds were used to provide incentives for health workers for existing outreach immunization sessions—rather than to implement additional outreach session—had a financial cost of $0.47 and $7.40 for reaching a zero-dose child at the facility and through outreach respectively. When including opportunity costs, the economic cost was estimated at $3.61 per child reached at the facility and $11.89 per child reached through outreach. Of the 5 facilities which implemented ZDROP outreach sessions and provided the number of zero-dose children reached, the average financial cost of reaching a zero-dose child was $4.28 and the economic cost was $11.52.

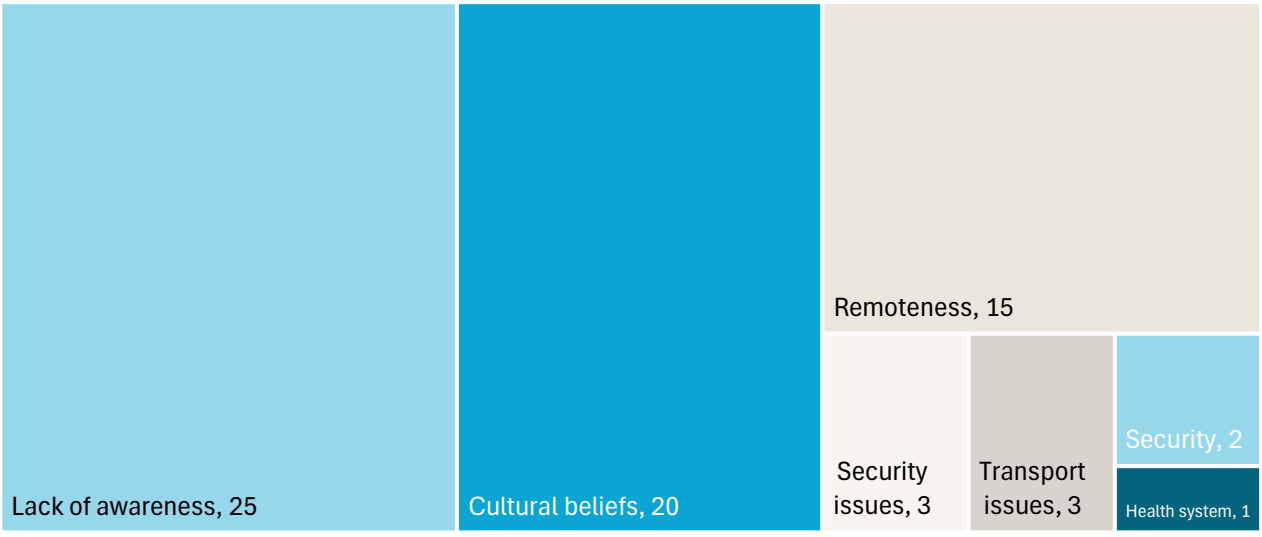
Table 6. Cost per zero-dose child reached at ZDROP facilities in Kaduna

	ZD children reached per month (per session)	Financial cost	Economic cost
Facility-based (n=1)	7 (2)	$ 0.47	$ 3.61
Regular outreach (n=1)	8 (2)	$ 7.40	$ 11.89
Additional ZDROP outreach (n=5)	18 (5)	$ 4.28	$ 11.52

Drivers of zero-dose prevalence

In Kaduna, ZDROP and other zero-dose initiatives reached more children, though implementing multiple zero-dose-focused initiatives had diminishing returns in terms of children reached and cost-efficiency. A lack of awareness of the benefits of immunization (reported by 25 facilities out of 31), issues with the distance (15 facilities) and transport to facilities (3 facilities) were major root causes of zero-dose prevalence at sampled sites in Kaduna. (Figure 17). The increased number of outreach sessions and social mobilization held as part of ZDROP were successful in reaching more children, as the average number of Penta1 doses delivered per month across all strategies increased at ZDROP facilities from 58 to 67 while they dropped slightly from 71 to 68 over the same period at non ZDROP facilities .When looking at whether implementing additional initiatives at the same facilities led to a greater effect, we see that at facilities which only implemented ZDROP, 56 Penta1 doses were delivered per month through outreach at a financial unit cost of $2.47 compared to 46 doses per month at a cost per dose of $3.69 at facilities implementing ZDROP in addition to other initiatives. While these differences may not be statistically significant, they suggests that implementing multiple zero-dose reduction initiatives at the same facility may not be as cost-efficient as focusing on one, if all initiatives are only addressing supply-side barriers. In Kaduna state, demand-side barriers such as hesitancy due to cultural beliefs are also prominent (reported by 20 out of 31 facilities) and were not adequately addressed by these initiatives which all focused on strengthening immunization service delivery.

Figure 17. Root causes of zero-dose prevalence reported by facilities in Kaduna (n)



4.3 LAGOS

Volume delivered and zero-dose children reached

In Lagos, the average volume delivered through outreach increased much more significantly during ZDROP implementation at ZDROP facilities compared to non-ZDROP facilities. Across all facilities, the number of doses delivered of all antigens and the number of Penta1 doses delivered decreased during ZDROP implementation. While for all antigens the decrease was slightly larger at ZDROP facilities (-16% compared to -14% at non-ZDROP facilities), for Penta1 the decrease was larger at non-ZDROP facilities (-18% compared to -7% at ZDROP facilities) (Figure 18 and Figure 19). The volume of doses delivered through outreach increased at both ZDROP and non-ZDROP facilities during ZDROP implementation, though to a greater extent at ZDROP facilities (+159% compared to +93% for all antigens, and +195% compared to +110% for Penta1 doses).

