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Reaching zero-dose children: lessons learned from the planning, implementation, and monitoring of Nigeria's Big Catch-Up initiative

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Abstract

Background: The COVID-19 pandemic disrupted routine immunisation (RI) services globally, leaving millions of zero-dose children, with Nigeria bearing the highest burden. In response, Nigeria conducted the Big Catch-Up (BCU) RI intensification between December 2024 and April 2025 to reach and vaccinate children aged 12-59 months who had missed vaccinations. This case study documented lessons learned from planning, implementing, and monitoring BCU activities in Bauchi and Rivers States to inform policy decisions on integrating catch-up vaccination into Nigeria's immunisation program.

Methods: This study used a sequential explanatory mixed-methods design in five purposively selected sites across the two states between July and August 2025. We obtained BCU call-in data (Rounds 1-3) and conducted 67 key informant interviews and 18 focus groups with purposively sampled program managers, partners, RI providers, and community members, including caregivers of children under five. Quantitative data were analysed descriptively and qualitative data thematically, with triangulation across datasets.

Results: Across the three rounds, BCU achieved 70% coverage (Penta2) in Bauchi and 75% (Penta3) in Rivers, with outreach reaching the most children in both states. Bauchi vaccinated more children aged 24-59 months, whereas Rivers vaccinated more children aged 12-23 months. Effective BCU planning relied on collaborative, multi-stakeholder engagement involving government, partners, and communities and leveraging existing immunisation governance structures and staff; detailed microplanning with geospatial mapping; and expanded vaccine supply. Effective BCU implementation combined multi-strategy service delivery adapted to local realities, community mobilisation through community leaders and groups (e.g., mama-to-mama),

and tailored communication to reach zero-dose children and address socio-cultural barriers. Effective BCU monitoring required age-segregated reporting tools, real-time digital data, daily review meetings, supportive supervision, and ward-level data validation, which enabled feedback, rapid problem-solving, and quality control. Collectively, the mechanism that worked leveraged routine systems rather than a parallel structure but depended in part on unpaid volunteers.

Conclusions: BCU demonstrated that reaching zero-dose children is feasible with adequate resources, coordination, and community engagement. Sustaining these gains requires formal policy positioning catch-up as a continuous RI component, supported by domestic financing, health system investment, operational flexibility, and formalised roles for community volunteers, rather than a periodic response to zero-dose children.

Keywords: Zero-dose children; Catch-up vaccination; Big Catch-Up; Routine immunisation; Health systems strengthening; Immunisation equity; Mixed methods; Nigeria

Background

Nigeria has the highest burden of zero-dose children worldwide (15%) [1], estimated at 2.1 million in 2023 [2,3], representing approximately 24% of the under-one cohort in the country [4]. These zero-dose and under-immunised children are heavily concentrated in the northern region, socially deprived groups, and underserved communities, including rural, remote, nomadic, and conflict-affected populations [5–7]. The country also has the largest immunity gap globally, with 3.1 million children lacking measles vaccination [3]. Despite significant government and partners' investments in Nigeria's immunisation program, vaccine coverage (i.e., the third dose of DPT-HepB-Hib) among children aged 12–23 months in 2024 is 53% [8], well below the global target of 90% [1]. In the same year, 39.4% were fully vaccinated with the basic antigens, and 19.8% were vaccinated according to the national schedule [8]. Given that vaccine-preventable diseases contribute to nearly 41% of under-five deaths in Nigeria [9], gaps in immunisation coverage continue to leave millions of children under-immunised or unvaccinated [3], and contribute to under-five mortality by 39% [9]. Expanded access to immunisation has been shown to reduce under-five mortality by 52% in the African region, including Nigeria [10–12]. However, multiple interconnected barriers hinder vaccination uptake and coverage in the country, spanning health systems (e.g., vaccine stockouts, workforce shortages, and poor communication from healthcare workers to caregivers), geographic access (e.g., long distances to immunisation centres), and socio-cultural (e.g., fears of vaccine side effects, misconceptions, lack of awareness, cultural and religious beliefs, and low maternal education) [13–16]. Immunisation coverage also varies by region, with the Northern region facing security challenges, difficult terrain, and male household heads' refusal to have their children immunised, while the Southern region faces challenges,

including separatist agitation in the Southeast, and geographic access barriers due to riverine terrain in the South-South, further compromising service delivery and disrupting immunisation efforts [2,13,17].

The COVID-19 pandemic exacerbated these challenges and disrupted routine immunisation (RI) services [18], resulting in a substantial pool of zero-dose and under-immunised children in the country [19], widening the immunity gap the country persistently faced [20,21], and increasing the risk of vaccine-preventable disease outbreaks [22,23]. Resources were also diverted, with human resources, logistics, and funds redirected to the COVID-19 emergency response [24]. Additionally, community fears of contracting COVID-19 at health facilities and widespread misinformation led to a substantial drop in vaccine uptake [25,26].

To address persistent challenges in the immunisation program and close the immunisation gap caused by the COVID-19 pandemic, Nigeria rolled out a country-specific zero-dose immunisation recovery plan (2023-2028) in 2023 [27], aligned with the Big Catch-up (BCU) launched in 2023 by the World Health Organization (WHO), the United Nations Children's Fund (UNICEF), and Gavi the Vaccine Alliance (Gavi) [28]. The BCU is a global initiative aimed at reaching un- and under-immunised children born between 2019 and 2022, restoring immunisation coverage for the 2023 cohort to at least 2019 levels, and strengthening immunisation systems within PHC approaches in 20 countries, including Nigeria, that accounted for 78% of all zero-dose children worldwide in 2021 [28]. Within this broader agenda, the Nigeria zero-dose immunisation recovery plan aims to catch up, restore, and strengthen immunisation services across the country through catch-up immunisation efforts, periodic intensification of routine immunisation and campaigns, restoration of comprehensive immunisation, bolstering community and primary health care (PHC) services,

and expanding immunisation service delivery [27]. The plan prioritises children who were missed between 2019 and 2022 and seeks to reduce the zero-dose population by 30% in 2025 and by 50% in 2028 [27]. Achieving the 2028 target in the country will help reduce the global zero-dose population by 6% [29].

As part of the global agenda to reduce the zero-dose population, Nigeria conducted the BCU RI intensification to reach and vaccinate un- and under-immunised children aged 12-59 months. The intervention was implemented across 200 prioritised local government areas (LGAs), comprising 2,643 wards, in 30 states (Abia, Akwa Ibom, Anambra, Bauchi, Bayelsa, Benue, Borno, Cross River, Delta, Ebonyi, Edo, Ekiti, Enugu, Imo, Jigawa, Kaduna, Katsina, Kogi, Kwara, Lagos, Niger, Ogun, Ondo, Osun, Oyo, Plateau, Rivers, Sokoto, Yobe, Zamfara) and the Federal Capital Territory from December 9, 2024, to April 18, 2025, through fixed, outreach, and mobile sessions. Children aged 0-23 months who had not received any vaccine were also vaccinated.

Methods

BCU RI intensification in Bauchi and Rivers States

In response to the country's zero-dose immunisation recovery plan, Bauchi and Rivers, launched BCU immunisation campaigns from December 2024 to April 2025 in the national prioritised LGAs for their respective States; two LGAs in Bauchi State (Bogoro and Kirfi), and 11 LGAs in Rivers State (Andoni, Asari-Toru, Abua/Odual, Ahoda-west, Akuku-toru, Bonny, Degema, Etche, Emohua, Ogba/Egbema/Ndoni and Port Harcourt); to catch up children 12-59 months who missed their vaccination by providing catch-up doses of vaccines, including three doses of pentavalent vaccine, two doses of bivalent oral polio vaccine (bOPV), two doses of inactivated

poliovirus vaccine (IPV), and one dose of pneumococcal conjugate vaccine (PCV). A total of 24 wards in Bauchi State and 165 wards in Rivers State conducted three rounds of BCU, using fixed posts at healthcare facilities, mobile services for distant or hard-to-reach settlements, and outreach services to nearby communities, with mop-up exercises after each round to cover missed settlements and children not reached. Each round lasted six to nine days. These states approached BCU implementation with markedly different backgrounds in catch-up vaccination efforts. Bauchi State has had repeated campaigns and programs that informed its approach to BCU and its achievements [30]. Rivers State, on the other hand, has had limited programs and campaigns. In Bauchi, the estimated number of zero-dose children aged 12 to 59 months in Bauchi was 38,773, of whom 25,202 (65%) were targeted for BCU in Bogoro and Kirfi LGAs. In Rivers, the estimated number of zero-dose children (12-59 months) was 281,198, of whom 182,779 (65%) were targeted for BCU in all 11 BCU LGAs. The target population for BCU was determined from monitoring data collected during the microplanning exercise and validated during the BCU planning phases for each round. Across both states, BCU recording and reporting tools included registers, tally sheets, daily call-in data sheets and digital platforms. Dashboards, Google Sheets, and Open Data Kit (ODK) checklists were used for supportive supervision. All technical stakeholders, including government and development partners, closely monitored and supervised the implementation of the BCU exercise. Figure 1 presents the timeline for BCU planning and implementation in Bauchi and Rivers.

