ROUND THREE - DECENTRALIZED IMMUNIZATION MONITORING BASELINE FROM FOUR STATES: BAUCHI, BORNO, KANO AND SOKOTO, NIGERIA

BY
ZERO DOSE LEARNING HUB (ZDLH)
NIGERIA

Gavi The Vaccine Alliance
AFENET African Field Epidemiology Network A healthier Africa
AFRICA HEALTH BUDGET NETWORK
JSI

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LIST OF ABBREVIATIONS

Abbreviation	Meaning
AFP	Acute Flaccid Paralysis
AFENET	African Field Epidemiology Network
ANC	Antenatal Care
BeSD	Behavioural and Social Drivers (of Immunization)
BMGF	Bill & Melinda Gates Foundation
COVID-19	Coronavirus Disease 2019
DHIS2	District Health Information Software, Version 2
DIM	Decentralized Immunization Monitoring
DPT / DTP	Diphtheria, Pertussis (Whooping Cough), and Tetanus Vaccine
EOC	Emergency Operations Centre
FGD	Focus Group Discussion
FMoH & SW	Federal Ministry of Health and Social Welfare
Gavi	Global Alliance for Vaccines and Immunization
GF	Global Fund
HCW	Health Care Worker
HepB0	Hepatitis B Birth Dose Vaccine
HFs	Health Facilities
IA2030	Immunization Agenda 2030
IDSR	Integrated Disease Surveillance and Response
IPV	Inactivated Poliovirus Vaccine
KAP	Knowledge, Attitude and Practice
LGA	Local Government Area
LMIC	Low- and Middle-Income Country
LQAS	Lot Quality Assurance Sampling

LIST OF ABBREVIATIONS

Abbreviation	Meaning
MCV1 / MCV2	Measles-Containing Vaccine (First / Second Dose)
NDHS	Nigeria Demographic and Health Survey
NPHCDA	National Primary Health Care Development Agency
NPSIA	Non-Polio Supplementary Immunization Activity
NTDs	Neglected Tropical Diseases
OPV	Oral Poliovirus Vaccine
PATH	Program for Appropriate Technology in Health
PCV	Pneumococcal Conjugate Vaccine
PCCS	Post-Campaign Coverage Survey
PHC	Primary Health Care
POC	Point-of-Care (Testing)
RRL	Rapid Responder Laboratory
RI	Routine Immunization
SBC	Social and Behaviour Change
SDG	Sustainable Development Goal
SIA	Supplementary Immunization Activity
SMC	Seasonal Malaria Chemoprevention
SPHCDA / SPHCB	State Primary Health Care Development Agency / Board
TBA	Traditional Birth Attendant
UNICEF	United Nations Children's Fund
WHA	World Health Assembly
WHO	World Health Organization
WHS	Ward Health System
ZD	Zero-Dose (Children who have not received first dose of Penta 1)

EXECUTIVE SUMMARY

The Round three (3) assessment of the Decentralized Immunization Monitoring (DIM) initiative demonstrates substantial progress in strengthening routine immunization (RI) performance across the eight Learning Hub LGAs in Bauchi, Borno, Kano, and Sokoto States. Building upon the findings of Rounds 1 and 2, the results confirm that the implementation of targeted micro-planning, community engagement, and data-use interventions is translating into measurable gains in immunization coverage and equity.

Coverage improvements were observed for key antigens such as DTP1–3, IPV1/2, PCV1–3, and MCV1, indicating better access and service continuity at the primary health care level. However, challenges persist in the uptake of birth-dose vaccines (HepB0 and OPV0), reflecting the ongoing gap in early post-natal service linkage, particularly among non-facility births. Dropout rates across multi-dose series (especially DTP and PCV) suggest that consistency in session delivery, defaulter tracking, and caregiver engagement remain critical to achieving full series completion.

The data reveal persistent inequities, with urban LGAs outperforming rural and security-challenged areas. Factors such as distance, insecurity, and socio-economic disadvantage continue to hinder equitable access. Multivariable analysis identified rural residence, low maternal education, lack of antenatal care, home deliveries, and lower household wealth as key determinants of zero-dose and under-immunized status. These findings underscore the need for integrated service delivery models that link immunization with maternal and child health services and reduce non-financial barriers to access.

Behavioral and Social Drivers (BeSD) data highlight that caregiver confidence, trust in health workers, and perceived service quality are major determinants of vaccination decisions. Interpersonal communication, positive family norms, and respectful service delivery emerged as critical enablers of vaccine uptake. Conversely, low intention to vaccinate and the need for male or spousal permission constrained decision-making in several settings, reinforcing the importance of tailored social and behavior change interventions.

From an operational standpoint, the LQAS-based DIM approach continues to prove effective in providing timely, actionable data. The reduction in failed lots between rounds confirms that local decision-making based on real-time evidence is improving campaign precision and resource targeting. The incidental detection of suspected AFP and pertussis cases through DIM processes further illustrates its added value in strengthening integrated disease surveillance.

Round 3 results affirm that decentralized monitoring is an effective strategy for improving immunization coverage, strengthening accountability, and enhancing equity in access. Sustaining progress will require embedding DIM within state-level review mechanisms, institutionalizing quarterly follow-up, addressing persistent birth-dose and dropout gaps, and intensifying behaviorally informed demand generation efforts. These actions align with Nigeria's National Immunization Recovery Plan, the Immunization Agenda 2030 (IA2030), and Gavi's equity acceleration framework, ensuring that no child is left behind in the journey toward universal immunization coverage.

BACKGROUND

Despite considerable progress globally and regionally in strengthening immunization system, Nigeria continues to significant systemic and operational challenges that hinders equitable coverage and sustained performance (1). Persistent geographic inequalities, weak health system infrastructures and sub-optimal human resources, including high staff turnover remain critical supply side challenges faced by RI programs. Demand barriers such as low caregiver awareness, socioeconomical and sociocultural resistance, misinformation and disinformation contribute significantly to the sub-optimal uptake of vaccine in Nigeria. Additionally, fragmented data systems, weak technical skills for evidence generation and data-driven decision-making limits timely response to performance gaps.

In 2023, the country aligned with the global momentum on immunization equity (1) and launched the National Immunization Recovery Plan focused on reaching children who missed vaccination during COVID 19 pandemic focused reaching 1,589,315 Zero dose children (1) across 100 prioritized Local Government Areas (LGAs) in 18 states. Other innovative strategies include implementation of Big-catchup in selected LGAs, development of a targeted Zero dose reduction plan, implementation of the Identify, Enumerate and vaccinate (IEV) and optimized outreach services (OOS) in targeted geographics targeting 30% reduction in zero-dose children by 2026 and 50% by 2028.

To generate localized evidence that supports these national goals, track progress and enables targeted interventions, the Decentralized Immunization Monitoring Approach funded by Gavi through the Zero Dose Learning Hub Nigeria (2) was piloted in Kumbotso Local Government Area of Kano State and scaled up to seven additional LGAs namely Sumaila – Kano, Maiduguri and Jere – Borno State, Bauchi and Ganjuwa in Bauchi State and Tambuwal and Wamakko – Sokoto State. The community-based survey attempts to complement existing tracking systems by NPHCDA by estimating RI performance and immunization coverage. Findings from the scale-up referred to as Round 1 established a localized RI baseline and identified some operational, behavioral, and structural barriers to immunization uptake. The survey methodology emphasizes rapid feedback loops from program managers across the level (LGA and State) to inform iterative action towards improving immunization programming.

Two (2) rounds of the community survey have been implemented with findings disseminated at the National, State and LGA levels coordination meetings and targeted audience to inform and influence different aspect of immunization programing including adoption for advocacy and sensitization activities, expansion of routine immunization health facilities on Tambuwal LGA, identification of missed settlements. In August 2025, the final round of the decentralized survey was conducted to assess the effectiveness of these interventions, track progress in coverage and service delivery, and identify persisting challenges.

This report presents the findings from Round 3, track improvement over time. It focuses on RI coverage trends, ward prioritization, and key drivers of low or improved vaccination uptake, providing evidence to guide future program adjustments and investments by government and development partners.

OBJECTIVE

The final round of the decentralized immunization monitoring survey was conducted to assess the effectiveness of interventions implemented following the Round 1 and Round 2 to generate updated evidence for strengthening routine immunization (RI) systems at the subnational level. The specific objectives were to:

1. Estimate current routine immunization coverage for key antigens at the LGA and compare findings with baseline data from Round 1
2. Assess changes in the prevalence of zero-dose children, dropout rates, and timeliness of vaccinations to determine the impact of targeted interventions
3. Identify persisting barriers and emerging facilitators to RI uptake at the household, community, and health system levels
4. Reclassify and prioritize wards based on current performance to guide operational focus and resource allocation

MATERIALS AND METHODS

The third round of the Decentralized Immunization Monitoring (DIM) adopted same methodology as the first and second rounds. The community-based survey adopted an independent cross-sectional design across all wards in the Learning Hub LGAs using Lot Quality Assurance Sampling (LQAS) to measure vaccination coverage, assess performance of routine immunization indicators and explore intersectoral factors affecting uptake of vaccination among caregivers of eligible children. Behavioural and Social Drivers of Vaccination (1) framework developed by the World Health Organization was adopted to understanding the uptake of vaccination among caregivers. The framework focuses on understanding the contextual drivers and facilitators of childhood vaccination across five domains (**Figure 1**).

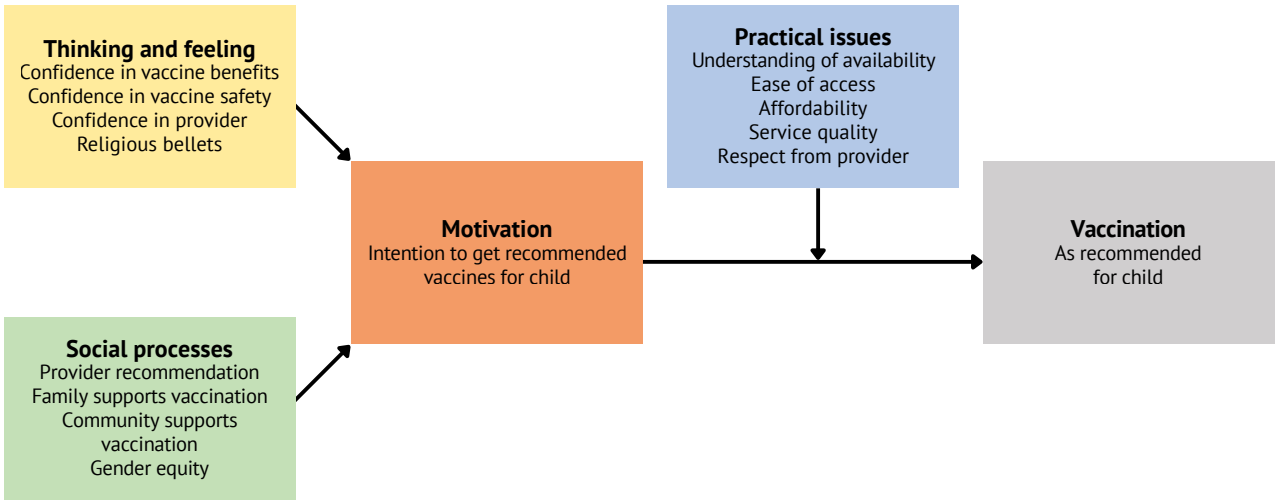


Figure 1: Behavioural and Social Drivers of Vaccination Framework

STUDY AREA/SAMPLING APPROACH

The third round was implemented in the same LGAs as Round 1 and Round 2. The states with ZDLH presence: Bauchi, Borno, Kano and Sokoto are among the 18 states with 100 prioritized LGAs with high number of zero dose children. Two LGAs with the highest number of ZD children were prioritized for the project and the study.