Box 4. Summary of zero-dose reduction initiatives in Lagos during study period

- 9 facilities implemented ZDROP, 5 did not implement any zero-dose reduction activity
- ZDROP implemented from July 2024 to February 2025
- Among ZDROP facilities, 8 facilities implemented additional outreach sessions, 1 did not
- No incentives for caregivers at any facilities

Figure 188. Average number of doses of all antigens delivered per month per population at facilities in Lagos

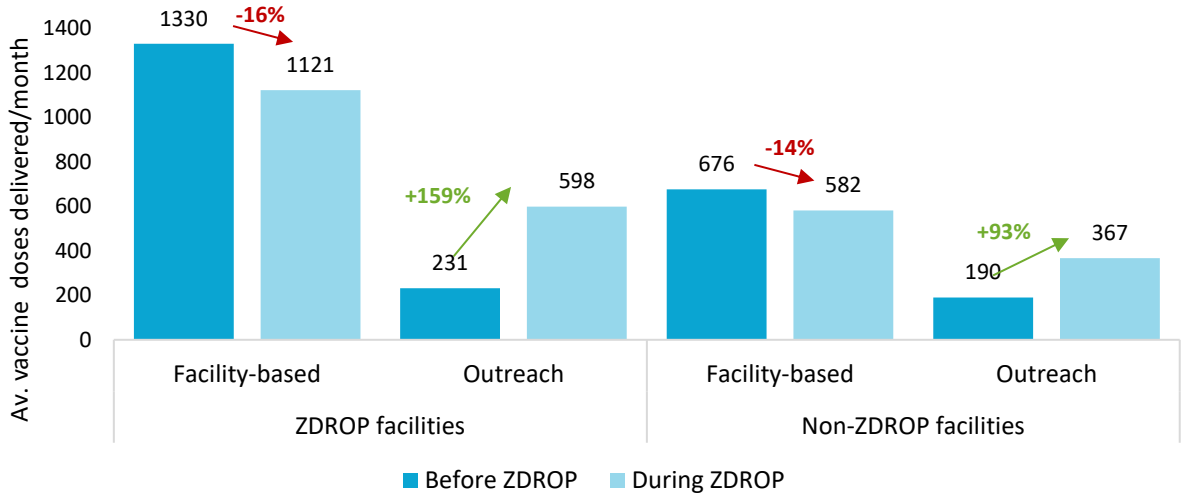
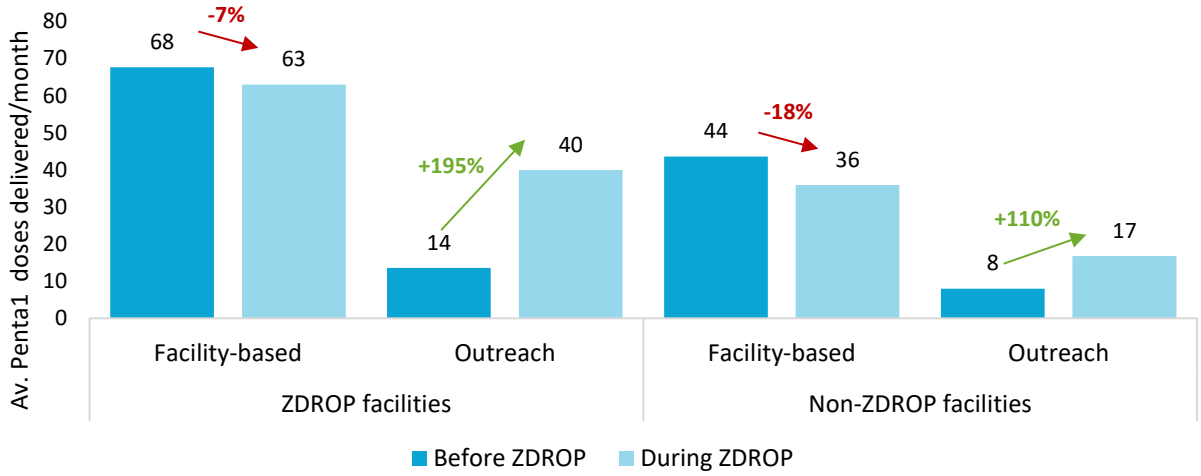


Figure 199. Average number of Penta1 doses delivered per month per population at facilities in Lagos



At facilities where additional ZDROP outreach sessions were implemented, an average of 23 zero-dose children per month were reached (Table 10). While data was not available for the number of zero-dose children reached prior to ZDROP implementation, at the two facilities which provided data only for ZDROP outreach sessions, an average of 23 zero-dose children per month were reached during ZDROP. At another facility which was not participating in ZDROP, an average of two zero-dose children per month were reached through facility-based delivery, and six through regular outreach.