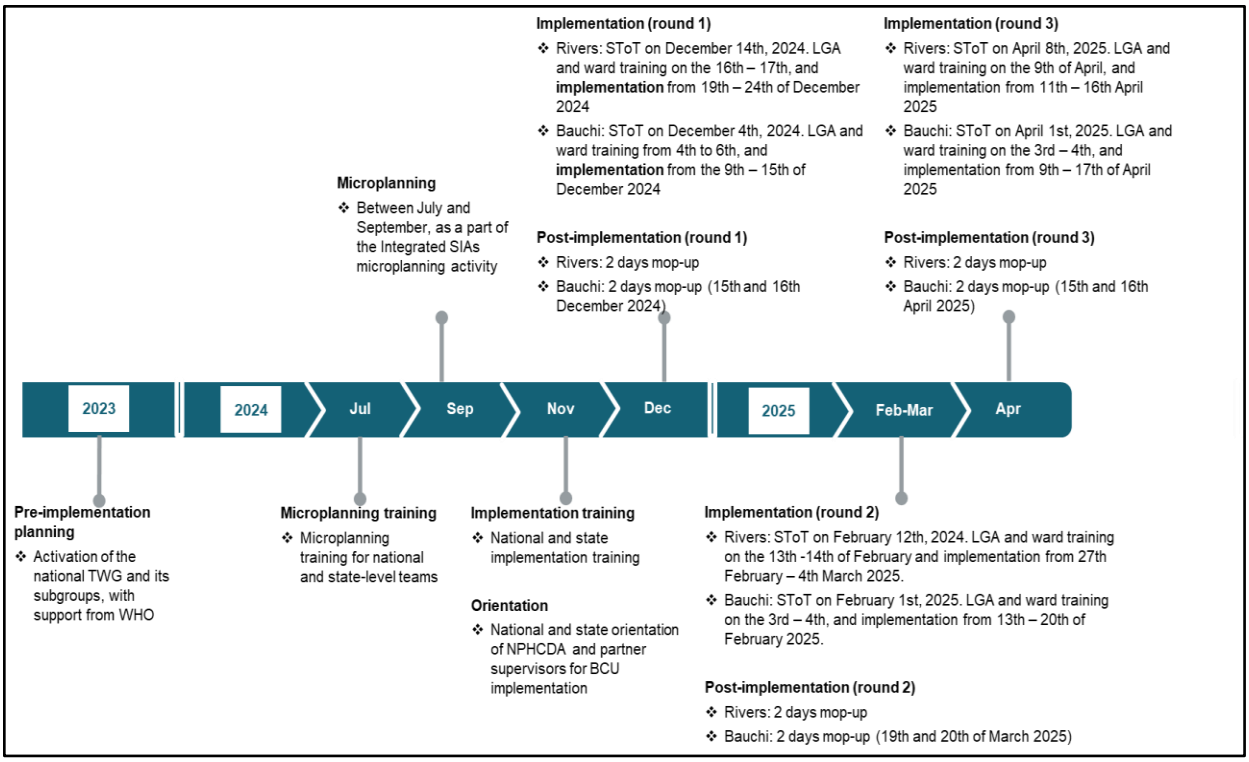


Figure 1. Timeline of key activities in BCU planning and implementation

Aim

This case study documented lessons learned from planning, implementing, and monitoring the BCU in Bauchi and Rivers States, Nigeria, to reach zero-dose and under-immunised children as part of immunisation services and PHC, and to inform the integration of catch-up vaccination into the country's RI system.

Study design

Our case study employed a sequential explanatory mixed-methods approach for complementarity [31]. We first analysed state-specific BCU monitoring and coverage data for rounds 1–3 (quantitative data), followed by key informant interviews (KIIs) and focus group discussions (FGDs) (qualitative data) to provide an in-depth understanding of lessons learned

from BCU planning, implementation, and monitoring, informing the institutionalisation of catch-up vaccination within RI and PHC services.

Study setting and site selection

We conducted the case study in Bauchi and Rivers states, selected as contrasting implementation contexts for the BCU. Bauchi State, located in the North-East, has a population of about 6,835,118, of whom 1,025,268 are under five [32]. It is primarily rural and Muslim-dominated, with over 55 distinct ethnic groups (primarily Hausa and Fulani), and comprises 20 LGAs [33]. RI coverage is 58.2% [34]. Rivers State, located in the South-South, has an estimated population of 6,585,693, of whom 987,854 are under five [32]. It is divided into 23 LGAs, is predominantly Christian, comprises over 30 ethnic groups, and includes more urban, peri-urban, and hard-to-reach riverine communities [35]. RI coverage in the state is 71% [34].

Within each state, we conducted the case study at six purposively selected LGAs (3 per state) based on (1) senatorial zone (1 per zone), (2) RI performance (high [≥70%] and low [≤69%] DTP3/Penta3 coverage), (3) BCU implementation status, (4) zero-dose proportion, (5) location (urban/rural/semi-urban), and (6) access (non-security-compromised areas). The sites were Andoni, Bonny, and Port Harcourt LGAs in Rivers State, and Bogoro, Kirfi, and Misau LGAs in Bauchi State. In Bauchi, BCU was conducted in two LGAs (Bogoro and Kirfi); however, Misau, where BCU was not implemented, was included as a comparator to understand general RI implementation and challenges. This selection was made in collaboration with the state leadership and immunisation teams at the Bauchi State Primary Health Care Development Agency (BSPHCDA) and the Rivers State Primary Health Care Management Board (RSPHCMB). However, in this article,

we report data across five LGAs (Andoni, Bonny, and Port Harcourt LGAs in Rivers State; and Bogoro and Kirfi LGAs in Bauchi State) where BCU was conducted. See Figure 2.

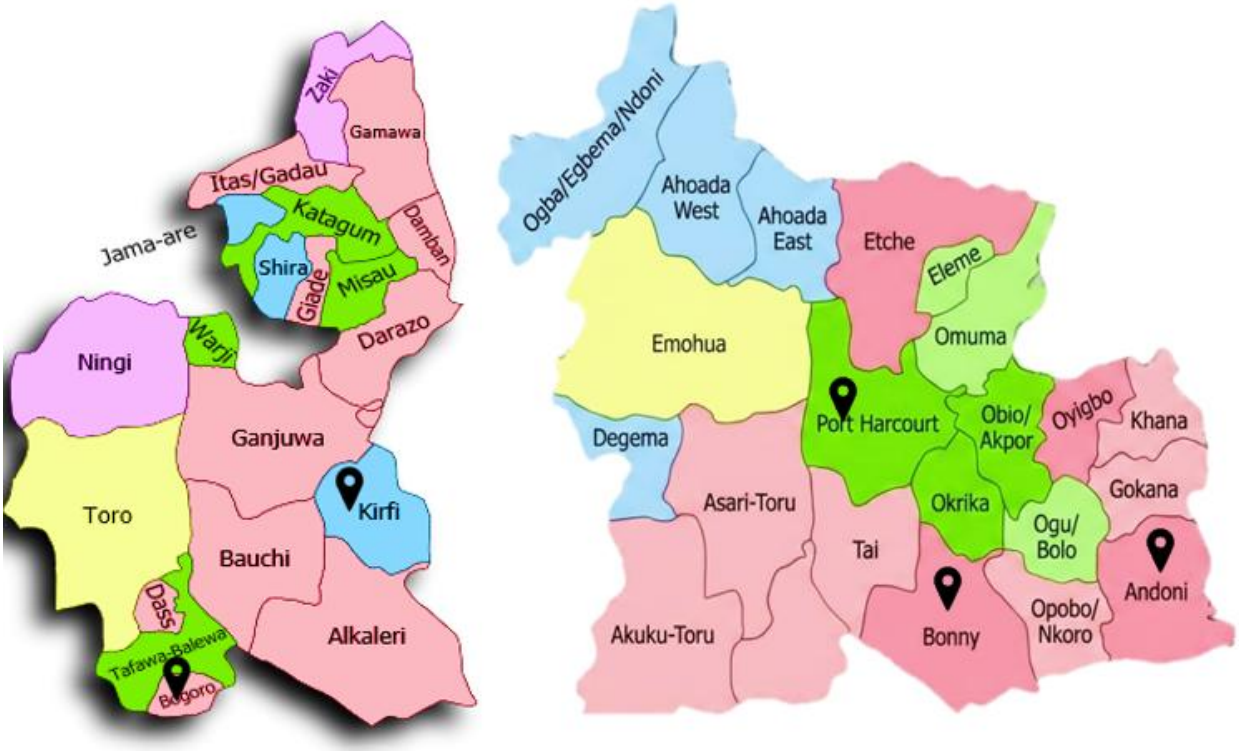


Figure 2: Map of the states (L-R: Bauchi and Rivers) showing the selected study sites

Study participants and materials

Quantitative: We used BCU monitoring and coverage data from all three BCU rounds in Bauchi and Rivers states. The data were retrieved from tally sheets and health facility registers and were used to describe BCU implementation performance across rounds.

Qualitative: We obtained BCU reports covering all three planned and implemented BCU rounds (1-3) in Bauchi and Rivers states. Across the five sites, 67 KIIs and 18 FGDs were conducted until data saturation was reached [36], and the sample size was derived using the information power concept [37]. Participants for the KIIs and FGDs were purposively sampled to capture key

characteristics of interest. KII participants included immunisation program managers at the state (n=13; 7 in Bauchi and 6 in Rivers) and LGA (n = 25; 13 in Rivers and 12 in Bauchi) levels, state partners supporting immunisation and BCU activities (n=4; 2 per state), facility in-charge, RI focal person, or vaccinator at the health facility level providing immunisation services (n = 20, 10 per state), and religious and traditional leaders (n =5; 3 in Rivers and 2 in Bauchi) at the community level, based on their involvement in the RI program and BCU activities in the last year. FGDs were also held with ward development committees (WDCs (n = 5; 3 in Rivers and 2 in Bauchi) at the ward level, and with caregivers of children under five (fully-, non-, or under-vaccinated) at the community level (n = 13; 7 in Bauchi and 6 in Rivers). State and LGA program managers and partners were identified and recruited from BSPHCDA and the RSPHCMB. RI providers were identified by their LGA program managers, who then identified the religious and traditional leaders and WDC members. Parents of children under five were identified through their community leaders, with assistance from the RI providers. The interviews were conducted by trained research assistants using a pretested, semi-structured interview guide from August 6 to 30, 2025. The guide covers BCU implementation across the PHC domains (program management and financing, human resources, vaccine supply, quality, and logistics, service delivery, demand generation, and data management); enablers, barriers, and lessons learned; missed opportunities and corrective measures; partners' role and involvement in the BCU activities; and institutionalising catch-up activities within RI and PHC services. Interviews at the community level were conducted in local languages to facilitate understanding. All interviews were conducted at a convenient location agreed upon by the participants and lasted an average of fifty minutes. Oral

consent was obtained from all participants, and the interviews were recorded. The participant lists for the KIIs and FGDs are presented in **Table 1**.