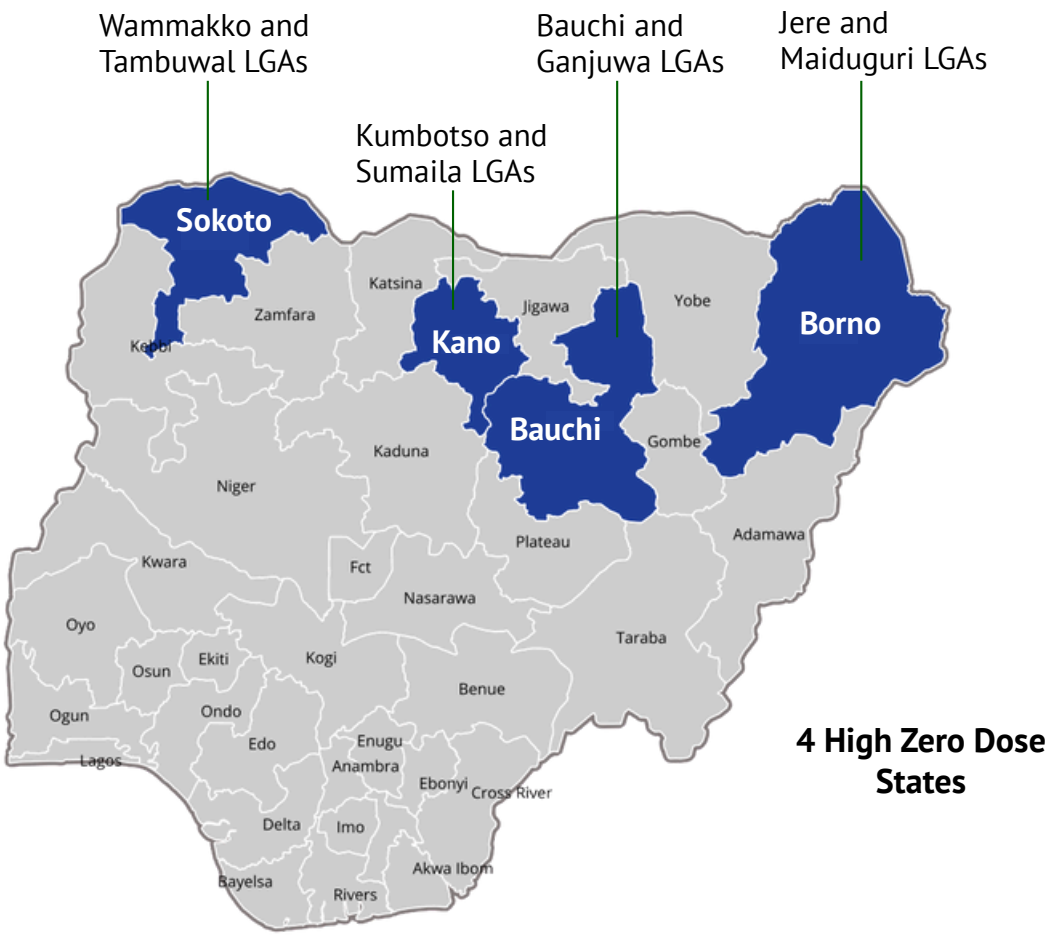


Figure 2: Map of Nigeria highlighting states of implementation

STUDY SITES

The follow-up study was implemented in selected communities in all 107 wards in the 8 LGAs across the 4 states. An additional ward – Tuba ward in Jere LGA of Borno state recently inhabited by displaced persons due to insecurity was included as against 106 in the previous rounds. Communities and households were sampled randomly independent of round 1 and 2.

STUDY POPULATION

Caregivers of children aged 4.5 to 11 months and 12-23 months were surveyed. These age groups were selected to allow comparison of the factors hindering immunization uptake. Newly relocated residents, visitors with less than three (3) months and secondary caregivers without history or evidence of vaccination were excluded (1).

HOUSEHOLD SAMPLING TECHNIQUE AND SAMPLE SIZE

A multi-staged sampling approach was employed to enhance the representativeness and reliability of the assessment, leveraging the Lot Quality Assurance Sampling (LQAS) methodology. LQAS is widely recognized for its ability to evaluate public health program performance against predefined benchmarks in specific populations (1, 2). The robust and cost-effective methodology has been adopted in health and non-health performance monitoring of different program interventions such as Malnutrition, HIV and immunization and Education and Literacy assessments (3, 4, 5, 6, 7, 8).

In the study, LGAs were designated as Catchment Areas (CAs) and Wards served as Supervision Areas (SAs). This hierarchical structure allowed for aggregation and calculation of coverage at the LGA and granular performance monitoring (pass/fail) of selected antigens against predetermined thresholds for vaccination coverage at the Ward level.

The LQAS sample included all wards across the eight selected (8) LGAs in the four (4) states, to allow for aggregation of the Ward level data for calculating a coverage at the LGA level (Table 1).

In each of the wards, a sampling frame was prepared using a collated master list of settlements with the estimated number of households submitted by the LGA management team. This sampling frame was used for the selection of 19 settlements using Population Proportionate to Estimated Size (PPES) sampling. The standardized LQAS sample size of 19 households per ward was statistically determined using the LQAS Sampling Plan Calculator (3) which allows for specificity and sensitivity of greater than 90% with alpha and beta error <10%.

In each of the 19 selected settlements, a segmentation sampling approach was employed to randomly sample each household to ensure systematic and representative data collection. The selected settlements were divided into smaller, non-overlapping segments with support of local guides using sketched maps and estimated number of households around key landmarks. To provide equal chances to each of the segments, the table of random numbers was adopted to select a segment.

Within the chosen segment, compounds were assigned number and the table of random numbers was used to select the reference and starting compound. Reference compounds in this study were not sampled to reduce bias; rather, the closest compound next to the reference compound, referred to as starting compounds, were visited for eligibility.

In each of the eligible households, one eligible caregiver (4.5-11 months or 12-23 months) was selected and interviewed. The next closest house was visited to sample caregivers of the remaining cohort (14) using principles of parallel sampling.

This process was systematically repeated at each of the selected interview locations.

Table 1: LQAS Sample by LGA (Catchment Area)

State	Learning Hub LGAs (Catchment Area)	Wards - Supervision Area	Number of settlements Per Ward	Number of cohorts (0-11 months and 12-23months)	Total sample across all Wards
Bauchi	Bauchi	20	19	2	760
	Ganjuwa	16	19	2	608
Borno	Maiduguri	14	19	2	532
	Jere	13	19	2	494
Kano	Kumbotso	11	19	2	418
	Sumaila	11	19	2	418
Sokoto	Tambuwal	11	19	2	418
	Wamako	11	19	2	418
				Total N	**4,066**

INSTRUMENT

The study adopted a standardized structured questionnaire - Behavioral and Social Drivers of Vaccination (BeSD) questionnaire. The framework explores factors contributing to low vaccination uptake as well as barriers to vaccination across four domains: thinking and feeling (cognitive and emotional drivers), social processes (social norms and influence), motivation (willingness and intentions) and lastly practical issues (access and logistics) in addition to socio-demographic characteristics, health seeking care of caregivers and vaccination history of sampled children. A Questionnaire control sheet was developed to document non-eligibility such as caregiver such as refusal to participate, vacant HHs, locked houses, and unavailability of eligible response. A data validation tool with selected variables was verified by supervisors to assess the reliability of reported data and team performance.

DATA COLLECTION AND DATA MANAGEMENT

Training: Field Research Assistant Training and deployment: From the pool of field research assistants and LGA supervisors trained in Round 1 and 2, available field researchers were re-engaged and few new field research assistants were recruited to fill identified gaps. The mandatory 2-days training was conducted focused on survey tools, data quality issues, ethical considerations in data collection practices, real-time electronic data capture procedures and strict adherence to study protocol.

Data Collection: Field data collection was conducted between April – May 2025 across the 4 states. Each team of research assistant comprised of two research assistants per ward and one supervisor overseeing three (3) wards over a period of six (6) days. The average workload of each team was 3 settlements per day (6 children). A monitoring checklist was developed for State and LGA supervisors with 2-3 average submissions per day.

Data Control and Security: All data were collected electronically on smart phones using Open Data Kit (ODK). Quality control was embedded throughout the research implementation. In each of the tools developed, skip patterns and constraints to ensure complete data. Daily data review and feedback by a Data Manager was institutionalized. All data collected was transmitted to a cloud ODK Central server.

DATA ANALYSIS

Data cleaning and analysis were conducted using Microsoft Excel and R-Studio (tidyverse and gtsummary packages version 1.7.4 and 1.3.1 respectively). Analysis incorporated surveys weights to generate population estimates with exploratory univariate, bivariate and multivariate analyses, with statistical significance set at a 95% confidence level. Demographic and behavioural characteristics were summarized using univariate analysis to better understand barriers while bivariate analysis such as chi-square, Fisher Exact test (frequencies <5) and Z test to explore associations between categorical variables. For the younger cohort (4.5–11 months), vaccination status was assessed inline with Correa et al (1), categorized late, timely and delayed vaccination. The cohort was also categorized as either No DPT or DPT1 Received for comparison with the older cohort. The older cohort (12–23 months) was also analyzed for antigen-specific coverage inline with global standardized surveys. The decision rule for the ward categorization was based on LGA coverage and the national target of 80% at 95% confidence interval and alpha and beta error of <10%.