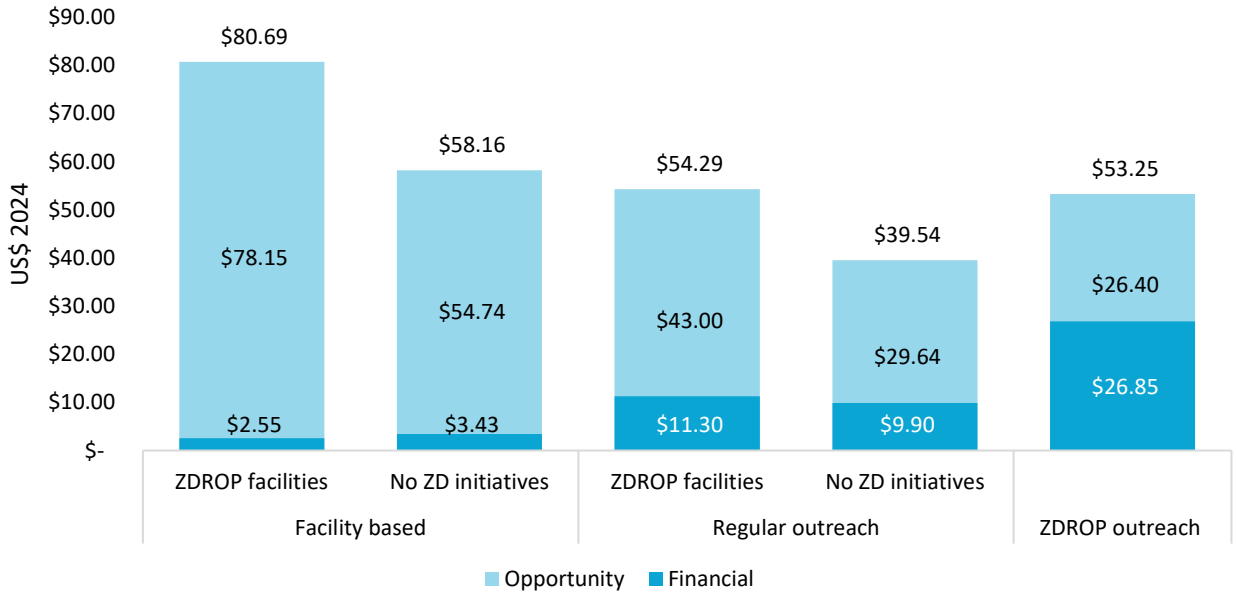
Table 7. Average number of Penta1 doses delivered to zero-dose children by strategy per facility per month

Strategy	Before ZDROP		During ZDROP	
	Number ZD reached	ZD reached as % of Penta1 doses delivered	Number ZD reached	ZD reached as % of Penta1 doses delivered
Facility-based (n=1)	Not available		2	4%
Regular outreach (n=1)	Not available		6	65%
Additional ZDROP outreach (n=2)	Not applicable		23	94%

Cost per immunization session

The average financial cost for additional outreach sessions conducted as part of ZDROP was $26.85, while regular outreach sessions cost $11.30 at ZDROP facilities and $9.90 at non-ZDROP facilities (Figure 20). ZDROP sessions incurred an average opportunity cost of $26.40 and overall economic cost of $53.25. The financial cost was substantially higher than for regular outreach, largely due to incentives provided for all additional ZDROP sessions, while incentives were only provided for regular outreach at four facilities, one of which implemented ZDROP. Transport costs were generally similar for ZDROP sessions compared to regular outreach, though they were slightly higher on average at the facilities which implemented ZDROP.

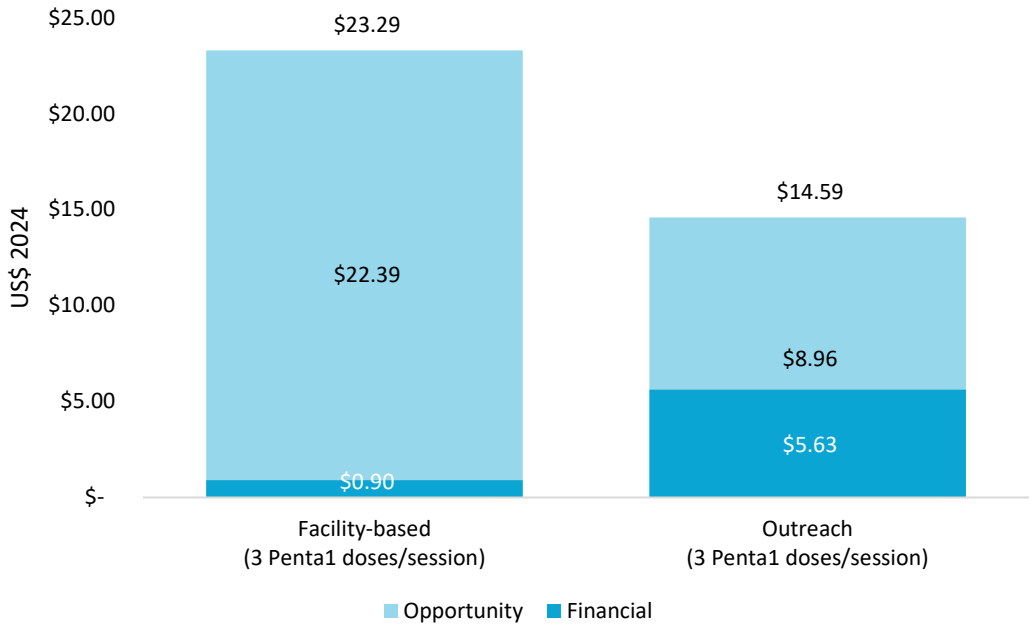
Figure 20. Average cost per immunization session in Lagos (facility level cost, US$ 2024)