Table 1: Summary table of KII and FGD respondents in Bauchi and Rivers State

Level	Respondent	Interview type	Number of interviews	Total number of respondents
State	Director Immunisation	KII	2	2
	State Immunisation Officer	KII	2	2
	State Cold Chain Officer	KII	2	2
	State Health Educator	KII	2	2
	State Monitoring and Evaluation Officer	KII	2	2
	State Disease Surveillance and Notification Officer	KII	2	2
	State BCU coordinator	KII	1	1
	WHO state coordinator	KII	2	2
	Unicef state coordinator	KII	1	1
	Other State partners	KII	1	1
LGA	LGA Immunisation Officer	KII	5	5
	LGA Cold Chain Officer	KII	5	5
	LGA Health Educator	KII	5	5
	LGA Monitoring and Evaluation Officer	KII	5	5
	LGA PHC Director	KII	5	5
Ward	Ward Development Committee	FGD	5	39
PHC Facility	RI Focal Person	KII	20	20
Community	Younger mothers of under-five child (vaccinated)	FGD	1	8
	Younger fathers of under-five child (vaccinated)	FGD	2	16

	Older mother of under-five child (vaccinated)	FGD	2	16
	Older father of under-five child (vaccinated)	FGD	2	16
	Younger mothers of under-five child (unvaccinated)	FGD	2	15
	Younger fathers of under-five child (unvaccinated)	FGD	2	16
	Older mother of under-five child (unvaccinated)	FGD	2	14
	Community leaders (traditional or religious)	KII	5	5
Total FGDs			**18**	**140**
Total KIIs			**67**	**67**
Total (KIIs and FGDs)			**85**	**207**

Data analysis

All quantitative data were cleaned and analysed descriptively in SPSS version 27 to assess BCU coverage by antigen, dose, and age group in both states, and visualised in Microsoft Excel version 2509. For qualitative analysis, audio-recorded interviews, including those conducted in local languages, were transcribed verbatim and back-translated into English. A combined deductive and inductive approach was used. First, AOA and FO developed an initial set of codes in a codebook based on the key domains of inquiry (planning, implementation, and monitoring). Next, AOA, CA, RO, and MA conducted an inductive analysis using Braun and Clarke's approach [38] to generate new codes from the data. New codes emerging from the data were entered into the codebook, discussed, iteratively reviewed, and revised by COJ to align with the study aim. Related

224 codes were grouped into categories and refined into themes, and their relationships to BCU
225 planning, implementation, and monitoring were described. Dedoose was used to support coding
226 and data management. Subsequently, the quantitative and qualitative findings were integrated
227 through triangulation during interpretation to achieve a more comprehensive understanding of
228 BCU planning, implementation, and monitoring.

229 **Results**

230 **BCU coverage by antigens and dose across the three rounds**

231 In Bauchi, across all BCU rounds, 25,202 children aged 12-59 months were targeted for catch-up
232 vaccination, but coverage varied substantially by antigen and dose. According to the BCU
233 monitoring data, Penta2 achieved the highest catch-up coverage at 70%, with 17,634 doses
234 administered to children aged 12-59 months. Moderate coverage rates were observed for OPV2,
235 Penta1, PCV1, and IPV2, ranging from 60% to 63%, while OPV1, Penta 3, and IPV1 achieved
236 coverage rates between 51% and 58%. The lowest coverage rates were recorded for PCV2 (3,162
237 doses, 13%), PCV3 (1,086 doses, 4%), and OPV3 (754 doses, 3%) (**Figure 3**).

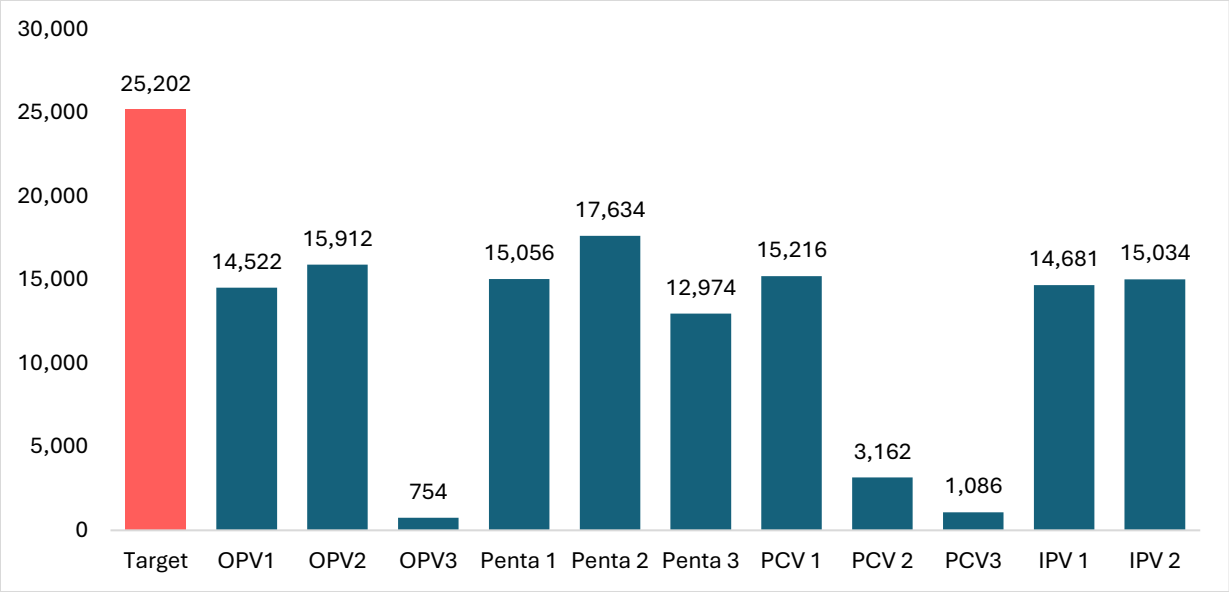


Figure 3: Cumulative target vs number of children (12-59 months) who received BCU vaccine dose, Bauchi

In Rivers State, across all BCU rounds, 182,779 children aged 12-59 months were targeted for catch-up vaccination. Coverage patterns differed from those in Bauchi State. Penta3 achieved the highest coverage, approximately 75%, with 136,414 doses administered. Penta2 closely followed with 128,723 doses, representing 70% coverage. OPV2, OPV3, Penta1, and IPV2 achieved

coverage slightly more than 50%. The lowest coverage rates were observed for IPV1 (38%), PCV2 (23%), and PCV3 (22%) (**Figure 4**).

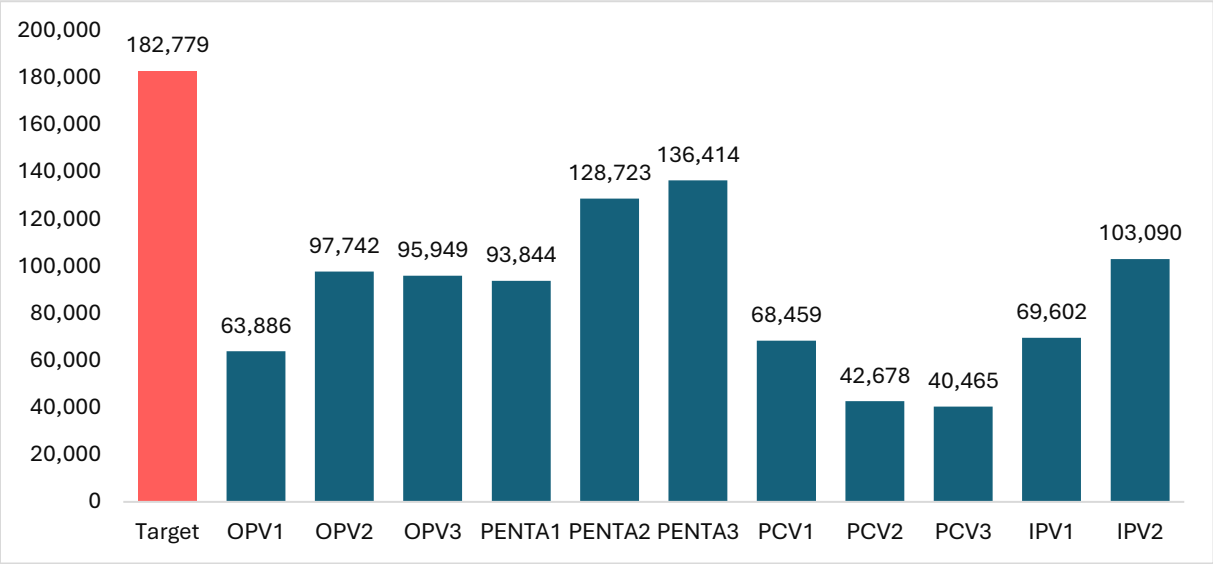


Figure 4: Cumulative target vs number of children (12-59 months) who received BCU vaccine dose, Rivers

Exploring reasons for the low PCV coverage in both states, respondents in the qualitative interviews cited limited PCV doses received and PCV stockouts, stemming from global supply constraints.