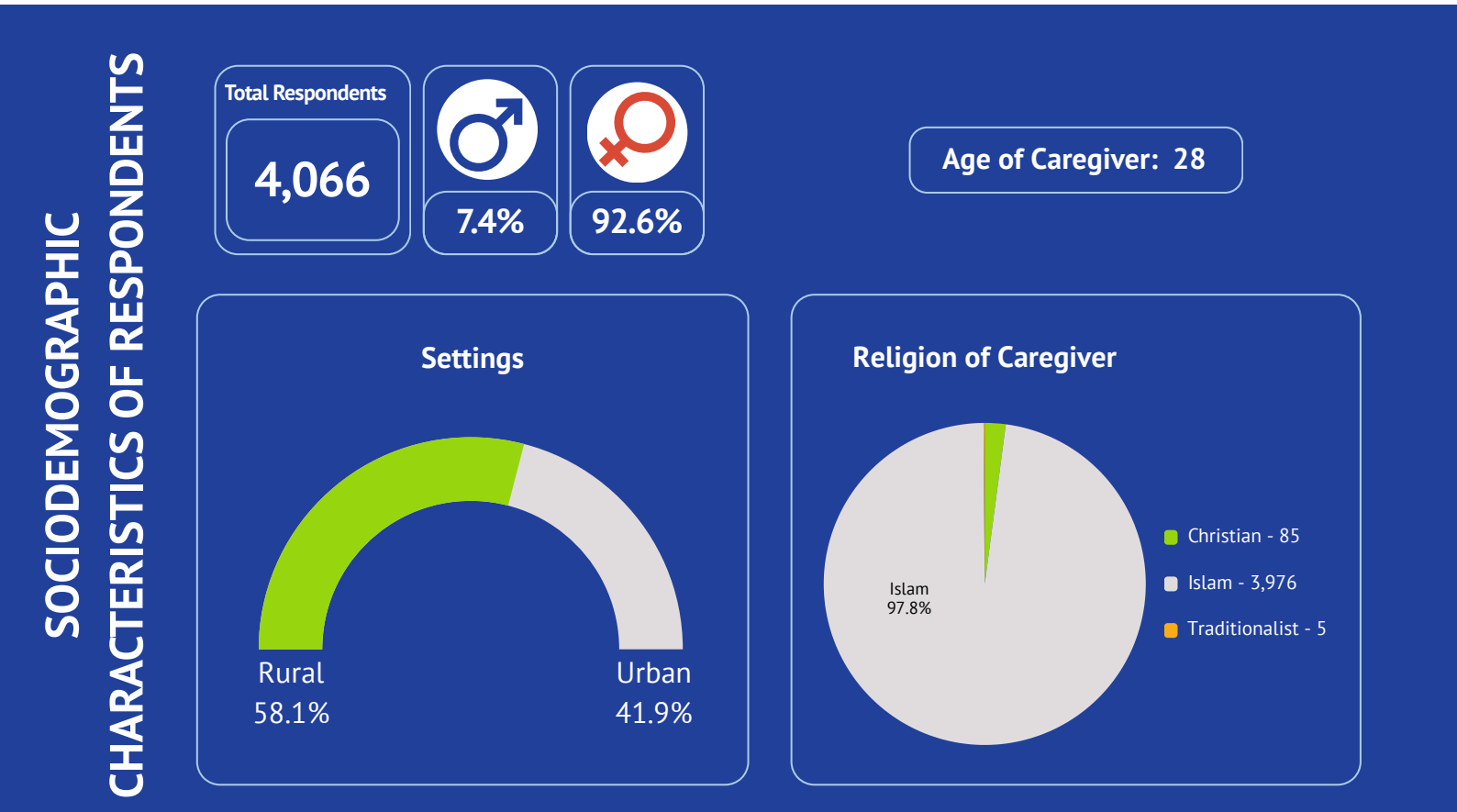
ETHICAL APPROVAL

This study received ethical approval from Nigeria's National Health Research Ethics Committee. The approval was granted under protocol number NHREC/01/01/2007-31/08/2023 and approval number NHREC/01/01/2007-11/09/202 as part of a larger research initiative implemented by the Nigeria Zero Dose Learning Hub. We obtained informed consent through culturally appropriate methods and ensured participant confidentiality through data anonymization and maintained rights to withdraw at any time without repercussion. Participation was entirely voluntary with no incentives or coercion applied to participants.

SURVEY FINDINGS

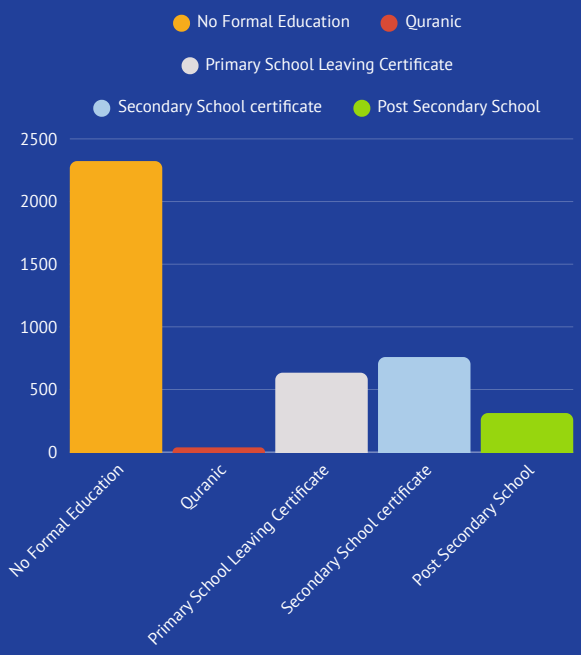
The implementation of the survey across the 8 LGAs achieved 100% coverage resulting in a total of 4,066 respondents sampled over 1500 settlements in 107 wards. A concordance score of 93.2% was reported across the 4 states following a 10 percent validation and reliability test of submitted data. Majority of the sampled caregivers were found to practice Islam 3,976 (97.8%) as their religion and slight over than half residing in rural 2,364 (58.1%) communities. The age of caregivers was found to be 28 years (+6 years) as shown below (**Table 1)**.

SOCIODEMOGRAPHIC CHARACTERISTICS OF RESPONDENTS

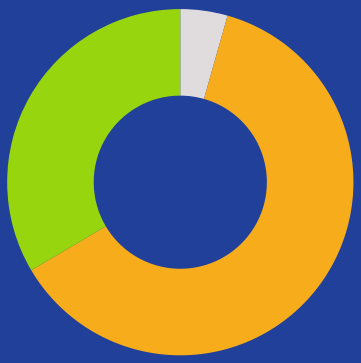


SOCIODEMOGRAPHIC CHARACTERISTICS OF RESPONDENTS

Educational Level of Caregivers



Employment Status of Caregivers



- Yes, I'm formally employed - 179
- I'm self employed - 2,525
- Not engaged and no source of income - 1,362

Wealth Index of Caregivers

Quintile 1 – Poorest	1,725	▼	42.4%
Quintile 2 – Poor	1,335	▼	32.8%
Quintile 3 – Average	522	▲	12.8%
Quintile 4 – Rich	317	▲	7.8%
Quintile 5 – Richest	167	▲	4.1%

Marital Status of Caregivers

98.1% - Married

The analysis showed that more than half (57.1%) of respondents had no formal education, one-third (33.5%) reported having no source of income, and 75.2% belonged to the poor and poorest wealth index categories based on the Nigeria Equity Assessment Tool across the study locations. These findings point to significant gaps in educational attainment and widespread economic vulnerability, which may affect access to health services and reduce motivation for health-seeking behaviors, including routine immunization.

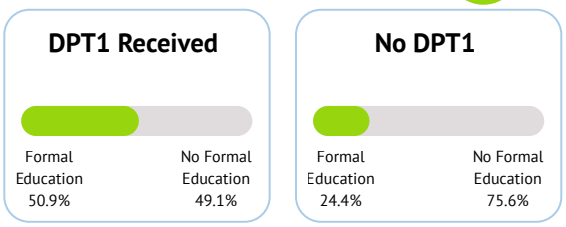
DEMOGRAPHIC AND SOCIO-ECONOMIC FACTORS AFFECTING DPT1 UPTAKE

Children sampled from both cohorts were categorized into a binary outcome variable using uptake of DPT1. Sampled children within the younger cohort who have received DPT1 and those yet to received were categorized into 'DPT1 Received' and 'No DPT' respectively while the younger cohort were categorized into 'non-zero dose' and 'Zero Dose' (ZD) children. To explore the association between demographic and socioeconomic variables with the vaccination status, adjusted odd ratio, 95% confidence interval and statistical power (p-value) of 0.05 was computed for each of the cohorts as shown below (**Table 2)**.

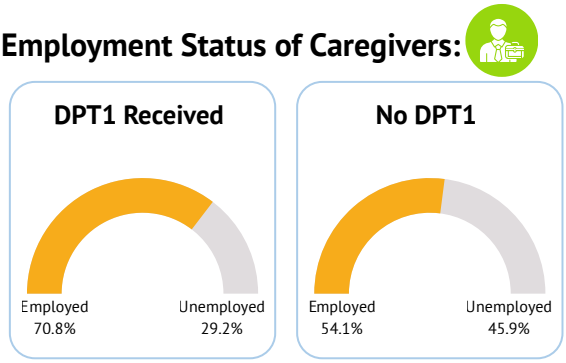
DEMOGRAPHIC CHARACTERISTICS AFFECTING VACCINE UPTAKE

4.5 - 11 Months

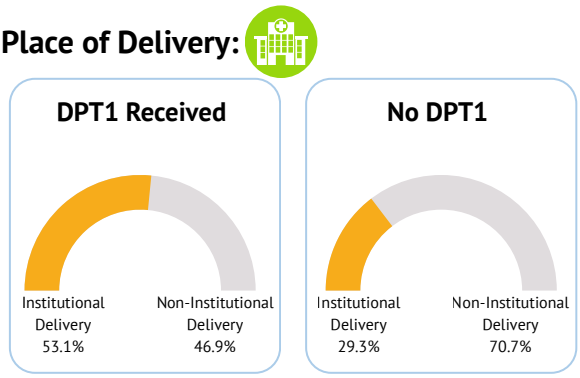
Educational Level of Caregivers:



Employment Status of Caregivers:



Place of Delivery:

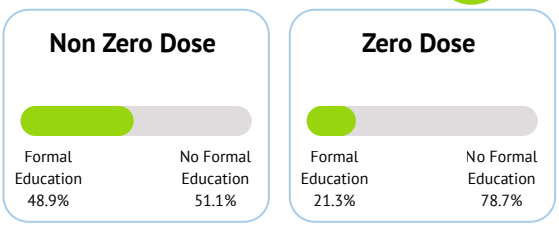


Ever attended Antenatal Services

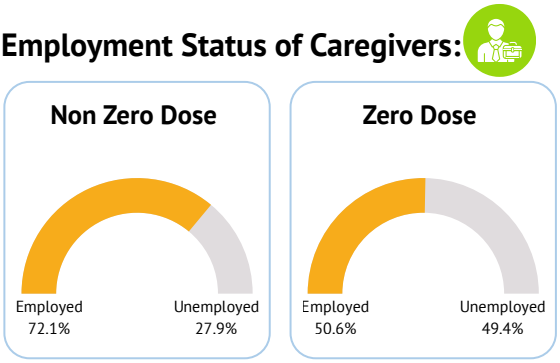
DPT1 Received: 1,375 (92.9%)
No DPT1: 312 (56.4%)

12 - 23 Months

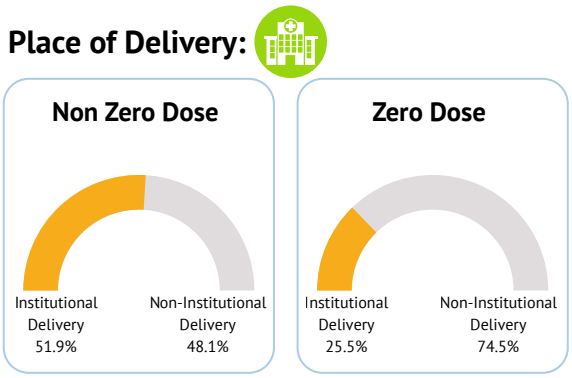
Educational Level of Caregivers:



Employment Status of Caregivers:



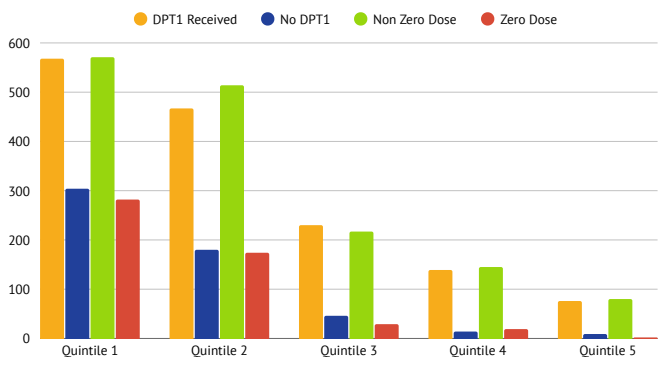
Place of Delivery:



Ever attended Antenatal Services

Non Zero Dose: 1,422 (93.1%)
Zero Dose: 264 (52.2%)

Wealth Index of Caregivers



Marital Status of Caregivers

≈98.2% - Married

The multivariable regression analysis highlights several significant sociodemographic predictors of immunization uptake. Amongst 4.5-11 months children, sampled, the likelihood of not receiving DPT1 were found to be higher among care givers residing in rural areas (AOR = 2.33, 95% CI: 1.72-3.15, p < 0.001), those without formal education (AOR = 1.88, 95% CI: 1.41-2.51, p < 0.001) and unemployed caregivers (AOR = 1.32, 95% CI: 1.04-1.68, p = 0.022). Similarly, non-institutional delivery (AOR = 1.45, 95% CI: 1.11-1.90, p = 0.006) and non-attendance of antenatal care (ANC) were strong predictors of missed DPT1 vaccination (AOR = 0.12, 95% CI: 0.09-0.17, p < 0.001). The analysis also showed that caregivers in the higher wealth index (4th and 5th) were significantly less likely to have unimmunized children compared caregivers in the poorest quintile. Similar trend was observed amongst 12 -2 3 months cohort indicating rural setting (AOR = 1.55, 95% CI: 1.14-2.10, p = 0.005), no formal education (AOR = 1.48, 95% CI: 1.10-2.01, p = 0.011), unemployment (AOR = 1.62, 95% CI: 1.26-2.07, p < 0.001), and non-institutional delivery (AOR = 1.39, 95% CI: 1.06-1.85, p = 0.02) were all significantly associated with higher odds of zero-dose status. These findings reveal that similar sociodemographic characteristics affects caregivers of both cohorts hence requiring similar targeted interventions to reduce equity challenges for health services, economic empowerment and social inclusion.