Cost per Penta1 dose delivered

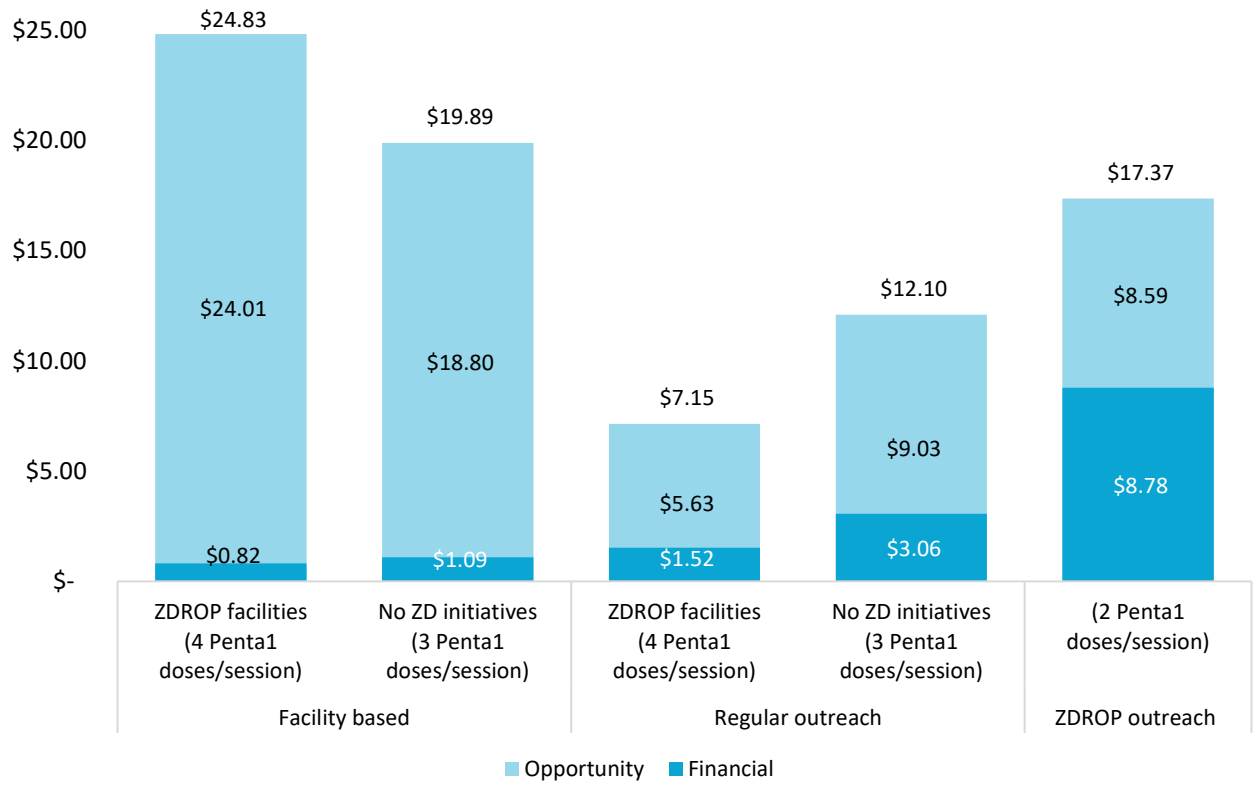
At sampled facilities in Lagos, the financial cost of delivering a dose of Penta1 vaccine through outreach was $5.63, while the economic cost per dose was $14.59 (Figure 21). The financial cost of delivering a Penta1 vaccine dose at sampled facilities in Lagos varied from $0.90 through facility-based delivery to $5.63 through outreach. When incorporating the opportunity cost of labor and use of existing resources, the economic cost per Penta1 dose delivered was $23.29 for facility-based delivery and $14.59 through outreach.

Figure 10. Cost per Penta1 dose delivered at facilities in Lagos (facility level cost, US$ 2024)