> *" There was some form of stockout of PCV vaccine, and so we try to attribute it to that because it is actually supposed to be a co-administered antigen."– Development Partner, Bauchi*

> *" … because of the availability of the vaccine, they said we were supposed to use PCV in round one and round three. So PCV was not used in round two. So of course, if you put all*

the data together, you see that a large number of children would not have PCV compared to Penta as well." – State program managers, Rivers

BCU coverage by age group across the three rounds

Across all BCU rounds in Bauchi State, age-disaggregated BCU monitoring data revealed that more older children aged 24-59 months were vaccinated with the BCU antigens than those aged 12-23 months (**Figure 5**). The smallest absolute totals across both age groups were for OPV3 and PCV3.

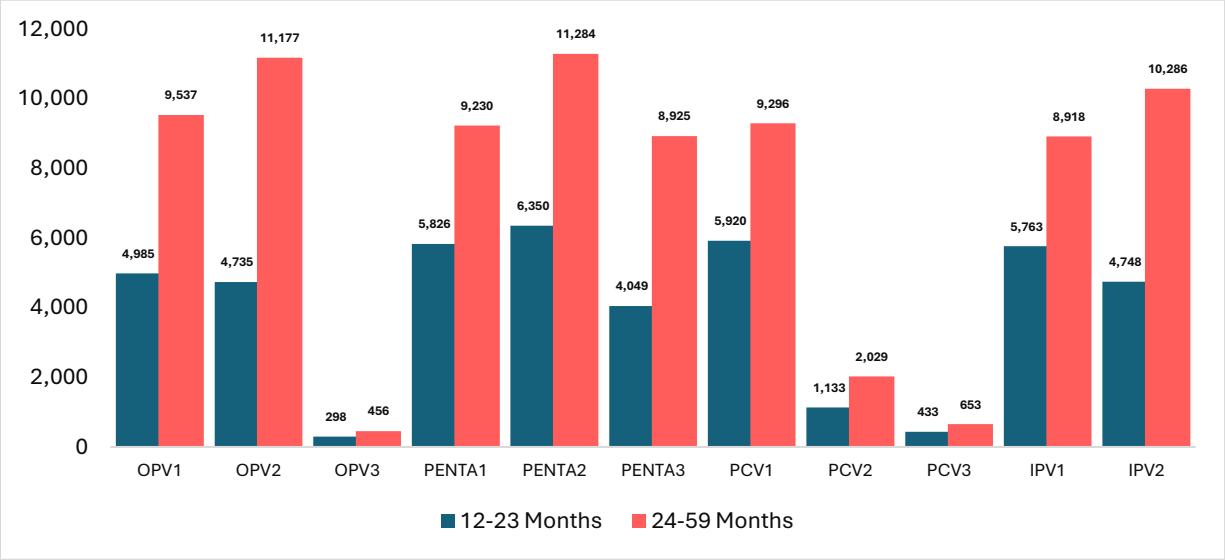


Figure 5: Number of children vaccinated by vaccine dose and age group (12-23 and 24-59 months), Bauchi

Qualitative interviews revealed that more children in the 24-59-month age range were targeted because they are the target group for BCU vaccination, as most children in the state were missed due to the COVID-19 pandemic. This was achieved with the help of the RI providers, who actively mobilised parents to bring their older children (24-59 months) for catch-up vaccination.

"What we did was that we mobilised caregivers to bring the children within the age group 24-59 months, to bring them and those who might have missed the subsequent vaccination to come for it. That was how it happened. Because in 2020, that was during COVID-19, that was where we missed most of the children because of this COVID-19."– LGA program manager, Bauchi

In Rivers, across all BCU rounds, age-disaggregated BCU monitoring data showed that more younger children aged 12-23 months were reached across all antigens, except OPV3. Across all antigens, the highest number of children aged 12-23 months were vaccinated with Penta 2 and 3. PCV doses were administered the least in both age groups, with PCV3 showing the lowest numbers (**Figure 6**).

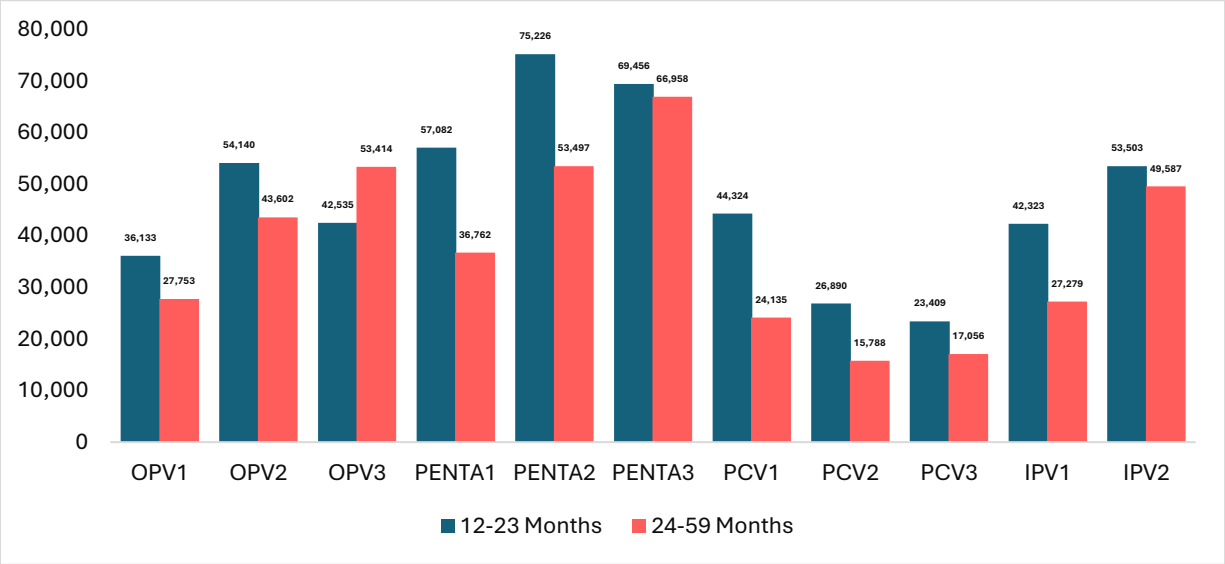


Figure 6: Number of children vaccinated by vaccine dose and age group (12-23 and 24-59 months), Rivers

From the qualitative interviews, intensive outreach during the pandemic was believed to reduce the burden on zero-dose and under- immunised older children (24-59 months); thus, this group was targeted less during the rounds.

> *" … during the COVID-19 time, with those shutdowns, we were able to push through our outreach activities. So, the number of children that we expect from the global phenomenon that is supposed to be in the catch-up, we didn't really have that number."– State program manager, Rivers*

BCU coverage by vaccine strategy across the three rounds

Across all BCU rounds in Bauchi, outreach strategies consistently reached more children with BCU antigens compared to fixed or mobile strategies. Mobile strategies reached the fewest children with BCU antigens across all rounds **(Figure 7).**

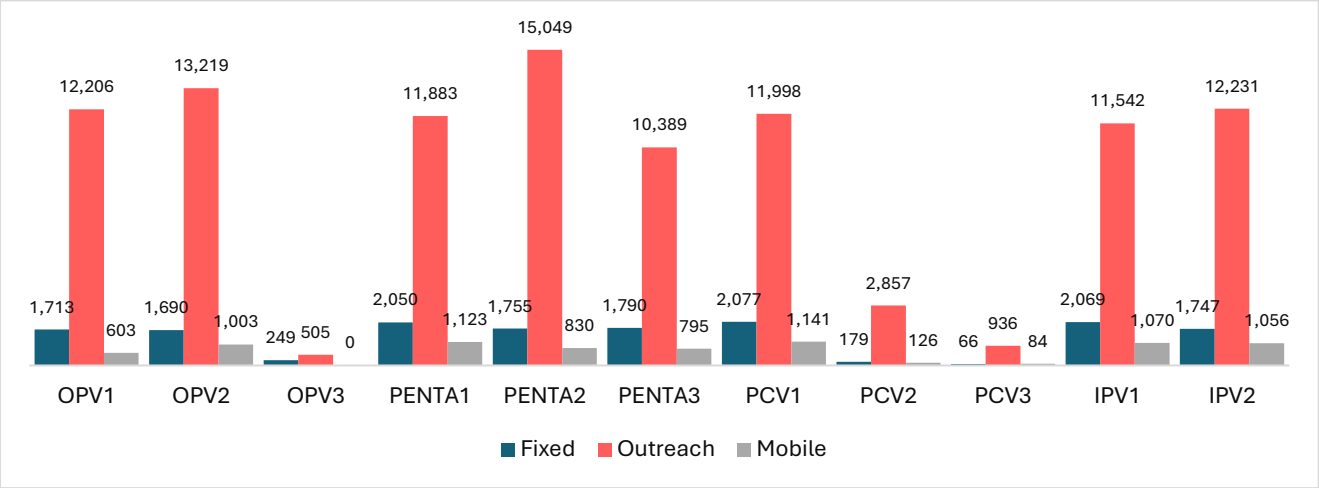


Figure 7: Number of children (12-59 months) vaccinated with BCU antigens by delivery strategy, Bauchi

Similarly, in Rivers, across all BCU rounds, outreach strategies consistently reached more children with BCU antigens compared to fixed or mobile strategies (Figure 8). Unlike Bauchi, where mobile strategies reached the fewest children, in Rivers State, fixed strategies reached the fewest children across all BCU antigens and rounds (Figure 8).