PREVALENCE OF NO DPT1 AND ZERO DOSE CHILDREN

NO DPT1 PREVALENCE

No DPT1 defined as children within 4.5 – 11 months yet to received DPT1. This category comprised of 399 (19.6%) children who had never received any dose of immunization and 154 (7.6%) who received some birth dose antigen yet to receive DPT1. Overall, the prevalence of No DPT1 was estimated at 27.2% across the 8 LGAs surveyed. Prevalence was found to be higher amongst caregivers with no antenatal visit 241 (69.6%), non-institutional delivery 391 (36.0%), no formal education 418 (36.5%) and in rural settings 372 (31.5%). Compared to previous round, a marginal decline of 5.2% was recorded against 33.1%. Across the 8 study locations, No DPT1 decline in most LGAs as shown in Figure 3 with Bauchi LGA sustaining its efforts and closely followed by Kumbotso. Marginal reductions of <=10% were observed in Ganjuwa, Jere and Maiduguri while Wamakko reported Sumaila 18.2% and 17.3% respectively between R2 and R3. Tambuwal LGA regrettably receded reporting higher prevalence in R3 (61.7%) compared to R2(50.2%)

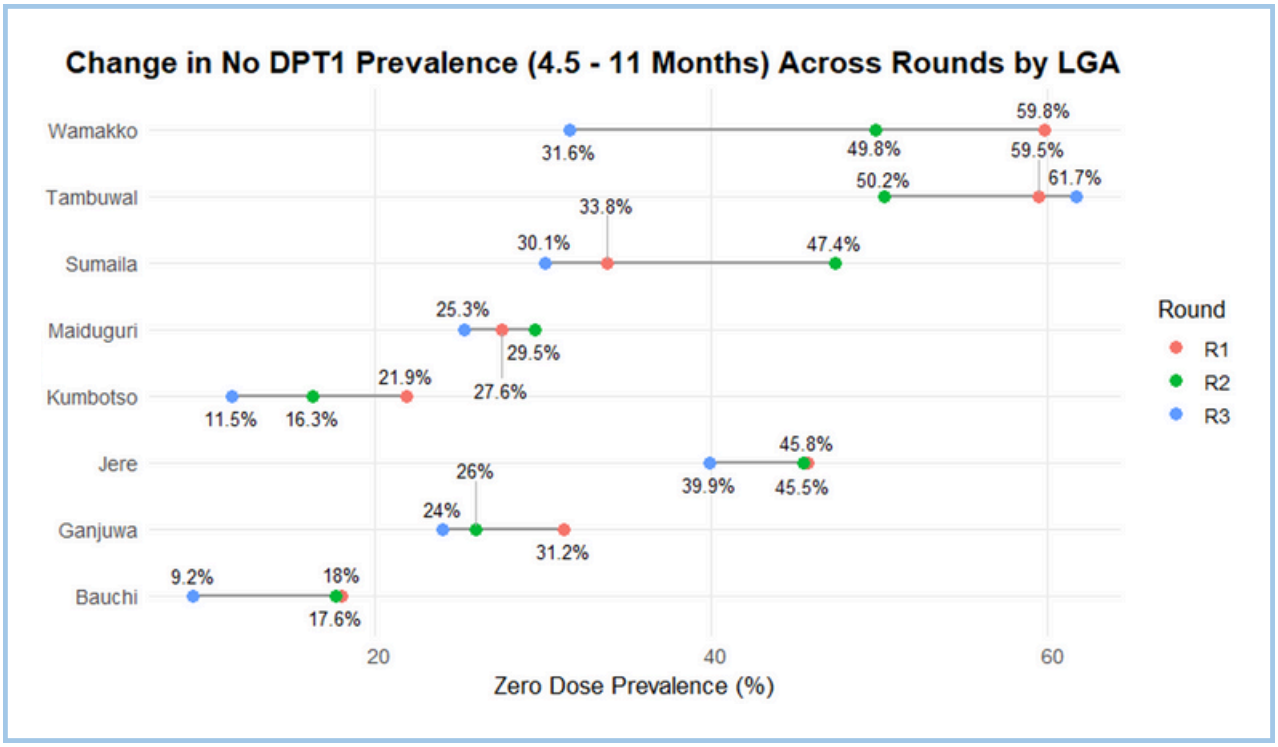


Figure 3: Trend of No DPT1 Disaggregated by LGA

PREVALENCE OF ZERO DOSE

The prevalence of Zero dose was estimated inline with the operational guideline definition using children 12 – 23 months yet to receive their first dose of DPT. From the analysis, 389 (19.1%) children were identified as 'no immunization' while 117 (5.8%) children received some or all birth dose antigen but lacked follow-up for DPT1. Cumulatively, the proportion of ZD was estimated at 24.9%, a decline of 5.0% from 29.9% reported in R2. The reduction in prevalence was found to be statistically significant with z-score of 3.57 p-value = 0.00036.

In a similar trend to No DPT1, prevalence was also found to be higher amongst non-institutional delivery (33.9%) compared to caregivers who experienced institutional delivery (13.9%), caregivers with no formal education (33.7%) compared to caregivers with formal education (12.6%), unemployed (36.9%) compared to employed (18.88%) and No antenatal attendance (69.7%) compared to caregivers with antenatal history (15.6%). Across the 8 LGAs, Kumbotso (7.7%) and Bauchi (10%) – both urban LGAs had the lowest ZD prevalence and showed a sustained effort from previous rounds. Wamako, Sumaila and Jere similar to No DPT reported wide decline from the previous rounds.

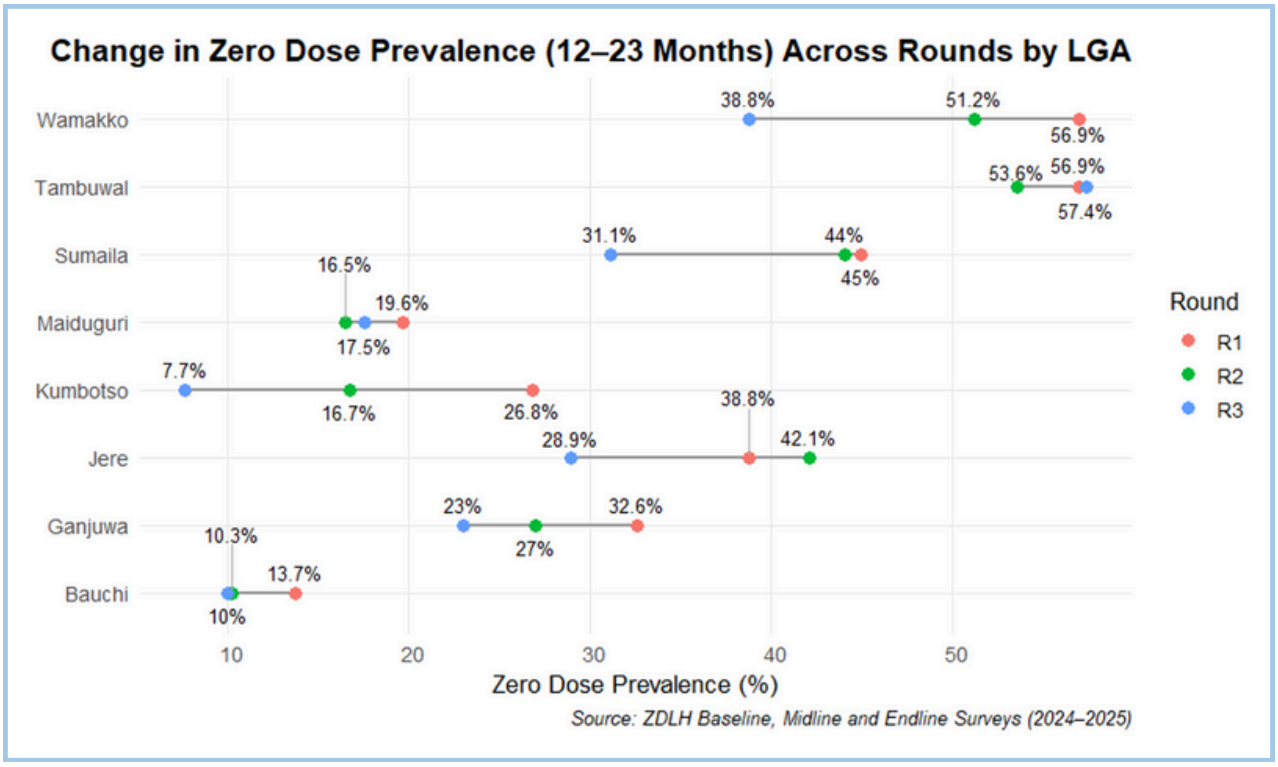


Figure 4: Trend of ZD Prevalence Disaggregated by LGA

Five LGAs Wammako, Tambuwal, Jere, Sumaila and Ganjuwa continue to consistently report high ZD prevalence. All these LGAs are rural with the exception of Jere with difficult terrains and experiences varied levels of insecurity. Accessibility due to raining season, incessant attacks and insecurity by a newly formed sect (Lasarawa) in Tambuwal LGA affected its performance.

IMMUNIZATION PERFORMANCE AND COVERAGE

IMMUNIZATION PERFORMANCE

The immunization coverage at the LGA level was estimated using the older cohort (12 – 23 months). Across the 2,033 children surveyed using both card and recall, a total of 506 children constituting 24.9% were yet to receive their first dose of DTP containing vaccine. 1,644 eligible children sampled had received at least 1 dose of immunization antigen of which 117 (5.8%) were yet to receive DTP1. Card retention amongst Ever vaccinated (1,644) was found to be high with 1,378 (83.8%) cards were seen, 244 (14.8%) cards were available but not seen and 64 (1.3%) reported missing cards. The proportion of Under Immunized (UI) was cumulatively estimated at 16.3% across the 8 LGA with wide variation across states and LGAs as shown in Table 4.