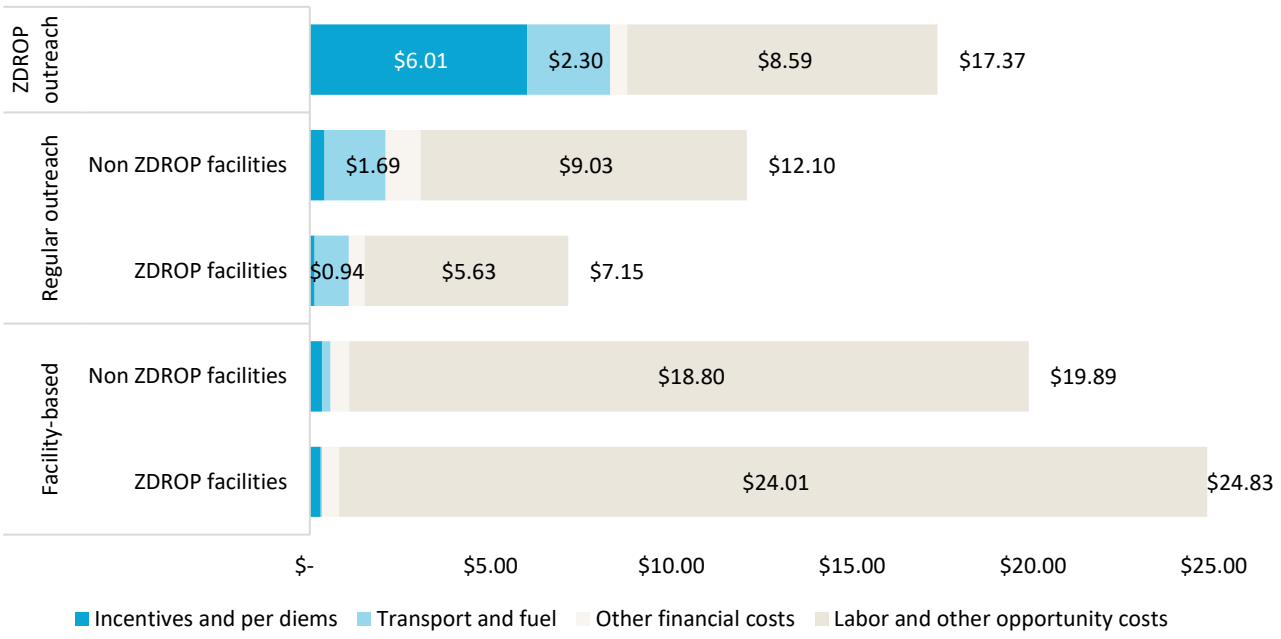
In Lagos, the financial cost per Penta1 dose delivered was much higher for additional ZDROP outreach sessions, compared to regular outreach at both ZDROP and non-ZDROP facilities, due the higher cost per session and a lower delivery volume. The financial cost per Penta1 dose delivered at ZDROP facilities in Lagos was $1.52 through regular outreach sessions and $8.78 for additional ZDROP sessions (Figure 13). Comparatively, regular outreach at facilities which were not part of ZDROP cost $3.06 per Penta1 dose delivered. On average, facilities which were part of ZDROP conducted two additional ZDROP outreach sessions per week as well as one regular outreach session per week. While the ZDROP sessions were costlier, they did not result in a higher output compared to regular sessions, with an average of 68 doses per session (of which 4 penta1 doses) being delivered through regular outreach compared to 39 per session (2 Penta1 doses) through ZDROP outreach (Figure 22). The financial unit cost of delivery was lowest through facility-based delivery though the opportunity cost was far higher than for outreach due to the large number of personnel involved in immunization at some facilities.

Figure 22. Average cost per dose per Penta1 dose delivered in Lagos (facility level cost, US$ 2024)



Labor was the largest cost across facility-based and outreach delivery in Lagos, with transport being the largest financial cost driver for regular outreach, and additional health worker incentives for additional ZDROP outreach sessions. Paid and volunteer labor accounted for the majority of the economic cost per dose across strategies in Lagos, particularly for facility-based delivery which had high staff numbers (Figure 23). Transport costs were the largest financial cost driver for regular outreach at both ZDROP and non-ZDROP facilities. Additional incentives provided to health workers were the key financial cost driver for ZDROP outreach sessions, accounting for 68% of financial costs.

Figure 2311. Average cost per Penta1 dose delivered, at facilities in Lagos by resource type (facility level cost, US$ 2024)



Cost per zero-dose child reached

The financial cost of reaching a zero-dose child through additional ZDROP outreach sessions was $12.22 compared to $7.90 through regular outreach at a non-ZDROP facility. An average of 23 zero-dose children were reached through additional ZDROP outreach sessions at two facilities, at a financial cost of $12.22 and economic cost of $25.26 per child (Table 11). At a non-ZDROP facility, the financial cost of reaching a zero-dose child through outreach was $7.90 and the economic cost was $21.49. The financial cost per zero-dose child reached at this facility was $22.45 and due to a large number of personnel working on facility-based immunization sessions and the very small number of zero-dose children reached, the economic cost was $367.09 per child.

Table 8. Cost per zero-dose child reached in Lagos (facility level cost, US$ 2024)