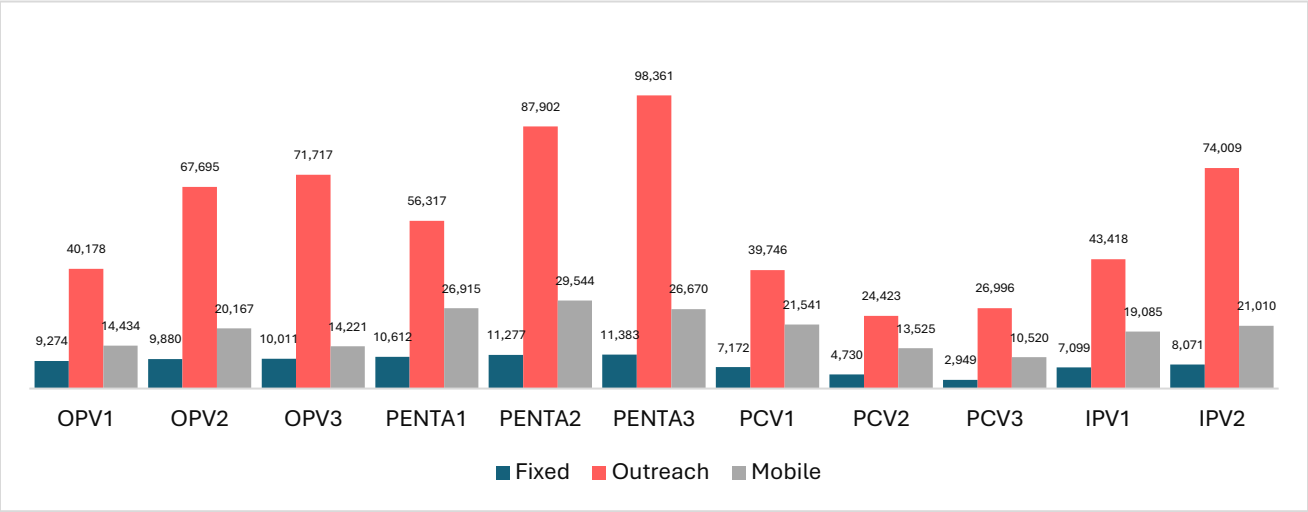


Figure 8: Number of children (12-59 months) vaccinated with BCU antigens by delivery strategy, Rivers

BCU planning

Strong multi-stakeholder collaboration and coordination

Across Bauchi and Rivers States, successful BCU planning relied on multi-stakeholder collaboration at all levels, including government (state and LGA immunisation officers, and RI providers, and ward focal persons from BSPHCDA and RSPHCMB), development partners (e.g., WHO, UNICEF), and communities (WDCs and traditional and religious leaders). In both states, participants described planning as a coordinated process in which state and LGA immunisation

teams worked with partners and community actors to plan each BCU round, assess implementation readiness, and develop daily implementation plans.

"*We had a planning meeting with the ward focal person and the LGA team, where we developed our daily implementation work plan. That is the plan that would help us to reach all the eligible children in their catchment area, and the backbone of this activity at the community level is the involvement of traditional leaders*."- LGA program manager, Bauchi

"*The planning was done by the ward focal person, involving the RI focal person and the community members. The WDC members were also involved. They were aware of what was happening as of then, before the Big Catch-Up started*."- LGA program manager, Rivers

Effective collaborative coordination was demonstrated through the division of responsibilities that aligned partner strengths with implementation needs in both states, and by creating a single integrated plan between government and development partners in Bauchi State.

"In Bauchi, we have one system where the government and partners have a single plan. For any activity, we first look at what is needed for implementation. UNICEF, WHO, and the Bauchi State Government worked closely on the Big Catch-Up vaccination. UNICEF provided logistics and waste management, while WHO funded personnel allowances and some supervision costs."- State program manager, Bauchi

" In Rivers State, you know, we have a lot of partners that are also supporting, which is a strength. WHO has a footprint of about six technical staff at the state level, nine LGA facilitators, and 46 volunteers. These are additional resources to what the state already

has, and there were also such resources from other partners like UNICEF, CHAI, and what have you that also support the process."- Development partner, Rivers

However, in both states, limited LGA coverage raised questions about strategic prioritisation and equity in reaching zero-dose children outside the nationally allocated priority areas.

"The only thing I would say, the least successful, is that this Big Catch-up campaign was only conducted in two LGAs. And why? And we have 20 LGAs, and they only select LGAs that have fewer wards, 13 wards. Bogoro has 13 wards, Kirfi has 13 wards. And there are some LGAs that have 20 wards with the largest issue of unimmunised children. So, you see that the national has limited the state to only two LGAs, and all of these LGAs are rural areas. They are not in urban places. And we have a lot of unimmunised children, non-compliance, and missed children in the urban places. So, it's a very big challenge to the state." - State program manager, Bauchi

"…the only thing that I would have questioned is the idea behind the picking of the LGAs for the Big Catch-up. There are a couple that I probably would have wanted to add to it. And if we're doing a campaign as Big Catch-up, I think it should be the whole state, you know, as opposed to picking just the 11 LGAs that were carried out in the Big Catch-up."– State program manager, Rivers

Leveraging existing immunisation governance structures and human resources

BCU planning relied on existing RI governance structures and human resources rather than new systems and people. Participants reported that leveraging existing government structures, coordination mechanisms, and personnel facilitated coordination across all health system levels

and continuity of service delivery. In Bauchi, at the community level, these structures were extended to include traditional and religious leaders, WDCs, mama-to-mama groups, and town announcers as part of local planning or mobilisation. In Rivers, planning was carried out through established immunisation coordination mechanisms, particularly the state technical working group, which included government and implementing partners.

"We are using the same one and not bringing new people. We are not recruiting people because of Big Catch-up; we are using the same structure that we have." — State policymaker, Bauchi

"During the planning…we involved all 20 ward focal persons, and they went back to their wards to cascade the information to stakeholders." — LGA program manager, Rivers

"On our part, we are always encouraging and sensitising the community on the need to take advantage of the vaccine – Community leader, Bauchi

However, the absence of vaccinators and health workforce shortages undermined vaccine uptake and the efficiency of BCU services. We also learned that facilities relied on community volunteers, whose attendance varied during BCU, to cope with government staff shortages.

" Sometimes, even when they come to the hospital, you will hear them say the person to give the immunisation is not around and they will not come back."– Mother of under-five child, Bauchi

"Like in my own facility, the volunteers are more than the government workers. We have 7 volunteers and 4 government staff... Sometimes they come on their own will because

they are volunteering, but if it's the government staff, he or she knows that there's a clock in and out, so when the supervisor comes, he will check it."- RI providers, Bauchi

" The challenge? Manpower. Oh, right. Lack of manpower. You can imagine when two people are attending to 100 people in a day. You attend to maybe 40, 50 people in a day. So, we need people who will assist, because as one person is vaccinating, the other person is recording, you're tallying, you must make sure everything is in order. You weigh the child, you keep all records, because if we don't keep records, it will be difficult for us. So, we lack manpower."– LGA program manager, Rivers

Detailed catch-up microplanning with multiple stakeholder involvement

A detailed catch-up microplanning process involving multiple stakeholders, including local community actors, was central to successful BCU planning and implementation. Microplanning was used to determine target populations, develop daily work plans, identify and validate settlements with high numbers of zero-dose and under-immunised children, and inform resource allocation and team deployment. In Bauchi, the microplanning process was further strengthened by using geospatial maps to validate catch-up settlements and track population movements during microplanning. In Rivers, the state used projected population figures and existing immunisation coverage data from District Health Information Software 2 (DHIS2) to prioritise specific wards and settlements and to guide team deployment.

" What we did was to ensure that all stakeholders at the community level, who would enrich the process of microplanning, were brought together during the process of

microplanning so that any change in the population would be accounted for during the process of the microplan".– Development Partner, Bauchi

"In the microplan process, too, maps were generated using software… The maps were able to capture each settlement …is now used to validate the actual presence of those settlements during the microplanning process... Through that, if a population had moved out of a settlement, it would be picked easily. So, those are technologies that also enhance the reach of the Big Catch Up" **–** Development Partner, Bauchi

"In Rivers state, we already have a system in place for RI, and occasionally, campaigns come in... There is data in the state, and we know the areas, especially the LGAs that have more zero-dose children. This data informed the deployment of vaccinators to those areas. Areas with more zero-dose children had more teams deployed, while areas with fewer had fewer teams." — Development partner, Rivers

Vaccine supply and cold chain management

The expansion of state-level infrastructure in Bauchi State and the effective forecasting and allocation systems based on facility needs in Rivers helped ensure adequate vaccine supplies during the BCU rounds.

" … before we didn't have many vaccine storage equipment at various levels, but now, thank God, there is an improvement in the number of the vaccine storage equipment facilities, more especially the solar refrigerator."- State program manager, Bauchi

" …after I have made my own request or forecast for vaccines I need… the information is passed to the state, the state also looks at it and then allocates vaccines to us based on our needs or based on their availability in the state."– LGA program manager, Rivers

BCU implementation

The use of multi-strategy service delivery

The effective use of the multi-strategy approach (fixed, outreach, and mobile) in both states ensured that zero-dose and under-immunised children were reached.

"The fixed sessions were there, the outreach programs, and then temporary posts … to ensure that eligible children were caught up during that program."— LGA program manager, Rivers

While the target group for BCU was children aged 12-59 months, both states ensured no child was missed by vaccinating younger children (0-11 months) alongside the primary BCU target group.

"We did not only focus on children aged 12–59 months, but also included children aged 0–11 months. It was an opportunity to ensure that all of them received the vaccination. If we had focused only on the older children, the 0–11-month group would not have benefited. That is why we carried antigens along; in case we came across such children in the community, we did not want to miss any child."- LGA program manager, Rivers

However, equity concerns arising from the need to reach zero-dose and unimmunised children in Rivers State, given its geography with upland and difficult riverine areas and long distances,

created major access challenges. Some communities in the state are considered "never-to-reach," and many RI providers are reluctant to offer services there due to harsh conditions.