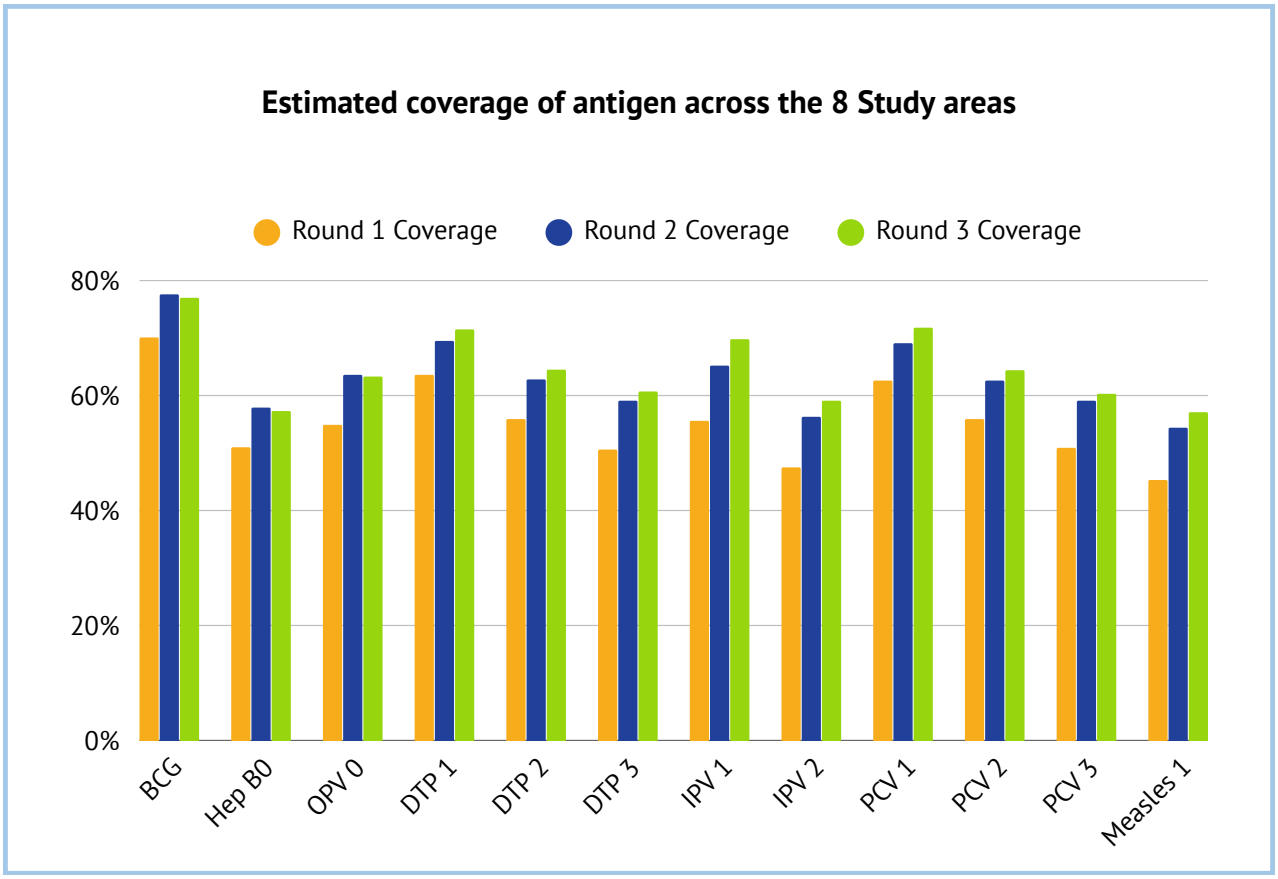
Table 2: Routine immunization performance across selected indicators disaggregated LGA

RI Indicators	Bauchi		Borno		Kano		Sokoto	
	Bauchi N =380	*Ganjuwa N =304*	*Maiduguri N =285*	*Jere N =228*	*Kumbotso N =209*	*Sumaila N =209*	*Tambuwal N =209*	*Wamakko N =209*
Ever Vaccinated	352 (92.7%)	243 (80%)	267 (93.7%)	198 (86.9%)	196 (93.8%)	149 (71.3%)	96 (46%)	143 (68.5%)
Under Immunized	11 (3.3%)	9 (3.9%)	87 (37.5%)	91 (56.6%)	5 (2.6%)	7 (5%)	15 (17.1%)	22 (17.5%)
Card Retention	328 (93.2%)	219 (90.2%)	200 (75%)	127 (64.2%)	164 (83.7%)	129 (86.6%)	86 (89.6%)	125 (87.5%)
No Immunization	28 (7.4%)	61 (20.1%)	18 (6.4%)	30 (13.2%)	13 (6.3%)	60 (28.8%)	113 (54.1%)	66 (31.6%)

The analysis shown in the table highlights the discrepancy across the study locations. Across the 8 LGAs, Bauchi and Kumbotso showed relatively strong immunization performance with over 90% of eligible children sampled receiving at least one immunization antigen while Tambuwal and Wammako continue to report the least performance. Under-immunization and card retention by caregivers remains a major challenge in both LGAs in Borno state despite good immunization commencement. These findings reveal the need for different targeted interventions such as incentivized/optimized outreach in Tambuwal and follow-up/retention strategies in Borno LGAs. The comparison of RI indicators across the 8 LGAs from Round 2 and Round 3 revealed notable improvement in key indicator particularly in vaccine uptake. The proportion of ever vaccinated notably increased in Ganjuwa (+2.3%), Kumbotso (+7.1%), Sumaila (+8.6%) and Wamakko (+11.5%).

ANTIGEN-SPECIFIC ANALYSIS

Across the 8 LGAs, weighted antigen-specific analysis was performed by aggregating individual ward level vaccination data, applying settlements-level estimates as weights. For each antigen, the proportion of vaccinated children sampled among the 19 eligible children sampled per ward was multiplied with the projected population of that ward. The resulting weighted values were then summed across all wards within each to arrive at the population adjusted antigen coverage estimate at the LGA level. This approach accounts for population heterogeneity across wards and reduces bias of high or low population sample sizes. Cumulatively, the estimated coverage of DTP1 and DTP 3 were 71.5% and 60.7%, indicating a slight improvement from 69.5% and 59.1% reported in Round 2 respectively as shown in table 5.



Across the three rounds, immunization coverage shows consistent improvement in most antigens over time. Coverage for early-life vaccines; BCG, HepatitisB0 and OPV0 maintained almost coverage. However, a strong upward trend was observed in DTP and PCV series, with DTP3 increasing from 59.1% to 60.7% and PCV3 from 59.1% to 60.3%, indicating gradual improvement in completion rates across rounds. Notably, IPV1 and IPV2 coverage rose from 65.2% and 56.3% in R2 to 69.8% and 59.1% in R3, marking one of the most substantial gains. Measles 1 coverage also improved by nearly 3 percentage points, underscoring progress in reaching children later in the schedule. The consistent overlap and narrowing of 95% confidence intervals across rounds suggest that these improvements are statistically meaningful and not due to random variation.

Wide geographic disparity was observed across the LGAs with Bauchi and Kano showing strong immunization coverage while Ganjuwa, Sumaila and Wamakko showed some progress. The coverage in Tambuwal remains sub-optimal as shown in **Table 6**. Antigens with coverage >=80% were conditionally formatted as 'Green', those between 50% and <80% as 'Yellow' while antigen coverages below <50% were shaded 'Red'.

Table 3: Estimated coverage of antigen disaggregated by LGA

	Bauchi		Maiduguri		Kano		Sokoto	
	Bauchi	**Ganjuwa**	**Jere**	**Maiduguri**	**Kumbotso**	**Sumaila**	**Tambuwal**	**Wamakko**
BCG	91.70%	79.10%	83.80%	82.60%	95.80%	72.00%	42.60%	68.70%
Hep B0	84.30%	48.50%	68.30%	67.10%	89.20%	48.50%	11.40%	40.70%
OPV 0	86.90%	57.30%	74.20%	66.50%	92.60%	59.30%	21.70%	47.70%
Penta 1	89.30%	77.10%	67.00%	69.60%	94.60%	68.00%	41.50%	65.20%
Penta 2	86.50%	74.40%	46.30%	50.80%	93.80%	66.60%	38.30%	59.10%
Penta 3	86.00%	73.70%	35.40%	42.10%	93.40%	64.80%	34.70%	55.80%
IPV 1	89.20%	75.50%	66.50%	69.40%	94.20%	65.70%	39.40%	58.70%
IPV 2	85.20%	72.50%	33.60%	41.90%	92.90%	62.20%	31.20%	53.10%
PCV 1	89.50%	77.10%	67.00%	69.60%	94.60%	69.30%	41.50%	65.90%
PCV 2	86.70%	74.40%	46.30%	50.80%	94.00%	65.90%	37.70%	59.70%
PCV 3	86.00%	73.40%	34.10%	42.10%	93.00%	63.80%	34.20%	55.80%
Measles 1	85.80%	69.10%	22.80%	35.70%	91.90%	65.00%	35.00%	51.40%

Key		> = 80% Coverage		50 -79.9% Coverage		< 50% Coverage

TIMELINESS OF VACCINATION

The timeliness of vaccination was assessed amongst children 4.5 – 11 months with evidence of vaccination seen. Across the 2066 children sampled, a total of 1,413 were reported to have Immunization Card with antigens received with corresponding dates of vaccination alongside the child's date of birth. The timeliness of DPT1 was estimated using date of first DPT uptake planned at 6 weeks of age according to the Nigeria Immunization Schedule and an additional 4-weeks grace-period.

The analysis showed out of the subset, 59% of DPT1 vaccinations were administered on time, about 21% were administered late while 12% were administered earlier than the 6 weeks in the policy. This varies widely across the LGAs. Using Bauchi LGA as reference, Tambuwal LGA reported statistically higher odd (AOR = 9.93, 95%CI = 4.49 – 21.93, p-value <0.001) – indicating 10 times higher odds of late uptake. Jere (AOR = 2.41, 95%CI = 1.31 – 4.45, p-value 0.004), Sumaila (AOR = 1.88, 95%CI = 1.05 – 3.36, p-value 0.03) and Wammako (AOR = 2.03, 95%CI = 1.10 – 3.74, p-value 0.02) reported statistically significant higher odds of late vaccination. Ganjuwa and Maiduguri reported 23% higher odd of late vaccination although found to be statistically not significant. Only Kumbotso had lower of late vaccination with 25% less likely to receive late vaccination compared to Bauchi.

The odds of DPT1-3 completion were also computed against Bauchi LGA at 95% CI and p<0.05. Cumulatively, 33.9% of children in this analysis showed timely vaccination across the 3 doses with pooled odd ratio of completing all 3 doses of DPT on time as 0.51. At the LGA level, Jere (AOR = 0.22, 95%CI = 0.11 – 0.42, p value <0.001), Maiduguri (AOR = 0.30, 95%CI = 0.19 – 0.46, p value <0.001), Tambuwal (AOR = 0.42, 95%CI = 0.17 – 0.99, p value 0.047) and Wamako (AOR = 0.47, 95%CI = 0.26 – 0.84, p value 0.012) reported statically significant lower odds of completing DPT1-3 on time as shown in the table 7.