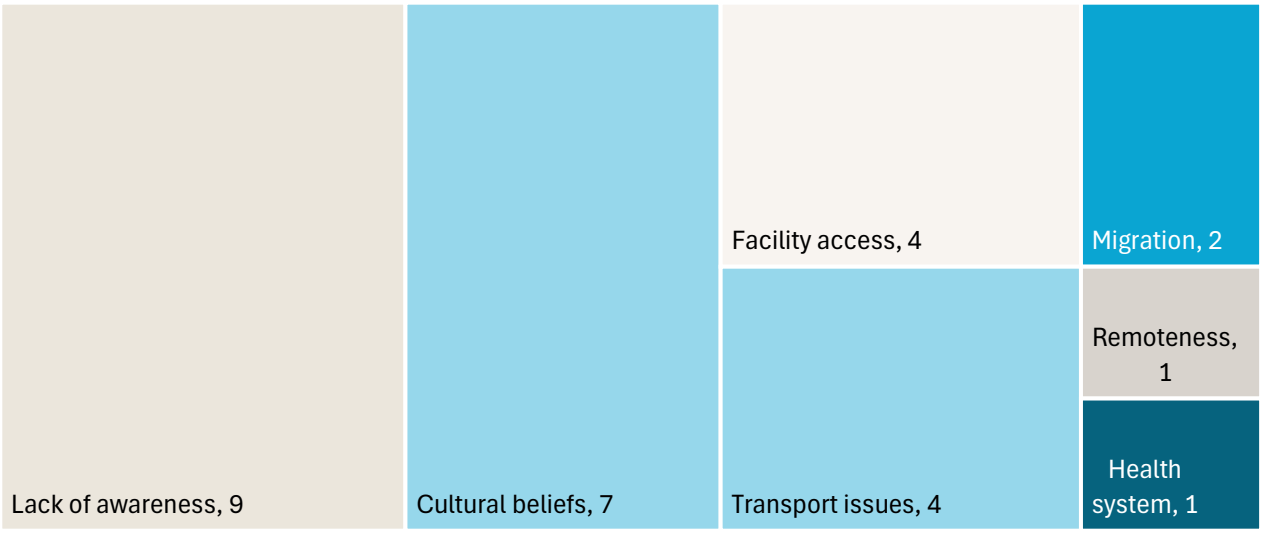
		ZD children reached per month (per session)	Financial cost	Economic cost
Non ZDROP (n=1)	Facility-based	2 (<1)	$ 22.45	$ 367.09
	Regular outreach	6 (2)	$ 7.90	$ 21.49
ZDROP (n=2)	ZDROP outreach	23 (3)	$ 12.22	$ 25.26

Drivers of zero-dose prevalence

Additional ZDROP outreach sessions were less cost-efficient than regular outreach sessions, potentially indicating higher costs of reaching zero-dose children in lower prevalence settings and the limitations of strengthening service delivery in settings where demand-side barriers are also prominent. With an average financial cost per session of $26.85, running additional ZDROP outreach sessions, which targeted zero-dose children in particular, was more costly compared to conducting regular outreach, which cost

$9.90 at non-ZDROP facilities and $11.30 at ZDROP facilities. While the very limited data on zero-dose children reached showed that ZDROP sessions reached more zero-dose children—an average of 3 per sessions vs. 2 at regular outreach sessions—ZDROP outreach was still more costly on a per zero-dose child reached basis, with a financial cost of $12.22 vs. $7.90 for regular outreach. We also found that while a lack of awareness on the benefits of vaccination was the most prominent barrier to getting zero-dose children vaccinated (mentioned at 9 facilities out of 14 in the sample), hesitancy due to cultural beliefs was also a key driver of zero-dose prevalence across facilities in Lagos (reported at 7 facilities), both at facilities those which participated in ZDROP and those that did not (Figure 24). Therefore, the higher cost of ZDROP outreach in Lagos is partly due to the higher resources required for vaccinating zero-dose children in a lower zero-dose prevalence setting. The two sampled LGAs for this state had some of the lowest prevalence among all zero-dose priority LGAs in the country, and the limited data available shows that additional ZDROP outreach was highly targeted and effective at reaching the unreached (with 94% of Penta1 doses delivered to zero-dose children, compared to 64% for regular outreach at ZDROP facilities). As zero-dose prevalence decreases, only the hardest-to-reach children remained unreached, and vaccinating them requires increasingly more resources. Moreover, our qualitative findings suggest that the cost-efficiency of additional ZDROP sessions in Lagos was likely limited by the prominence of demand-side drivers of zero-dose prevalence, which were not addressed by ZDROP's extension of service delivery.

Figure 24. Root causes of zero-dose prevalence reported by facilities in Lagos (n)



5. KEY TAKEAWAYS

This study examined the cost of reaching zero-dose children in Jigawa, Kaduna and Lagos states through facility-based and outreach delivery for routine immunization at facilities that were part of the ZDROP initiative. We assessed how delivery volumes changed when ZDROP was implemented, assessed the cost of ZDROP implementation, and compared the cost-efficiency of different delivery strategies and zero-dose reduction initiatives in different settings. From our findings, the following key takeaways have emerged:

- **ZDROP facilities reached more children with Penta1 as well as with other antigens, particularly through outreach.** During ZDROP implementation, the number of children reached with Penta1 doses, as well as with any antigen, was higher at ZDROP facilities compared to those facilities which were not part of ZDROP, particularly for outreach delivery. This was true both in settings where caregivers received financial incentives for immunization and where they did not.
- **Increasing outreach delivery proved cost-efficient in settings where drivers of zero-dose prevalence can effectively be tackled by strengthening service delivery**. Operating additional outreach sessions in Jigawa state achieved cost-efficiencies through the increased number of children reached, despite the additional financial expenditures on a per session basis. In Jigawa, lack of awareness on the benefits of vaccination was reported to be a key driver of zero-dose prevalence among sampled sites. The additional outreach conducted as part of ZDROP in this state—which normally was accompanied by additional social mobilization—seemed to effectively tackle the main root causes of zero-dose prevalence, leading to higher volume delivered and lower unit costs, indicating that extending service delivery in this context proved cost-efficient.
- **When multiple initiatives tackle the same drivers of zero-dose prevalence while failing to address other key barriers to immunization, diminishing returns are observed.** Implementing ZDROP in addition to another zero-dose reduction initiative concurrently, as was seen in Kaduna, may not be cost-efficient if different root causes of zero-dose prevalence are not addressed. In Kaduna, while supply-side determinants of zero-dose prevalence were predominant, some demand-side barriers—like vaccine hesitancy due to cultural beliefs—were also reported. However, where multiple zero-dose initiatives were implemented, they all focused on strengthening or extending service delivery. As a result, while all facilities implementing some zero-dose reduction intervention reached more children through outreach than those that did not, those that only implemented ZDROP or other initiative reached more children at a lower financial unit cost.
- **Reaching zero-dose children in lower prevalence settings likely requires more resources.** In Lagos, where zero-dose prevalence was considerably lower than in the other states, the limited data available on the number of zero-dose children suggests that additional ZDROP sessions—which were targeted to zero-dose children—were effective at reaching the unreached, with the great majority of Penta1 doses at those additional sessions being delivered to zero-dose children. However, these sessions were more costly on to run both per session and per Penta1 dose delivered, indicating the higher resource requirements of reaching the hardest-to-reach.
- **Only investing in strengthening service delivery may not be cost-efficient in settings where zero-dose prevalence is lower and demand-side barriers are prominent.** Despite being better resourced and targeted towards zero-dose children, dedicated ZDROP outreach sessions in Lagos reached more zero-dose children per session but at a much higher unit cost. This likely indicates the higher resource requirement for reaching the hardest-to-reach in a setting with lower zero-dose prevalence, but may also suggest the need for better tailoring of interventions to address the root cause of zero dose prevalence in these areas.

- **What is cost-efficient in one setting may not be in another.** The root causes of zero-dose prevalence varied across states and settings. Tailoring strategies to address the key drivers of zero-dose prevalence increases cost-efficiency as it enables interventions to reach more children, thereby bringing the costs per child reached down.

6. ANNEXES

ANNEX 1. COST ACTIVITIES

Table A1. Definitions of cost activities included in the study

Cost activity	Definition
Microplanning and program management	Time and resources spent on planning, budgeting, managing the immunization program at various levels. This may include the cost of time and resources spent on forecasting vaccine needs and microplanning. Costs will include attendance at immunization-related meetings.
Vaccine collection, distribution and storage	Time and resources spent collecting vaccines and other commodities at distribution points and distributing vaccines down to facilities and to the outreach sites.
Cold chain maintenance	Time and resources spent maintaining the cold chain.
Training	Time and resources spent attending and/or providing immunization-related training. Training costs include the cost of venue, per diem for participants, cost of trainers, and reproduction of training materials.
Social mobilization and advocacy	Social mobilization includes holding community meetings, printing flyers and educational materials, conducting events, other sensitization of the community. Includes any time and resources spent mobilizing the community and households, and advocating for vaccination (value of time, per diem, cost of materials, etc.). This could include the cost of media advertisements.
Supervision	Time and resources spent by staff on supervising subordinate or peer health or community workers for outreach delivery.
Service delivery: facility-based	Time and resources spent on waiting for beneficiaries and the act of administering vaccination to children within the facility during an immunization session
Service delivery: outreach sites	Time and resources spent on traveling to and from a place, waiting for beneficiaries and the act of administering vaccination to children through outreach delivery (all immunization sessions outside the facility, including mobile if relevant)
Waste management	Time and resources spent on disposing used vials/bottles, sharps and infectious non-sharp wastes.
AEFI management	Time and resources spent following-up post-vaccination events that may occur during immunization.
Record-keeping, HMIS, monitoring and evaluation	Time and resources spent on data entry and analysis, including maintaining stock registers, maintaining records of children vaccinated, completing reports and analysing, monitoring, and evaluating immunization program data.

ANNEX 2. RESOURCE TYPES

Table A2. Definitions of resource types included in the study

Resource types	Description	Financial vs. opportunity cost
Recurrent resource types		
Paid labor	Share of the salary paid to health workers and government employees proportional to the time they spent working on activities related to the intervention	Opportunity cost
	Salary paid to temporary workers, contractual workers, or new employees hired specifically for the delivery strategy	Financial cost
Volunteer labor	Value of volunteer labor (community health volunteers, voluntary social mobilizers) who do not receive a regular salary.	Opportunity cost
Workshops & meetings	Food, beverages, and meals provided to regular and volunteer staff.	Financial cost
Strategy incentives	Incentives provided to health workers for immunization sessions	Financial cost
Per diem and allowances	Daily allowances and/or subsidies and travel allowances paid to regular employees and volunteers for participation in activities related to immunization	Financial cost
Transport and fuel	Fuel costs specifically for activities that required travelling (supervision, trainings, vaccine distribution, etc.)	Financial cost
Cold chain equipment repairs and energy costs	Routine and non-routine cold chain maintenance/repairs done during the study period	Financial cost
	Electricity bill for the cold chain	Financial cost
Communication	Costs incurred for internet and cellular data used by paid or volunteer staff.	Financial cost
IEC and other printing costs	The cost of printing tally sheets, registers, social materials and other information, education and communication (IEC) materials for the immunization program.	Financial cost
Stationery and other supplies	Cost of stationery purchased for the immunization program.	Financial cost
Other recurrent costs	Cost of equipment rental and fuel for burn pits.	Financial cost
Capital items		