"Talking about out-of-reach areas, hard-to-reach areas. Sometimes, even the health personnel feel reluctant to get to those places. Perhaps they have to go by water, and sometimes the condition of the environment does not convince them. Some people [RI providers] just avoid those kinds of places, and it is a real challenge to make sure that these children get vaccinated."– WDC member, Rivers

" I have not vaccinated [the child] because of where I'm staying. The place is a distance far from here, this main community where we are now… I talked to some of these health personnel here in our local health... I asked them why they are not bringing some of those vaccines down to that place where we are, the fishing camps. The response they gave to me was that if we can contribute money, and I mean pay their transport fare, that the government is not supporting them to spend."– Father of under five children, Rivers

Adaptations in service delivery to account for local realities

In Bauchi, adaptations were made between BCU rounds to reflect local realities and ensure every zero-dose and unimmunised child was reached. For instance, adjusting fixed-day vaccination schedules, extending operating hours, and conducting early-morning outreach during the farming season transformed service delivery and improved access and uptake.

"Before, there was this problem; there's a fixed date, so if you don't come on that day, you will not be vaccinated. So, our vaccination time is today; if you don't come…and come on

any other day, you will not be vaccinated with other vaccines, but now…you can come when it's not on the vaccination day; we can give you."— RI providers, Bauchi

"We used to go there early in the morning so that we would catch them at home because they used to go to the farm. So, we are going there early in the morning to do our activities... Before they say anything, we'll finish it; they go to their farms." – RI provider, Bauchi

Additionally, vaccine supply constraints in Bauchi forced adaptations in some rounds. While this maintained implementation schedules, it drew down RI vaccine stocks.

" There was a round where we did not receive an adequate supply of vaccines for the Big Catch Up, and we had to use the RI doses that we had to make up while waiting for National to sign the consignment for the Big Catch Up." - State program manager, Bauchi

Use of community resource groups

Engaging community groups for door-to-door mobilisation and traditional and religious leaders in microplanning, supervision, and community dialogues helps identify eligible children and overcome sociocultural barriers. In Bauchi, BCU was effectively implemented using community resource groups, such as mama-to-mama, to identify zero-dose and unimmunised children. However, the mama-to-mama community networks received no compensation despite substantial time commitments.

"The use of community resource groups, I think, really helped in the success of the Big Catch Up because the mama-to-mama resource groups were actively going house to

house identifying those children that were eligible, zero dose, and making sure that they were brought out to the vaccination post for the vaccination." — Development partner, Bauchi

Meanwhile, Rivers leveraged existing local social structures and communication channels, and trusted community figures helped to create awareness and generate demand for catch-up vaccination services. Participants reported that the most effective strategy was to engage religious and traditional leaders in demand-generation efforts. Other stakeholders engaged included WDC members, who provided a formal platform for community engagement and mobilisation, as well as women and youth leaders.

"Ok, we usually have what we call the WDC meetings, so during those meeting we engage with the community representatives like the WDC chairman, they also have the Clergy with him, then we have the educator, that's the teacher, youth leader, they are there, we try to engage, so when they go back to their respective home too, they help to let them know that okay, this is what is going on, to also encourage their wards to come to the health center for the vaccination."— RI Providers, Rivers

Notably, in both states, the active involvement of traditional and religious leaders provided legitimacy, facilitated access and uptake, and supported implementation.

"We engage the traditional leaders, and they are on top of every activity. The traditional community leaders were well informed, and they even came out during the catch-up, and they sometimes supervise teams by themselves." - Development partner, Bauchi

Whenever programmes like that come up, we do mobilisation. I, as the Ndunama women leader, contact the Ndunama women and urge people to come. The community chairmen are also part of the mobilisation. Whenever there is a message, we pass it on to them, and they mobilise the people. – WDC, Rivers

These community structures can address knowledge gaps, misconceptions, and misinformation by providing tailored and trusted community-level health communication.

"…the most important thing is to debunk the wrong ideas that parents have. You need to convince them and ensure they understand the benefits. We are in a developing country where many parents are not well educated. They do not understand the value and benefits of vaccination. That is the basic problem. More educated parents tend to accept vaccination more than less educated ones."– WDC, Rivers

Tailored communication strategies

Tailored communication strategies in both states, e.g., the use of town announcers in areas with limited access to mass media, rallies, and health talks during RI sessions, were instrumental in overcoming socio-cultural barriers and misinformation and raising vaccination awareness. In both states, communication was adapted to local channels, languages, and influencers. In Bauchi, the communication team developed banners and key messages on the benefits and safety of vaccination to educate the community. In Rivers, mobilisation activities were tailored to local contexts to generate demand for catch-up activities. For instance, at the ward level, town announcers disseminated information about BCU activities, particularly in communities with

limited access to mass media. Still, it required financial investment at the facility level. At the LGA level, rallies were held.

> *"We work with the communication team to develop key messages that will educate the caregivers, giving them the right information about the benefits and safety of vaccines, and also trying to debunk any misinformation that is being circulated in the community with proven facts that are scientifically tested."*— Development partner, Bauchi

> *"At the ward level, there was a town crier. They did town-crying work, and in terms of the facility, a health talk was given to mothers on all RI session days. The information was passed through the mothers during the RI session while the town crier went around the communities... Then, for the LGA level, they did a rally concerning the Big Catch-Up, which involved all the wards from Ward 1 to Ward 20 at the LGA level. So, after that, every ward goes to their various community to inform their people, their local heads, the chiefs, the elders and, um, the WDC chairman, the women leader and the youths' leader."*- State program manager, Rivers

WDCs and other community members also acknowledged that the use of town announcers in areas was instrumental in overcoming socio-cultural barriers and misinformation, and in increasing awareness of vaccination

> *"The major reason they have so many children is because they came with the town announcer, they came out with Red Cross and went house to house, so that also drives the children to collect this immunisation" – WDC member, Bauchi*

BCU monitoring

Clear tools for recording and reporting

Clear, age-segregated data tools (i.e., existing RI registers, BCU registers, and tally sheets) in both states enabled effective documentation of children reached during catch-up activities, distinct from RI.

> *"…the data tools were very clear, like the tally sheet and the register. It captured every un-immunised child by their settlements, because it's there in the data tools, the register and the tally sheet, we can segregate them by their age and their settlements too."- RI provider, Bauchi*

> *"On the data tools, we have our child immunisation registers, tally sheets, which are the primary source of data, and we have the call-in data that we use during campaigns because we wanted a differential between routine immunisation activities and the Big Catch-up period."* – State program manager, Rivers.

In Rivers, colour-coded cards (green for 12-23 months and brown for 24-59 months) facilitated age-disaggregated monitoring during BCU.

> *"…cards are given based on the target population. On the 12-23 months, we have their green cards, and that is based on the targeted population we plan to meet for the age group12-23 months, and then the brown cards is also giving for the older children, which is for the age group 24-59 months, and it's also given based on what was targeted for*."- LGA program manager, Rivers.

However, concerns were raised about the inadequate supply of registers, gaps in the data platform, as these age groups are not captured in DHIS 2, and the burdensome and repetitive nature of the tools.

" For data management, it's very important because we don't have registers for those children who are vaccinated between 24 and 59 months. But registers were made solely for the Big Catch-up... There is no column for them in the DHIS to have them incorporated because they were missed. They were missed. And that is a special group, and it was not captured in the DHIS tool for 24-59."- Development partner, Bauchi

" The data tools were stressful. We had three different tools, and questions were repeated across them. If one tool is for implementation, it should focus on that. If another is for exit interviews, it should not repeat implementation questions."- LGA program manager, Rivers.

Real-time digital data collection and monitoring

Real-time digital data collection in both states, using a daily call-in data tool in Google Sheets and ODK checklists, provided immediate visibility into progress and enabled rapid daily adjustments, though submission delays from remote areas occasionally undermined real-time monitoring.

"With the use of the digital checklist to monitor the activities, most especially the ODK, and the use of Google sheet to record data and have the real-time data, during the campaign also helped in the digital way of these activities, cause we can monitor what is going on instantly and address it instantly."— State program manager, Bauchi

" Yes, technology has actually helped a lot because, now the use of ODK, you can go with your handset, you can ask the questions, you submit…then the call-in data tool is also electronic; the wards too have their own."– State program manager, Rivers

" Sometimes, because of the location where the teams conducted the sessions, data came in late, so we had some delays."– Development partner, Bauchi

Daily review meetings

Daily evening review meetings during the BCU periods facilitated operational improvements in both states. In Bauchi, they utilised daily evening review meetings to assess the day's results, identify challenges, and plan necessary adjustments. In Rivers, the daily evening review meetings between supervisors and field teams provided a platform to assess LGA performance, identify implementation gaps, and provide targeted feedback for improvement.

"During the implementation, we conduct a daily evening review meeting when we hear feedback on what happened; then we look at that daily call-in data because it is like a Google Sheet. As they enter it, the state is viewing what is being entered."— Development partner, Bauchi

"The review meetings, where we talk about challenges in the field, what didn't go well and what the focal person did or didn't do, are very helpful. The review meeting at the end of the day is what I think is most valuable." – LGA program manager, Rivers

Supportive supervision for implementation fidelity and quality

Intensive supportive supervision at all levels in both states provided real-time support and improved implementation quality and accountability. Bauchi employed multiple mechanisms to

ensure implementation quality, provide real-time support, and create accountability for results. These included (i) the use of standardised supervision checklists, (ii) team-based supervision for accountability, (iii) multi-level supervision cascade, (iv) daily supervision routines during campaign periods, particularly the daily cycle of observation, feedback, and adjustment that enabled rapid quality improvement, (v) on-the-job mentorship integrated with supervision, and (vi) participation of traditional leaders in supervision. In Rivers, supportive supervision ensured that planned sessions were conducted and unimmunised children within the targeted age group were vaccinated.

> *"We have state supervisors, we have LGA supervisors, we have ward supervisors, and we have the supervisors that are at the health facility level supervising the activities of the team members."— State program manager, Bauchi*

> *"I actually think that Big Catch Up is one of the programs that was over-supervised. Because we have state supervisors by the second round, each local government has one supervisor from the state… It was able to improve the situation. Of course, when you go to the field, and they say, this person is coming from the States, they see people tend to respond and tend to do what they are supposed to do." - State program manager, Rivers*

Additionally, the use of a standardised BCU implementation checklist on the ODK facilitated systematic supervision and ensured adherence to the BCU-planned activities.