Table 4: Timeliness of Vaccination by LGA

LGA	OR vs Bauchi	95% CI	p-value	Interpretation
Bauchi	1.00 (Ref)	–	–	Reference group
Ganjuwa	0.78	0.52 – 1.18	0.24	22% lower odds of completing all 3 doses (not significant)
Jere	0.22	0.11 – 0.42	<0.001*	78% lower odds of completing DPT1–3 on time (significant)
Kumbotso	1.09	0.70 – 1.70	0.7	Slightly higher odds of completion (not significant)
Maiduguri	0.3	0.19 – 0.46	<0.001*	70% less likely to complete all 3 doses (significant)
Sumaila	0.93	0.58 – 1.49	0.77	Similar odds to Bauchi (not significant)
Tambuwal	0.42	0.17 – 0.99	0.047*	58% less likely to complete on time (significant)
Wamakko	0.47	0.26 – 0.84	0.012*	53% less likely to complete on time (significant)

WARD PRIORITIZATION AND RISK STRATIFICATION

Using the Lot Quality Assessment Strategy (LQAS) methodology, wards were categorized into prioritized or non-prioritized based on their ability to meet a predefined immunization coverage benchmark. This analysis applied statistical upper threshold of 80% and lower threshold of 50% using a sample size of 19 children per ward. Wards with fewer number of children who have received the recommended vaccine than the decision rule of 13 (equivalent to the upper threshold of 80%) were identified as prioritized wards indicating sub-optimal immunization performance and urgent programmatic attention. The prioritization process was repeated for BCG, HepB0, DTP-Series, PCV-Series, IPV-series and Measles1.

Across the 107 wards, a total of 25 (23.4%) Lots failed BCG, 60(56.1%) Lots failed HepB0, 51 (47.7%) Lots failed OPV0, 32 (29.9%) 44 (41.1%), 50 (46.7%) Lots failed DTP1, 2 and 3 respectively. Almost half of the Lots (49.5%) failed Measles1. Below are the disaggregation's:

Bauchi

Bauchi – Galambi, Kangere and Tirwin wards reported 9, 12 and 9 failed Lots across the antigens with other wards reporting <2 failed lots.

Ganjuwa – Gungura B, Miya B and Ganjuwa A failed all antigens. 7 wards failed HepB0 and OPV0

Kano

Kumbotso – Danbare ward failed HepB0 and OPV0 while Chalawa failed HepB0

Sumaila – Gani, Gediya, Massu and Kanawa failed all antigens. Other wards were prioritized for HepB0 and OPV0

Borno

Jere - Alau Ward, Dusuman, Khaddamari Ward lots failed all antigens. Across other wards, DPT2, DPT3, IPV2, PCV2, PCV3, and Measles 1 were majors concerns.

Maiduguri - Maisandari Ward (Maiduguri) failed 11, Mafoni, Bolori 1 and Bolori II failed 8 antigens each. PCV3 and Measles were also found to be a major gap

Sokoto

Tambuwal – All wards in Tambuwal with exception of Bashire failed all antigens. Bashire failed HepB0, OPV0 and IPV2

Wamakko - Bado Kasarawa, Gidan Hamidu, Gumbi Wajake, Gwamatse, Kaura Gedawa and Wamakko Ward failed all antigens. Only Arkilla Gwiwa successfully passed all lot. Prioritized antigens for most wards include HepB0, OPV0, IPV1 and Mealses1.

A downward trend in the number of failed lots was observed across the three rounds as shown in Figure 5 though varied by LGA. Nineteen wards (Tambuwal 7, 5 in Wamakko, Sumaila 3, Jere 2, Ganjuwa 1, and Bauchi 1) with >10 failed antigens remained unchanged from Round 2 while 39 wards maintained <5 failed antigens across the rounds. Additional 19 wards with failed lots exceeding 10 and some exceeding 5 reported <5 failed lots in Round 3. This signifies gradual improvement in improving immunization coverage. HepB0 and OPV0 however experienced the least change.

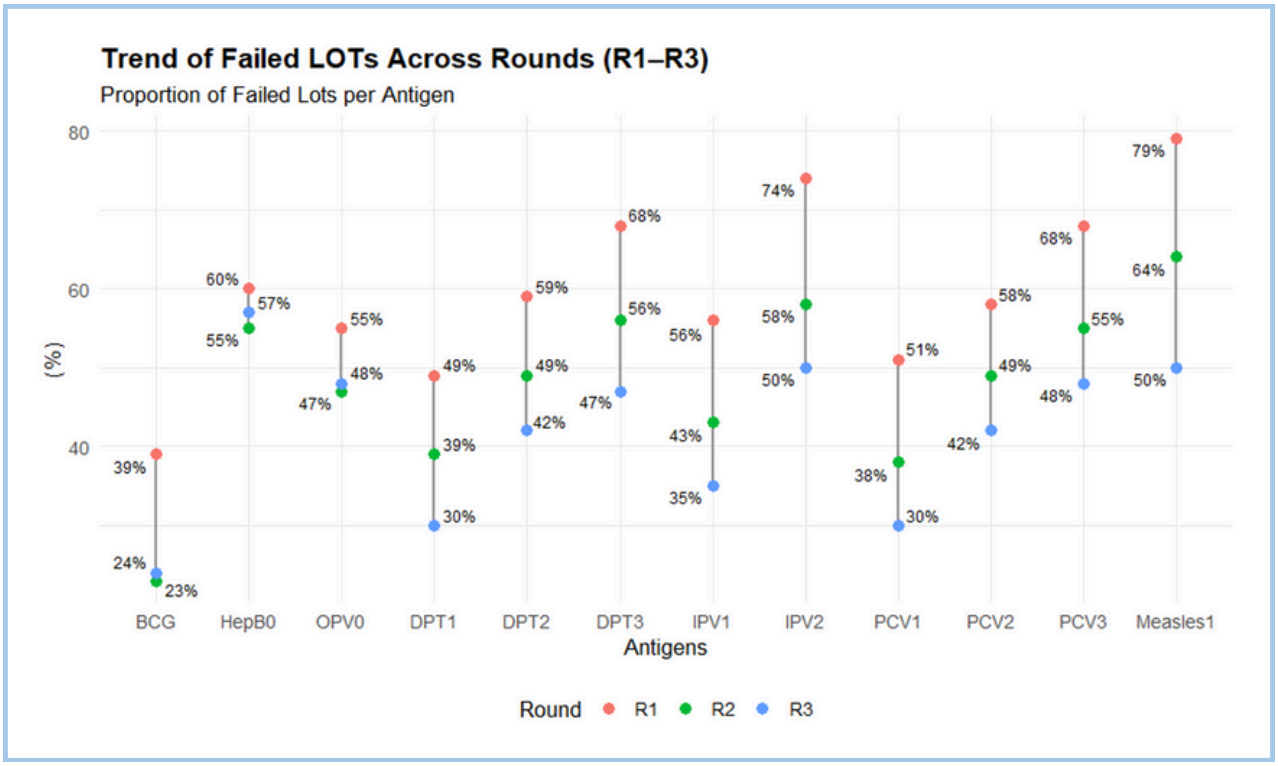


Figure 5: Trend of Failed Lots across Rounds

BEHAVIOURAL AND SOCIAL DRIVERS OF VACCINATION

The framework seeks to understand the underlying factors influencing immunization uptake across four critical domains: Caregivers' Thinking and Feeling, Social Processes, Motivation of caregivers to vaccinate, and Practical Issues hindering vaccination uptake. Associations between these domains and immunization behavior (uptake) provides valuable insight into both demand- and supply-side barriers for program managers to iterate immunization programming. It specifically explores how caregivers' perceptions, social influences, personal motivation, and contextual or logistical factors collectively shape decisions to vaccinate their children.

THINKING AND FEELING

To explore caregivers' knowledge, perceptions, and emotions that influence decisions to vaccinate their children, we assessed confidence in vaccine safety and effectiveness, trust in health workers and the health system, perceived risk of vaccine-preventable diseases, and emotional responses against vaccination status. The analysis in Table 7 shows caregivers with positive perception were significantly more likely to vaccinate their children. Caregivers of 4.5-11 months (AOR = 0.29, 95% CI: 0.18–0.46, $p < 0.001$) and 12-23 months (AOR = 0.15, 95% CI: 0.10–0.24, $p < 0.001$) with negative perception are 71% and 85% less likely to vaccinate their children with DPT1 respectively.

Table 5: Caregivers Thinking and Feeling disaggregated by Age Cohort

	4.5 - 11 Months					12 - 23 Months				
	DPT1 Received, N = 1,480	No DPT, N = 553	AOR	95% CI	*p*-value	Non ZD, N = 1,527	ZD, N = 506	AOR	95% CI	*p*-value
Vaccine Benefit										
Negative	81 (5.5%)	295 (53.3%)	—	—		67 (4.4%)	301 (59.5%)	—	—	
Positive	1,399 (94.5%)	258 (46.7%)	0.29	0.18, 0.46	<0.001	1,460 (95.6%)	205 (40.5%)	0.15	0.10, 0.24	<0.001
Vaccine Safety										
Negative	69 (4.7%)	297 (53.7%)	—	—		69 (4.5%)	297 (58.7%)	—	—	
Positive	1,411 (95.3%)	256 (46.3%)	0.15	0.09, 0.25	<0.001	1,458 (95.5%)	209 (41.3%)	0.19	0.12, 0.30	<0.001
Healthcare Worker's Trust										
Little or No Trust in HCWs	92 (6.2%)	205 (37.1%)	—	—		112 (7.3%)	220 (43.5%)	—	—	
Trust HCWs	1,388 (93.8%)	348 (62.9%)	0.6	0.41, 0.88	0.009	1,415 (92.7%)	286 (56.5%)	0.55	0.38, 0.81	0.002

Children of caregivers who expressed confidence in vaccine safety were substantially more likely to be vaccinated with DPT1. Amongst both the young cohort (AOR =0.15, 95% CI: 0.09–0.25, p < 0.001) and the older cohort (AOR = 0.19, 95% CI: 0.12–0.30, p < 0.001) suggests that negative safety concerns reduce the odd of vaccination. Trust in healthcare workers also emerged as a significant determinant of vaccine uptake. The odds of vaccination increased by about 40% (AOR = 0.60, 95% CI: 0.41–0.88, p = 0.009) amongst 4.5 – 11 month and 45% (AOR = 0.55, 95% CI: 0.38–0.81, p = 0.002) amongst 12- 23 months. Sensitization of caregivers with negative perception to vaccine benefit and safety as well as building HCW trust amongst caregivers are pivotal to increasing vaccination uptake.

SOCIAL PROCESSES

The Social Processes domain highlights the influence of social norms, interpersonal relationships, and community structures on caregivers' decisions to vaccinate their children.

Table 6: Social Process

Characteristic	4.5 - 11 Months					12 - 23 Months				
	DPT1 Received N = 1,480	**No DPT, N = 553**	**AOR**	**95% CI**	***p*-value**	**Non ZD, N = 1,527**	**ZD, N = 506**	**AOR**	**95% CI**	***p*-value**
Parent Norms	1,447 (97.8%)	394 (71.2%)	0.23	0.14, 0.39	<0.001	1,488 (97.4%)	340 (67.2%)	0.19	0.11, 0.32	<0.001
Family and Friends support to vaccinate child	1,450 (98.0%)	395 (71.4%)	0.23	0.13, 0.39	<0.001	1,489 (97.5%)	355 (70.2%)	0.3	0.17, 0.52	<0.001
Support from Religious Leaders to vaccinate child	1,476 (99.7%)	506 (91.5%)	0.52	0.10, 2.06	0.4	1,521 (99.6%)	464 (91.7%)	2.62	0.49, 12.1	0.2
Support from Community Leaders to vaccinate child	1,470 (99.3%)	504 (91.1%)	1.85	0.59, 5.89	0.3	1,522 (99.7%)	464 (91.7%)	0.36	0.07, 1.93	0.2
HCW recommendation for vaccination	1,450 (98.0%)	436 (78.8%)	0.2	0.12, 0.33	<0.001	1,475 (96.6%)	393 (77.7%)	0.33	0.21, 0.50	<0.001
Permission seeking to vaccinate child	1,453 (98.2%)	457 (82.6%)	0.31	0.18, 0.54	<0.001	1,508 (98.8%)	424 (83.8%)	0.19	0.10, 0.34	<0.001

Results demonstrate that parental approval, peer support, recommendations from HCW and permission significantly predict immunization uptake across both age cohorts. Caregivers of children endorsing positive parental support are 23% (AOR = 0.23 95% CI: 0.14–0.39, p < 0.001) for 4.5 – 11 months and 19% (AOR = 0.19, 95% CI: 0.11–0.32, p < 0.001) for 12 – 23 months more likely to be vaccinated with DPT1. Support from Family and Friends as well as HCW recommendations are strong positive association with vaccine uptake across both age cohorts. Caregivers whose caregivers reported encouragement from friends and family are 70-80% more likely to receive DPT1. Permission seeking dynamics was also significantly associated with vaccination uptake. Children of caregivers who reported need to seek permission before vaccination were less likely to be vaccinated (AOR = 0.31, 95% CI: 0.18–0.54, p < 0.001 for 4.5–11 months; AOR = 0.19, 95% CI: 0.10–0.34, p < 0.001 for 12–23 months).