Resource types	Description	Financial vs. opportunity cost
Cold chain equipment	Depreciation costs of existing cold chain equipment used for the delivery strategy	Opportunity cost
Vehicles	Depreciation costs of existing vehicle(s) used for the delivery strategy (trainings, supervision, vaccine collection/distribution) at study sites.	Opportunity cost
Other equipment	Depreciation costs of existing equipment items used for the delivery strategy	Opportunity cost

ANNEX 3. IMPUTATION METHODS FOR MISSING DATA

Table A3. Imputation methods for missing data

Data gap	Imputation method
Missing cost data on printing costs	Average at other facilities in the same ward inputted
Cold chain storage costs missing due to facilities not having their own refrigerators	Cold chain storage costs at facilities which stored vaccines for other facilities allocated based on average monthly vaccine volume delivered
General social mobilization sessions carried out rather than strategy specific	Costs divided equally over strategies used at facility
Transport costs for supervision missing	Inputted in line with general transport costs for immunization sessions

ANNEX 4. OVERVIEW OF FINDINGS

Table A4. Summary of volume delivered and costs in Jigawa

		Facility-based		Outreach	
		Add. outreach	No add. outreach	Add. outreach	No add. outreach
Av. sessions/month		4	4	9	6
Av. Doses/month		350	165	536	50
Av. Penta1 doses/month		16	27	31	9
Av. Doses/session		77	41	74	9
Av. Penta1 doses/session		3	7	4	2
% Penta1 doses/session		4%	17%	5%	78%
Av. ZD child/session*		n.a.	3	n.a.	1
Cost per month	Economic	$201.34	$211.73	$584.77	$361.40
	Financial	$45.35	$53.07	$234.91	$117.35
Cost per session	Economic	$50.34	$52.93	$78.14	$62.08
	Financial	$11.34	$13.27	$38.62	$21.51
Cost per Penta1	Economic	$12.68	$7.93	$18.84	$40.64
	Financial	$2.86	$1.99	$7.57	$13.20
Cost per ZD child*	Economic	n.a.	$16.51	n.a.	$79.06
	Financial	n.a.	$4.14	n.a.	$25.67

*For 7 facilities in Dutse LGA which reported data on number of zero-dose children reached

Table A5. Summary of volume delivered and costs in Kaduna

		Facility-based delivery				Outreach			
		ZDROP	ZDROP + other ZD initiatives	Other ZD initiatives	No ZD initiatives	ZDROP	ZDROP + other ZD initiatives	Other ZD initiatives	No ZD initiatives
Av. sessions/month		7	7	7	10	8	8	8	6
Av. doses/month		237	566	358	742	333	566	631	89
Av. Penta1 /month		34	34	72	61	56	46	88	12
Av. doses/session		43	71	83	67	49	66	83	15
Av. Penta1/session		6	6	10	6	7	5	11	2
% Penta1 session		14%	9%	12%	8%	15%	8%	13%	16%
Av. ZD child/session*		2	-	-	-	2	-	-	-
Cost per month	Economic	$241.69	$124.12	$223.39	$320.02	$346.07	$281.71	$348.69	$172.53
	Financial	$25.89	$35.77	$40.94	$52.94	$137.38	$168.55	$221.05	$55.37
Cost per session	Economic	$30.25	$19.20	$25.82	$29.31	$43.46	$32.14	$50.91	$34.77
	Financial	$4.40	$5.50	$8.78	$5.49	$17.50	$19.41	$31.55	$10.20
	Economic	$6.44	$2.82	$5.16	$5.29	$6.22	$6.16	$3.52	$14.60

Cost per Penta1	**Financial**	$0.69	$0.81	$0.95	$0.87	$2.47	$3.69	$2.23	$4.69
Cost per ZD child*	**Economic**	$3.61	-	-	-	$11.89	-	-	-
	Financial	$0.47	-	-	-	$7.40	-	-	-

* For 1 ZDROP facility

Table A6. Summary of volume delivered and costs in Lagos

		Facility-based delivery		**Regular outreach delivery**		**Additional ZDROP outreach**
		ZDROP facilities	**Non-ZDROP facilities**	**ZDROP facilities**	**Non-ZDROP facilities**	**ZDROP facilities**
Av. sessions/month		18	13	4	4	8
Av. doses/month		1,121	582	273	367	325
Av. Penta1 /month		63	36	21	17	19
Av. doses/session		57	45	68	74	39
Av. Penta1/session		4	3	4	3	2
% Penta1 session		7%	6%	6%	4%	6%
Av. ZD child/session*		-	<1	-	2	3
Cost per month	**Economic**	$1,530.32	$738.37	$217.17	$158.15	$426.01
	Financial	$47.62	$38.69	$45.18	$39.58	$214.79
Cost per session	**Economic**	$80.69	$58.16	$54.29	$39.54	$53.25
	Financial	$2.55	$3.43	$11.30	$9.90	$26.85
Cost per Penta1	**Economic**	$24.83	$19.89	$7.15	$12.10	$17.37
	Financial	$0.82	$1.09	$1.52	$3.06	$8.78
Cost per ZD child*	**Economic**	$367.09	-	-	$21.49	$25.26
	Financial	$22.45	-	-	$7.90	$12.22

* For 1 non-ZDROP facility and 2 facilities operating ZDROP outreach

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