> *"Supervision actually works well… there are already well-organised questionnaires… with the use of ODK, so it went well because the questions are well organised."* – LGA program manager, Rivers

However, competing programs, logistical constraints, and large LGA sizes (e.g., Rivers) hindered effective supervision.

> *"Competing programs sometimes affect supervision. For example, if a Big Catch Up is happening, and there is also another activity taking place, the number of supervisors is limited. They might not be able to effectively reach all the team members that they are supposed to supervise because their attention is also required elsewhere."- Development partner, Bauchi*

> *" There are supervisors sent to every LGA, Rivers State… has some LGA bigger than some, while some LGA are more problematic to supervise than some due to their sizes."- State program manager, Rivers*

Ward-level data validation

Using existing ward-level data validation exercises served as a quality-control mechanism, strengthening data quality and accountability. In Bauchi, respondents described existing validation exercises that compared register entries, monthly summaries, and reported indicators before uploading to DHIS2. It was also noted that the data review and validation helped identify errors, simplify ambiguous datasets, and improve subsequent rounds.

> *"We have the ward data validation, whereby we start at the state and look at what the indicators are that are going to be tracked this month… So that they will validate to ensure that what has been captured in the register is the same information that has been documented in the monthly summary before uploading to the DHIS." — State program manager, Bauchi*

In Rivers, validation extended beyond forms and summaries. Validation was conducted through the submission of action photos taken with community leaders and direct communication with them to confirm that BCU activities were conducted in the designated settlement

> *"So, what we employed was that they sent action pictures as well as… we had contact with the community leaders or the WDC chairmen in some communities. So, by the time they send those action pictures to our platforms and also our communication with the different community heads, we were able to monitor, and we were sure the team got there."— LGA program manager, Rivers*

Box 1 presents a summary of the key lessons learned for BCU planning, implementation, and monitoring to inform the integration of catch-up activities in RI and PHC systems.

BCU planning

- Successful BCU planning relies on strong multi-stakeholder collaboration with government, partners, and communities.
- A single integrated plan aligns partner strengths with implementation needs.
- Top-down prioritisation of LGAs for catch-up activities, without input from local stakeholders, undermines equity in efforts to reach zero-dose children.
- Leveraging existing governance structures, coordination mechanisms, and personnel facilitates coordination across all levels of the health system and ensures continuity of service delivery.
- Reliance on community volunteers to fill gaps in the government health workforce undermines service efficiency and continuity due to a lack of formal accountability.
- Detailed catch-up microplanning, with active community involvement and geospatial mapping technology, informed the identification and validation of zero-dose settlements, as well as resource allocation.
- Systematic vaccine distribution planning, including forecasting and allocation systems based on facility needs, helps ensure supply availability.

BCU implementation

- A multi-strategy approach (fixed, outreach, mobile) with community groups (mama-to-mama) effectively reached zero-dose children.
- Service delivery adaptations, including adjusting fixed-day vaccination schedules and conducting early-morning outreaches during farming seasons, improve vaccine access and uptake.
- Engaging community groups for door-to-door mobilisation and involving traditional and religious leaders in microplanning, supervision, and community dialogues help identify eligible children and overcome social and cultural barriers.
- Tailored communication strategies overcome misinformation and generate demand for catch-up activities.

BCU monitoring

- Clear, age-segregated data tools (i.e., existing RI registers, BCU registers, and tally sheets) in both states enabled effective documentation of children reached during catch-up activities.
- Real-time digital data collection using Google Sheets and ODK provided immediate visibility for rapid daily adjustments.
- Daily evening review meetings enable problem-solving and operational improvements.
- Intensive supportive supervision at all levels provides real-time support and improves implementation quality and accountability.
- Standardised supervision checklists facilitate systematic supervision and ensure adherence to planned activities.
- Ward-level data validation serves as a quality control mechanism, strengthening data quality and accountability.

Discussion

We documented lessons on how the BCU was planned, implemented, and monitored in Bauchi and Rivers States, Nigeria. The BCU campaign demonstrated that across all three rounds, reaching zero-dose and under-immunised children 12-59 months is feasible. Findings from the coverage data showed that Penta3 (75%) had high coverage in Rivers State, while Penta2 (70%) had high coverage in Bauchi. We learned that successful BCU planning relies on strong multi-stakeholder collaboration and coordination, an integrated plan, leveraging existing immunisation structures, detailed catch-up microplanning, and vaccine forecasting and allocation systems based on facility needs. For implementation, the use of multiple service delivery strategies (fixed, mobile, and outreach sessions), adaptation of service delivery to local realities, use of existing community resource groups and structures, and tailored communication strategies were instrumental in identifying and reaching zero-dose and unimmunised children, overcoming socio-cultural barriers and misinformation, and generating demand for catch-up vaccination. Additionally, in both states, the outreach program reached the largest number of children. Furthermore, we found that BCU's success was shaped by several monitoring processes, particularly the use of clear age-segregated recording and reporting tools, employing real-time digital data collection tools (ODK and Google Sheets) and supervision implementation checklist, daily evening review meetings, supportive supervision, and ward-level data validation, which enabled effective documentation and data quality, problem-solving, operational improvements, implementation quality, and accountability. Essentially, the BCU was not simply a recovery initiative following COVID-19 disruptions of RI services; it was also an intervention aimed at closing equity gaps.

BCU monitoring and coverage data

The high coverage of Penta 3 (75%) in Rivers and Penta 2 (70%) in Bauchi State suggests that the initiative successfully retained and reached over 70% of children with immunisation services. Evidence shows that supplementary immunisation activities, often termed campaigns, conducted within and outside health facilities at short intervals, improve RI coverage and reduce dropout rates in Nigeria [39]. While our case study findings indicate that the BCU can help close immunisation equity gaps, coverage levels remained below global targets [3], highlighting the need to strengthen the RI program as a long-term approach and conduct effective catch-up activities or campaigns in the short-term to ensure every child is reached and protected from vaccine-preventable diseases [40].

Planning

A key lesson learned was that strong multi-stakeholder collaboration and coordination involving government, development partners, and community structures during planning were vital to BCU's success. This highlights the importance of early engagement, the inclusion of all stakeholders in planning, and the role of influential community structures in facilitating buy-in and effective mobilisation to enhance vaccination reach and coverage [41–43]. Similar studies have highlighted that involving local partners in planning enables greater access to communities, and utilising partners' networks broadens a campaign's reach [41,42,44]. Indeed, coordinated planning ensures alignment among stakeholders at the national, state, and community levels and fosters local ownership of vaccine delivery and uptake [45].

The collaboration during BCU planning was feasible because it leveraged existing immunisation governance coordination structures and human resources, including the providers that deliver RI services. Leveraging existing coordination structures kept catch-up activities within the RI program, facilitated planning decisions, minimised disruptions to routine care associated with establishing new structures and recruiting new personnel for the campaign, and ensured accountability [46]. Additionally, it led to the development of a single integrated plan that aligns with partners' strengths and BCU implementation needs from the onset, rather than figuring it out during implementation. These coordination structures and personnel, being part of the routine system, mean that future catch-up activities can use them. Logistically, this matters because large-scale catch-up efforts are resource-intensive and should complement RI, and sustaining BCU gains requires continuous investment in immunisation programs [47].

Detailed catch-up microplanning was crucial for identifying zero-dose and unvaccinated children. The use of geospatial mapping to identify settlements in Bauchi State, along with the involvement of multiple stakeholders, including healthcare workers and community actors, in validating settlement lists, helped enhance reach, track population movements, and guide deployment in hard-to-reach areas. The combination of digital technology and local knowledge for microplanning aligns with a landscape analysis of microplanning in low- and middle-income countries (LMICs), which found that microplanning is most effective when health care workers and communities are engaged in the development process and that digital tools, especially geospatial technologies, accurately mapped catchment areas [48]. However, while digital tools enhance microplanning, they should not replace community engagement, as they cannot accurately capture migration patterns, community movement, or perspectives on the timing and

location of outreach services without community insights [48]. This emphasises the importance of a “bottom-up” approach to microplanning that includes health care workers and community members in microplanning processes to ensure the identification of children and communities that immunisation services do not reach [48–50]. Additionally, despite PCV shortages reported due to global vaccine issues, the bottom-up microplanning process ensured vaccine availability across the BCU rounds, as vaccine forecasting and allocation were based on validated facility-level settlement lists and target populations. This is consistent with a study in Tanzania that documented the use of bottom-up microplanning for vaccine allocation based on available budget [51].

Our case study identified an equity issue with the LGA selection for BCU at the national level, with respondents questioning the rationale for their selection. In Bauchi, the two BCU LGAs were rural and had fewer wards, while program managers cited urban areas with zero-dose and under-immunised children that were not reached. This is important because the distribution of zero-dose and under-immunised children in Nigeria varies significantly, with the highest prevalence in the northern region, particularly the northwest and the northeast, including Bauchi [5,40]. Also, a trend analysis from 2018 to 2024 reported that zero-dose inequities widened within and between states in Northern regions [6]. An LGA selection that does not draw from the evidence on where these zero-dose and under-immunised children are risks implementing scarce resources and interventions away from the target population. Most importantly, while the national prioritisation of zero-dose LGAs was data-informed, it should be co-developed with the states, whose contextual knowledge can add value.

BCU planning also faced persistent structural barriers, including shortages of health workers, which the initiative could not solve. Both states relied on community volunteers, who are often unpaid and whose attendance varies because they are not formalised in the system, to cover shortfalls in government staffing, thereby affecting service delivery. Other studies in sub-Saharan Africa have also found that reliance on unremunerated community volunteers affects service continuity, and that attrition of these volunteers contributes to this effect [52,53]. Future catch-up activities should formalise the community volunteer system with clearly defined roles, training, supervision, and remuneration [52,53].