MOTIVATION

The Motivation domain of the BeSD framework examines caregivers' readiness and willingness to vaccinate their children.

Table 7: Motivation

Characteristic	4.5 - 11 Months					12 - 23 Months				
	DPT1 Received N = 1,480	No DPT, N = 553	AOR	95% CI	*p*-value	Non ZD, N = 1,527	ZD, N = 506	AOR	95% CI	*p*-value
Intention to Vaccinate										
All	1,281 (86.6%)	198 (35.8%)	—	—		1,316 (86.2%)	172 (34.0%)	—	—	
Some or None	199 (13.4%)	355 (64.2%)	11.5	9.20, 14.5	<0.001	211 (13.8%)	334 (66.0%)	12.1	9.60, 15.3	<0.001

Across both cohorts, over 80% of caregivers indicating intention to vaccinate had their children vaccinated while about 35% had intention but remained as either No DPT or ZD. The adjusted odds ratio (AOR) of 11.5 (95% CI: 9.20–14.5, $p < 0.001$) indicates that children of caregivers with no or partial intention to vaccinate were over 11 times less likely to be vaccinated. Similarly, for children aged 12–23 months, caregivers with low intention to vaccinate were 12 times less likely to have vaccinated their children (AOR = 12.1, 95% CI: 9.60–15.3, $p < 0.001$). Strengthening motivation through behaviour change communication to translate intentions into action.

PRACTICAL ISSUES

The Practical Issues domain of the BeSD framework assesses the extent to which logistical, financial, and service delivery factors facilitate or hinder caregivers' ability to vaccinate their children.

Findings showed that while most caregivers demonstrated strong awareness and access to immunization services, service satisfaction and accessibility remain critical determinants of vaccine uptake. Knowledge of where to vaccinate was found to be almost universal amongst both age cohorts, although statistically not significant in the younger cohort, the older cohort (AOR = 0.10, 95% CI: 0.02–0.50, $p = 0.005$) indicated that children of caregivers who

Table 8: Practical Issues

Characteristic	4.5 - 11 Months					12 - 23 Months				
	DPT1 Received N = 1,480	No DPT, N = 553	AOR	95% CI	*p*-value	Non ZD, N = 1,527	ZD, N = 506	AOR	95% CI	*p*-value
Knowledge of Where to get children vaccinated	1,475.0 (99.7%)	482.0 (87.2%)	0.47	0.07, 9.19	0.5	1,524.0 (99.8%)	434.0 (85.8%)	0.1	0.02, 0.50	0.005
Ease of Vaccination										
Affordable	1,189.0 (80.3%)	309.0 (55.9%)	—	—		1,237.0 (81.0%)	288.0 (56.9%)	—	—	
Unaffordable	291.0 (19.7%)	244.0 (44.1%)	1.37	0.91, 2.02	0.12	290.0 (19.0%)	218.0 (43.1%)	1.41	0.88, 2.21	0.14
Service Satisfaction										
Satisfied	1,447.0 (97.8%)	136.0 (88.3%)	—	—		1,498.0 (98.1%)	107.0 (91.5%)	—	—	
Unsatisfied	33.0 (2.2%)	18.0 (11.7%)	4.61	2.38, 8.67	<0.001	29.0 (1.9%)	10.0 (8.5%)	3.55	1.51, 7.80	0.002
Vaccination Strategy										
HF - Government	1,397.0 (94.4%)	139.0 (90.3%)	—	—		1,442.0 (94.4%)	107.0 (91.5%)	—	—	
HF – Private	22.0 (1.5%)	1.0 (0.6%)	0.52	0.03, 2.53	0.5	18.0 (1.2%)	0.0 (0.0%)	0		>0.9
HF – Faith-based	2.0 (0.1%)	1.0 (0.6%)	5.86	0.27, 61.7	0.2	1.0 (0.1%)	0.0 (0.0%)	0		>0.9
Outreach/Community	52.0 (3.5%)	12.0 (7.8%)	1.73	0.83, 3.33	0.12	64.0 (4.2%)	10.0 (8.5%)	1.48	0.63, 3.06	0.3
Others	7.0 (0.5%)	1.0 (0.6%)	1.6	0.09, 9.13	0.7	2.0 (0.1%)	0.0 (0.0%)	0		>0.9

do not know where to vaccination services takes place are 90% less likely to have received DPT1. Service satisfaction of caregivers also emerged as a predictor of vaccination uptake. The analysis indicated that children of unsatisfied caregivers were 3 - 4 times less likely to receive DPT1 amongst 4.5-11 months (AOR = 4.61, 95% CI: 2.38–8.67, p < 0.001) and 12 – 23 months (AOR = 3.55, 95% CI: 1.51–7.80, p = 0.002) signifying the importance of quality of care and HCW attitude. Vaccination strategy although found not to be statistically significant showed complementarity of outreach services to Government health facilities.

DISCUSSION

Round 3 of the Decentralized Immunization Monitoring (DIM) confirms a steady upward trajectory in routine immunization (RI) performance across the eight Learning Hub LGAs in Bauchi, Borno, Kano, and Sokoto. Antigen-specific coverage increased for most vaccines between Rounds 1 and 3 particularly DTP1, DTP3, IPV1/2, PCV1/2/3 and MCV1 indicating that subnational actions implemented after earlier DIM rounds are translating into measurable gains in access and uptake. These improvements are consistent with Nigeria's National Immunization Recovery Plan and the broader IA2030 agenda, both of which emphasize targeting zero-dose (ZD) and under-immunized children and institutionalizing data-use for micro-planning (1, 16, 17).

Notwithstanding these gains, persistent program bottlenecks remain, most notably for birth-dose antigens (HepB0 and OPV0), which showed only marginal change between Rounds 2 and 3. The pattern strongly suggests missed opportunities around delivery and the immediate post-natal period, likely driven by high rates of non-facility births, delayed care-seeking, and weak post-natal referral linkages findings that mirror national and global evidence on the determinants of timely birth-dose vaccination. (1, 16, 17) In parallel, the 10–12 percentage-point drop-out observed across multi-dose series (DTP, PCV) underscores system challenges with series completion including session predictability, follow-up/defaulter tracking, and caregiver burden all well-documented constraints in LMIC RI programs. (1, 18).

Geographic inequities remain pronounced. Urban LGAs (e.g., Bauchi, Kumbotso) consistently outperformed rural or harder-to-reach areas (e.g., Tambuwal, Wamakko, Sumaila, parts of Jere), achieving near-universal coverage on several antigens versus <60% for others. These urban–rural gradients likely reflect composite disadvantages: longer travel times, security-related disruptions, seasonal inaccessibility, and lower health-literacy and opportunity costs in poorer communities. The persistently higher ZD and No-DPT1 prevalence in Sokoto LGAs compared to peers suggests context-specific barriers including leadership engagement, social norms, facility readiness, and outreach frequency that require tailored packages rather than uniform inputs. (16, 17).

Multivariable findings clarify who is being left behind. Across both age cohorts, rural residence, no formal education, unemployment, ANC non-attendance, non-facility delivery, and lower wealth quintiles were associated with markedly higher odds of ZD/No-DPT1 status. These patterns argue for integrated strategies that link RI with antenatal/post-natal services, strengthen institutional deliveries, and lower non-financial barriers (time, distance, childcare). They also justify equity-oriented targeting of resources and supervision toward


LGAs/wards with the greatest deficits—exactly the use case envisioned by the Recovery Plan and IA2030. (16, 17, 18).

The BeSD results add essential demand-side nuance. Perceptions of vaccine benefits and safety, trust in health workers (HCWs), and positive family/peer norms were strong independent predictors of uptake, while permission-seeking dynamics and limited intention to vaccinate suppressed coverage. These findings validate an intensified social and behaviour change (SBC) approach leveraging HCW recommendation quality, male champions, religious/traditional leaders, and women's groups to move caregivers from intention to action core guidance within the WHO BeSD framework (3). Importantly, service satisfaction was a significant predictor: dissatisfied caregivers were 3–4× less likely to vaccinate, highlighting how respectful care, waiting time, and session reliability operate as trust-building levers alongside classic SBC.

At service-delivery level, DIM's LQAS-based ward stratification continues to be an operational asset. The downward trend in failed lots across rounds albeit uneven by LGA demonstrates that rapid, granular feedback loops are prompting course corrections in micro-planning, outreach routing, and supervision. Yet, the failure of HepB0/OPV0 lots in many wards indicates that birth-dose logistics (early life contact points, newborn tracking, TBA-to-facility referral, and post-natal home visits) remain the critical frontier. The LQAS approach used here is aligned with global guidance and remains cost-efficient for frequent, local performance checks (19).

Notably, the "unexpected findings" including AFP and suspected pertussis clusters illustrate DIM's value beyond coverage estimation. Community-proximate data collection acted as an informal surveillance amplifier, prompting rapid investigation and reactive responses (e.g., line-listing, plus-up campaigns). This RI-surveillance interface is precisely what national policies envisage: decentralized, data-driven systems that surface missed settlements, unreached groups (e.g., nomads/IDPs), and incipient outbreaks early enough to act (16).

Methodological considerations warrant acknowledgment. First, although card retention was high, caregiver recall may still bias coverage estimates especially for dose timing despite efforts to validate responses. Second, the cross-sectional design limits causal attribution; observed improvements plausibly reflect interventions implemented post-Round 1/2, but residual confounding cannot be excluded. Third, insecurity, flooding, and seasonal access constraints may have influenced reach and measurement in certain wards. These constraints argue for institutionalizing DIM as a routine, cyclical process that can smooth seasonal artefacts and triangulating with administrative data and special studies where feasible (16, 18, 19).

The Round 3 findings validate decentralized monitoring as a practical pathway to lift coverage, reduce ZD prevalence, and sharpen equity focus. The next phase should consolidate gains in Bauchi/Kumbotso-like settings while deepening tailored, context-sensitive packages in lower-performing LGAs (e.g., intensified birth-dose systems, defaulter tracing, optimized outreach in insecure/seasonal terrains, and BeSD-led SBC). Embedding DIM within routine state processes with quarterly LGA/ward reviews and clear accountability for corrective actions will be pivotal to sustaining progress toward IA2030 and national targets. (16, 18, 19, 20)

RECOMMENDATION

1. Prioritize High-Burden LGAs: Intensify outreach, supervision, and catch-up activities in low-performing LGAs (Wamakko, Tambuwal, Sumaila, Jere). Deploy mobile teams and integrated health outreaches tailored to security and terrain challenges.
2. Strengthen Birth-Dose Vaccination: Strengthen the linking of traditional birth attendants to community health workers for referral of home deliveries to improve the uptake of birth dose vaccines while encouraging facility-based deliveries
3. Address Drop-Out Rates: Implement structured defaulter tracking systems through community health volunteers, house-to-house visits, and SMS reminders to ensure completion of vaccine series.
4. Deepen Community Engagement and Social Behaviour Change: Engage traditional and religious leaders, male influencers, and women's groups to promote vaccine acceptance, dispel myths, and reinforce community ownership of immunization services.
5. Promote Women's Education and Economic Empowerment: Collaborate with social protection and education programs to address the root determinants of vaccine inequity especially among low-literacy and economically disadvantaged caregivers.
6. Scale and Institutionalize the DIM Approach: Mainstream the DIM methodology into state immunization programs, ensuring routine rounds of decentralized data collection, rapid feedback, and evidence-based microplanning.
7. Improve Health Worker Support and Supervision: Continue mentoring and supportive supervision of frontline staff to enhance service quality, documentation, and respectful care.
8. Enhance Data Use and Local Accountability: Institutionalize quarterly ward and LGA data review meetings to ensure timely corrective actions and sustain data-driven decision-making at subnational levels.
9. Despite uniform exposure to the same interventions, Sokoto State LGAs (Wamakko and Tambuwal) have shown slower progress, suggesting that underlying contextual and behavioural barriers are limiting results (not program design). Interventions in this state may therefore require adaptive, locally tailored approaches emphasizing social mobilization, leadership engagement, and strengthened service delivery in hard-to-reach communities

CONCLUSION

The Round 3 DIM findings demonstrate that decentralized, evidence-based monitoring has strengthened routine immunization performance across the ZDLH states. Improvements in DTP, IPV, and measles coverage, alongside reductions in zero-dose prevalence, validate the effectiveness of community-driven and data-informed approaches.

Nonetheless, persistent disparities highlight that access, gender, education, and socio-economic barriers continue to shape immunization outcomes. The next phase must therefore consolidate gains in high-performing LGAs while deploying intensified, context-sensitive strategies in underserved areas.

Sustaining progress will depend on continuous community engagement, integration of RI with maternal health services, robust supervision, and institutionalization of the DIM model as a permanent feedback mechanism within Nigeria's immunization system. By doing so, the vision of getting to the last mile to reach every child no matter where they live can move from aspiration to reality.

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Table 9: Sociodemographic Characteristics of Respondents

Characteristic	Overall N = 4,066	4.5 - 11 Months N = 2,033	12 - 23 Months N = 2,033
Age of Caregiver	28 (25, 32)	28 (24, 32)	29 (25, 33)
Sex of Caregiver			
Female	3,766 (92.6%)	1,884 (92.7%)	1,882 (92.6%)
Male	300 (7.4%)	149 (7.3%)	151 (7.4%)
Religion of Caregiver			
Christian	85 (2.1%)	37 (1.8%)	48 (2.4%)
Islam	3,976 (97.8%)	1,994 (98.1%)	1,982 (97.5%)
Traditionalist	5 (0.1%)	2 (0.1%)	3 (0.1%)
Settings			
Rural	2,364 (58.1%)	1,179 (58.0%)	1,185 (58.3%)
Urban	1,702 (41.9%)	854 (42.0%)	848 (41.7%)
Educational Level of Caregivers			
No Formal Education	2,323.0 (57.1%)	1,144.0 (56.3%)	1,179.0 (58.0%)
Quranic	38.0 (0.9%)	19.0 (0.9%)	19.0 (0.9%)
Primary School Leaving Certificate	634.0 (15.6%)	291.0 (14.3%)	343.0 (16.9%)
Secondary School certificate	759.0 (18.7%)	416.0 (20.5%)	343.0 (16.9%)
Post Secondary School	312.0 (7.7%)	163.0 (8.0%)	149.0 (7.3%)
Employment Status of Caregivers			
Yes, I'm formally employed	179.0 (4.4%)	91.0 (4.5%)	88.0 (4.3%)
I'm self employed	2,525.0 (62.1%)	1,256.0 (61.8%)	1,269.0 (62.4%)
Not engaged and no source of income	1,362.0 (33.5%)	686.0 (33.7%)	676.0 (33.3%)
Wealth Index of Caregivers *			
Quintile 1 – Poorest	1,725.0 (42.4%)	872.0 (42.9%)	853.0 (42.0%)
Quintile 2 – Poor	1,335.0 (32.8%)	647.0 (31.8%)	688.0 (33.8%)
Quintile 3 – Average	522.0 (12.8%)	276.0 (13.6%)	246.0 (12.1%)
Quintile 4 – Rich	317.0 (7.8%)	153.0 (7.5%)	164.0 (8.1%)
Quintile 5 – Richest	167.0 (4.1%)	85.0 (4.2%)	82.0 (4.0%)
Marital Status of Caregivers			
Married	3,990.0 (98.1%)	1,997.0 (98.2%)	1,993.0 (98.0%)
Divorced	33.0 (0.8%)	15.0 (0.7%)	18.0 (0.9%)
Separated	6.0 (0.1%)	4.0 (0.2%)	2.0 (0.1%)
Single	12.0 (0.3%)	7.0 (0.3%)	5.0 (0.2%)
Widowed	25.0 (0.6%)	10.0 (0.5%)	15.0 (0.7%)

* Nigeria Equity Tool assesses availability of 10 household items: Television, Electric iron, A fan, Refrigerator, Electricity, Generator, Household bank account, Watch, floor type and open fire cooking

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Table 10: Demographic Characteristics affecting Vaccine uptake

Characteristic	4.5 - 11 Months					12 - 23 Months				
	DPT1 Received N = 1,480	No DPT1 N = 553	AOR	95% CI	*p*-value	Non ZD, N = 1,527	ZD, N = 506	AOR	95% CI	*p*-value
Age of Caregiver	28 (25, 32)	27 (23, 30)	0.98	0.97, 1.00	0.082	30 (25, 33)	29 (24, 32)	0.99	0.97, 1.01	0.4
Sex of Caregiver										
Female	1,381 (93.3%)	503 (91.0%)	—	—		1,404 (91.9%)	478 (94.5%)	—	—	
Male	99 (6.7%)	50 (9.0%)	1.05	0.68, 1.59	0.8	123 (8.1%)	28 (5.5%)	0.6	0.36, 0.96	0.04
Religion of Caregiver										
Christian	36 (2.4%)	1 (0.2%)	—	—		45 (2.9%)	3 (0.6%)	—	—	
Islam	1,442 (97.4%)	552 (99.8%)	5.68	1.20, 102	0.089	1,480 (96.9%)	502 (99.2%)	2.39	0.82, 10.3	0.2
Traditionalist	2 (0.1%)	0 (0.0%)	0	0.00, 0.00	>0.9	2 (0.1%)	1 (0.2%)	2.33	0.08, 41.8	0.6
Settings										
Rural	807 (54.5%)	372 (67.3%)	—	—		818 (53.6%)	367 (72.5%)	—	—	
Urban	673 (45.5%)	181 (32.7%)	2.33	1.72, 3.15	<0.001	709 (46.4%)	139 (27.5%)	1.55	1.14, 2.10	0.005
Educational Level of Caregivers										
Formal Education	754 (50.9%)	135 (24.4%)	—	—		746 (48.9%)	108 (21.3%)	—	—	
No Formal Education	726 (49.1%)	418 (75.6%)	1.88	1.41, 2.51	<0.001	781 (51.1%)	398 (78.7%)	1.48	1.10, 2.01	0.011
Employment Status of Caregivers										
Employed	1,048 (70.8%)	299 (54.1%)	—	—		1,101 (72.1%)	256 (50.6%)	—	—	
Unemployed	432 (29.2%)	254 (45.9%)	1.32	1.04, 1.68	0.022	426 (27.9%)	250 (49.4%)	1.62	1.26, 2.07	<0.001
Ever attended Antenatal Services?	1,375 (92.9%)	312 (56.4%)	0.12	0.09, 0.17	<0.001	1,422 (93.1%)	264 (52.2%)	0.11	0.08, 0.15	<0.001
Place of Delivery										
Institutional Delivery	786 (53.1%)	162 (29.3%)	—	—		793 (51.9%)	129 (25.5%)	—	—	
Non-Institutional Delivery	694 (46.9%)	391 (70.7%)	1.45	1.11, 1.90	0.006	734 (48.1%)	377 (74.5%)	1.39	1.06, 1.85	0.02
Wealth Index of Caregivers										
Quintile 1	568 (38.4%)	304 (55.0%)	—	—		571 (37.4%)	282 (55.7%)	—	—	
Quintile 2	467 (31.6%)	180 (32.5%)	0.96	0.74, 1.25	0.8	514 (33.7%)	174 (34.4%)	0.89	0.68, 1.16	0.4
Quintile 3	230 (15.5%)	46 (8.3%)	0.75	0.49, 1.13	0.2	217 (14.2%)	29 (5.7%)	0.64	0.39, 1.02	0.064
Quintile 4	139 (9.4%)	14 (2.5%)	0.49	0.25, 0.88	0.024	145 (9.5%)	19 (3.8%)	0.69	0.38, 1.19	0.2
Quintile 5	76 (5.1%)	9 (1.6%)	0.52	0.23, 1.06	0.091	80 (5.2%)	2 (0.4%)	0.14	0.02, 0.48	0.008
Marital Status of Caregivers										
Married	1,451 (98.0%)	546 (98.7%)	—	—		1,496 (98.0%)	497 (98.2%)	—	—	
Unmarried	29 (2.0%)	7 (1.3%)	0.67	0.24, 1.67	0.4	31 (2.0%)	9 (1.8%)	0.88	0.35, 1.97	0.8

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Table 11: Estimated coverage of antigen across the 8 Study areas

Antigen	R1 Coverage	95% Confidence Interval	R2 Coverage	95% Confidence Interval	R3 Coverage	95% Confidence Interval
BCG	70.10%	68.1% – 72.1%	77.60%	75.7% - 79.4%	77.00%	75.1% – 78.9%
Hep B0	51.00%	48.8% – 53.2%	57.90%	55.7% - 60%	57.30%	55.2% – 59.4%
OPV 0	54.90%	52.7% – 57.1%	63.60%	61.5% - 65.7%	63.30%	61.3% – 65.3%
DTP 1	63.60%	61.5% – 65.7%	69.50%	67.5% - 71.6%	71.50%	69.6% – 73.4%
DTP 2	55.90%	53.7% – 58.1%	62.80%	60.7% - 64.9%	64.50%	62.5% – 66.5%
DTP 3	50.60%	48.4% – 52.8%	59.10%	57% - 61.3%	60.70%	58.7% – 62.7%
IPV 1	55.60%	53.4% – 57.8%	65.20%	63.2% - 67.4%	69.80%	67.8% – 71.7%
IPV 2	47.50%	45.3% – 49.7%	56.30%	54.2% - 58.5%	59.10%	57.0% – 61.2%
PCV 1	62.60%	60.5% – 64.7%	69.10%	67.1% - 71.2%	71.80%	69.9% – 73.7%
PCV 2	55.90%	53.7% – 58.1%	62.60%	60.5% - 64.7%	64.40%	62.4% – 66.4%
PCV 3	50.90%	48.7% – 53.1%	59.10%	56.9% - 61.3%	60.30%	58.3% – 62.3%
Measles 1	45.30%	43.1% – 47.5%	54.40%	52.3% - 56.7%	57.10%	55.0% – 59.2%