Implementation

Fixed, outreach, and mobile strategies were used together, with trusted community groups, such as mama-to-mama, identifying eligible children ahead of the sessions. This suggests that various strategies are needed to reach zero-dose and unimmunised children, especially those in inaccessible areas, including crisis-affected settings [13,54]. Among the vaccine delivery strategies employed, more children were reached through outreach sessions, similar to a study in Uganda, which reported that outreach significantly improved child immunisation coverage [55]. This reinforces a central equity lesson that when children are systematically excluded from routine facility-based delivery, catch-up vaccination must be brought closer to where they live through tailored outreach and mobile strategies [56–60]. Meanwhile, when planned sessions conflicted with local realities, the teams adapted them, e.g., early morning outreaches during the farming season and adjusting fixed session times, which improved access and uptake. Conversely, a study in Sokoto State reported that outreach efforts failed because people had already gone to farm [61]. Immunisation programs to reach zero-dose and unimmunised children should be flexible

765 enough to adapt to local realities, and this should be built in from the planning stage rather than
766 waiting until implementation.

767 In addition, engaging trusted community resource groups, such as mama-to-mama, for door-to-
768 door mobilisation, and involving traditional and religious leaders in microplanning, supervision,
769 and community dialogues helped identify eligible children and address sociocultural barriers to
770 vaccination. This lesson is important because zero-dose children are often missed due to
771 communities' lack of trust in the health system [16]. Systematic reviews and meta-analyses have
772 reported that engaging trusted community actors reduces barriers to vaccination and improves
773 vaccination efforts and coverage globally and in LMICs [62,63]. A cluster-randomised control trial
774 in Cross-Rivers State, Nigeria found that engaging traditional and religious leaders significantly
775 improved the uptake of RI vaccines [64], and traditional institutions such as the Northern
776 Traditional Leaders Council have resolved 65% of reported cases of vaccine refusal across 17
777 northern states [65]. Thus, community engagement should be integrated as a core
778 implementation mechanism for equity [66].

779 Tailored communication strategies targeted at specific barriers and deployed using existing
780 community and health facility structures, e.g., town announcers and health facility platforms and
781 health talks during RI sessions, were instrumental in overcoming socio-cultural barriers and
782 misinformation [67]. Recent studies. Studies have also found that culturally tailoring messages
783 significantly improved vaccination knowledge, perceived trustworthiness, and coverage [68,69].

784 **Monitoring**

There were innovations deployed during BCU monitoring. Age-segregated registers, tally sheets, and, in Rivers, colour-coded cards enabled effective documentation and the differentiation of children reached during catch-up activities from those reached by RI. Studies have also shown that colour-coded cards and tally sheets are highly effective tools for tracking vaccination coverage, ensuring age-appropriate catch-up doses, and monitoring target populations[70,71]. Without these, older children reached with catch-up vaccines would have been misattributed, or it would have been assumed that BCU did not reach them. Given that children aged 24-59 months accounted for 54-86% of missed vaccinations and the DHIS2 does not routinely report these age groups [30], there is a need to expand the platform to capture them, thereby strengthening monitoring and enhancing the identification and follow-up of missed children.

Real-time digital data entry and monitoring provided immediate visibility into progress, enabling state teams to rapidly correct issues as implementation progressed, while the daily evening review meetings informed decisions using the data. This is more important for catch-up efforts than for routine service delivery because each round lasted six to nine days, a limited window to address any identified issue, as it will not be resolved after the round ends. Similarly, other studies have reported that digital tools improve problem-solving and program performance [72,73] and are associated with improved vaccine uptake [74]. However, these gains are not evenly distributed due to delayed submissions from remote areas. This implies that monitoring of implementation in settlements where children are least likely to be reached was limited.

Supportive supervision at all levels, guided by standardised checklists, provided real-time support and facilitated implementation fidelity, and ward-level validation checked data quality before uploading. However, Avortri et al. (2019) associate checklists with periodic inspection and control,

report that improving supervision quality is preferable to increasing frequency, and argue that external supervision models, with their funding and logistics requirements, are not sustainable in low-income countries [75]. The authors further made a case for internal supportive supervision at the health facility or ward level, anchored in a strong system for monitoring, data, and information management [75]. BCU's supervision was external (i.e., state teams visiting LGAs and wards), intensive, and checklist-based, and respondents said it improved performance. While external supervision provided support and pressure for a time-bound activity, and ward-level validation provided internal supportive supervision, the effectiveness and affordability of intensive supervision once catch-up is routinised are beyond our study findings. Strengthening capacity at the health facility level for internal supportive supervision has been recommended to reduce systemic and logistical implementation challenges in low-income countries [75].

Implications for policy and practice

Our study demonstrates that the resources required to sustain catch-up vaccination are available in some form, including governance structures at all levels, microplanning approaches, service delivery adaptations, community mobilisation channels, and monitoring tools. What is therefore needed is (i) formal policies that position catch-up as a routine, continuous component of immunisation programs rather than as a time-bound campaign or recovery plan, (ii) sustainable domestic financing for catch-up activities, (iii) formalising community resource groups within the health system structure, with defined roles, training, supervision, and remuneration, and (iv) expanding reporting systems to capture children aged 24-59 months. A subnational review of BCU implementation across Nepal, Myanmar, India, and Timor-Leste identified transitioning from campaign-style activities to fully institutionalised routine systems, strengthening real-time data

and digital systems, targeted microplanning, and community engagement as priorities to sustain catch-up gains [76], which were the same components that emerged from Bauchi and Rivers States in Nigeria.

Strengths and limitations

This study has several strengths. First, we used a sequential explanatory mixed-method design, which allowed us to triangulate coverage data with interviews and focus groups to provide an in-depth understanding of the "how" and "why" of BCU planning, implementation, and monitoring. Secondly, including multiple respondent groups (program managers, health workers, partners, and community members) across two states with contrasting geographies and immunisation roles broadened the range of perspectives captured and enabled lessons to be drawn from different implementation realities.

However, there are limitations. Because the case study was conducted in two purposively selected states, our findings are not generalisable. Regardless, the purposive selection of contrasting contexts helped to generate lessons transferable to similar settings. Data collection was conducted after the completion of the three BCU rounds, so the findings relied on participant recall rather than real-time observation, which may have introduced recall and social desirability biases. We mitigated this by triangulating interviews with coverage records. Finally, the BCU coverage data were obtained from the program's monitoring data, the quality of which we did not independently verify.

Conclusion

The BCU has demonstrated that reaching zero-dose and under-immunised children is achievable when strong multi-stakeholder coordination, adequate resources, and genuine community engagement converge. Across the three rounds, the BCU successfully reached children aged 12-59 months despite logistical and contextual challenges, confirming the feasibility of catch-up vaccination efforts. However, feasibility is not sustainability. Without addressing the root causes of under-immunisation, Nigeria risks perpetuating a cycle of periodic catch-up campaigns that respond to accumulated backlogs of zero-dose and under-immunised children rather than preventing them through timely vaccination coverage. The path forward demands simultaneous action across multiple fronts. Catch-up needs to be formalised as a continuous RI activity through clear policies, and the community volunteer networks that proved critical to BCU success need to be formalised with defined roles, training, supervision, and remuneration. Integration with existing platforms, such as the periodic intensification of routine immunisation, offers immediate opportunities, while comprehensive integration into the PHC provides holistic health services beyond vaccination. This case study presents the evidence and the strategies; what remains is the political commitment and sustained domestic financing to act on them. The measure of BCU's success will be whether these lessons will catalyse the systemic changes needed to make on-time vaccination the norm for every child, regardless of their location, family, or community challenges. Nigeria's immunisation programme must now shift from restoring immunisation coverage to sustaining it, so that zero-dose and under-immunised children are reached equitably.

List of abbreviations

AHPSR: Alliance for Health Policy and Systems Research

BSPHCDA: Bauchi State Primary Health Care Development Agency

BCU: Big Catch-up

RI: Routine Immunisation

COVID-19: Coronavirus Disease 2019

DHIS2: District Health Information Software 2

FGDs: Focus Group Discussions

KIIs: Key Informant Interviews

LGAs: Local Government Areas

HREC: Health Research Ethics Committee

ODK: Open Data Kit

PHC: Primary Health Care

RSPHCMB: Rivers State Primary Health Care Management Board

Declarations

Ethics approval and consent to participate

We obtained ethical approval from the Bauchi State Health Research Ethics Committee (approval number: NHREC/TR/BAU-HREC/28/8/2023) and the Rivers State Health Research Ethics Committee (approval number: RSHMB/RSHREC/2025/042). Informed oral consent was obtained from all study participants before data collection, using standard oral consent scripts, and documented. All respondents approached provided consent and were interviewed. All data were de-identified, stored in a password-protected system accessible to the key research team and backed up weekly to a OneDrive cloud repository accessible to selected consortium team members. Quotes were also anonymised to protect participants' privacy.

Consent for publication

Not applicable

Availability of data and materials

The datasets used and analysed for the case study are available from the corresponding author on reasonable request.

Competing interests

The authors declare that they have no competing interests

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Authors' contributions

COJ conceptualised and designed the study, developed the interview guides, reviewed the qualitative and quantitative analysis, conducted synthesis, and drafted the manuscript; AOA developed the codebook, led the qualitative analysis, and supported the manuscript development; CO reviewed the data analysis and interpretation; CA contributed to the qualitative coding, analysis, and synthesis; CO and MTM led the quantitative data analysis; RO contributed to the qualitative coding and analysis; MA supported study coordination and contributed to the qualitative coding; FO contributed to the study design, coordinated the study, co-developed the interview guides, and reviewed the codebook; BU contributed to the study design, data analysis, and interpretation. All authors read and approved the final manuscript for submission.

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