



Health Workers' Perspectives on Missed Childhood Immunisation Appointments and SMS Reminder Implementation in Primary Healthcare Centres in, Abuja, Nigeria

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Abstract

Context: Childhood immunisation remains an effective public health intervention for preventing vaccine-preventable diseases. Missed appointments undermine vaccine uptake. Short Message Service (SMS) reminders have demonstrated effectiveness in improving childhood immunisation uptake and timeliness. Evidence on implementation barriers from frontline health workers remains limited. This study explored health workers' perspectives on factors associated with missed childhood immunisation appointments, the feasibility and implementation of SMS-based reminder in Abuja, Nigeria.

Materials and Methods: This qualitative design used key informant interviews. Twenty-eight different categories of health workers were purposively recruited from 14 primary healthcare facilities until thematic saturation was achieved. The interview guide explored immunisation attendance patterns, reasons for missed appointments, health system barriers, existing defaulter-tracking practices, and perceptions of SMS-based immunisation reminders. Interview transcripts were analysed using Braun and Clarke's six-step thematic analysis framework (2006) to identify recurring themes and patterns.

Results: Seven themes emerged: household constraints; mobility and continuity of care; clinic-organisation barriers; defaulter-tracking; acceptability of mobile reminders; operational barriers and community engagement and service responsiveness. Health workers viewed SMS reminders favourably but highlighted literacy, network coverage, electricity access and mobile phone ownership as implementation challenges. Participants with previous exposure to automated reminder systems expressed greater confidence in digital reminder interventions.

Conclusion: Missed childhood immunisation appointments arise from a complex interplay of caregiver, health system, and programme-level factors rather than a single cause. While health workers view SMS reminders as feasible and acceptable, long-term sustainability remains a key challenge for successful implementation. These findings support implementing a locally sustainable, funded, multi-channel follow-up system.

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1. Introduction

Routine childhood immunisation is one of the most

effective and cost-effective public health interventions, preventing an estimated 3.5–5 million deaths annually from vaccine-preventable diseases such as measles, diphtheria, tetanus, pertussis and poliomyelitis. In addition to reducing childhood morbidity and mortality, immunisation contributes to healthier communities, lowers healthcare costs and strengthens health security. Despite these achievements, millions of children worldwide continue to miss essential vaccines, leaving them vulnerable to preventable diseases and outbreaks.^{1,2}

Globally, childhood immunisation coverage has improved substantially over recent decades but has plateaued in recent years. In 2024, approximately 85% of infants received three doses of diphtheria-tetanus-pertussis (DTP3) vaccine, while an estimated 14.3 million children remained completely unvaccinated ("zero-dose" children). The greatest burden of under-immunisation occurs in low- and middle-income countries, where poverty, fragile health systems, conflict and limited access to health services continue to impede routine immunisation. Recognising these challenges, the World Health Organization's Immunisation Agenda 2030 (IA2030) calls for equitable access to vaccines, stronger routine immunisation systems, community-centred service delivery and targeted strategies to reach zero-dose and under-immunised children.^{1,2}

Nigeria continues to experience substantial gaps in routine childhood immunisation. According to the 2024 Nigeria Demographic and Health Survey, only 39% of children aged 12–23 months received all basic antigens, reflecting persistent challenges in vaccine access, timeliness and completion.³ Children may miss recommended vaccine doses or receive them later than scheduled. Delayed or incomplete vaccination should be distinguished from a missed opportunity for vaccination, which occurs when an eligible child attends a health facility but does not receive all vaccines for which they are eligible. In Ondo State, 32.8% of eligible children experienced missed opportunities during health-facility visits, with caregiver knowledge, health worker practices and service organisation contributing to the problem.⁴ A national scoping review further identified maternal education, household circumstances, community context, geographical access, vaccine availability and vaccinator availability as important determinants of zero-dose and missed-dose vaccination in Nigeria.⁵

There are multiple barriers that can all contribute to missed appointments. Caregivers may miss appointments because of transport costs, competing work and household responsibilities, fear of adverse events following immunisation, or limited family support. There are also several areas where health facilities can contribute, such as vaccine shortages, disruption of services, long waiting times, negative attitudes of health workers, limited clinic days, lack of space, insufficient staff or poor tracking systems. Several qualitative studies in Nigeria have revealed that financial and geographical barriers, negative experiences at facilities, limited awareness, misconceptions, adverse events occurring after immunisation and household decision-making have all been identified to influence the enrolment of children for immunisation.^{6,7}

To overcome forgetfulness and poor awareness of appointments, mobile reminder systems have been suggested. SMS, automated calls, or a combination of both have been shown to increase vaccination completion and timeliness in Nigeria and Pakistan.^{8,9,10} Similarly, a systematic review in Nigeria found high mobile-phone ownership and willingness to receive reminders among caregivers, although preferences for SMS, telephone calls, timing and language were found to differ significantly by context.¹¹ The results indicate that reminder systems can be effective, but this varies according to the context, content, delivery method, staffing, and financing of these reminders and their integration with routine services.

Although evidence on caregiver acceptability of mobile reminders is growing, little is known about their implementation from the perspective of frontline health workers operating within routine primary healthcare services in Nigeria. Health workers are responsible for recording appointment dates, maintaining tracking cards, reaching out to defaulters and responding when reminder systems generate increased attendance.

This study explored health workers' perspectives on factors associated with missed childhood immunisation appointments and examined their views on the feasibility, acceptability and implementation requirements of SMS-based reminder systems.

2. Materials and Methods

2.1 Study design

This study employed a qualitative descriptive design to obtain experience-based accounts of immunisation attendance, missed appointments, defaulter follow-up and reminder-system feasibility. This design was appropriate because the study sought a straightforward account of operational experiences across multiple primary healthcare facilities rather than the development of a formal explanatory theory. The analysis followed the six-phase approach to thematic analysis by Braun and Clarke.¹² Reporting was informed by the Consolidated Criteria for Reporting Qualitative Research, or COREQ.¹³

2.2 Study setting

The study was conducted in 14 primary health care facilities (Aleyita, Apo, Damagasa, Durumi, Garki, Gosa, Gwa-Gwa, Gwarinpa, Iddopada, Idu, Jikwoyi, Karu, Kuchingoro and Lugbe) that provide routine childhood immunisation in Abuja Municipal Area Council (AMAC), FCT, Nigeria. The facilities were purposively selected because of their high client volume and served urban, peri-urban, resettlement, commercial and pastoral communities, including settlements near the Nasarawa State boundary.

2.3 Study population and sampling technique

Study participants were Health workers (Community Health Extension Workers (CHEWS), nurses, midwives, routine immunisation focal persons, facility officers-in-charge, ward focal persons, immunisers, records staff and volunteers) directly involved in routine childhood immunisation or supporting immunisation records and follow-up. A purposive sampling technique was employed to recruit health workers who had direct knowledge of routine immunisation services. From each selected facility, two participants were interviewed, giving a total of 28 interviews. Recruiting health workers across different facilities allowed for rich comparisons of experiences across catchment settings. The research team continued sampling and analysis until they judged that additional interviews were no longer producing substantively new categories relevant to the research questions.

2.4 Data collection

Face-to-face semi-structured key informant

interviews were conducted at each facility where the participants worked. The interview guide included questions exploring the participant's role and experience, perceived attendance patterns, reasons for missed appointments, groups perceived to be at higher risk, effects of travel and relocation, facility and health-system barriers, existing tracking methods, previous experience with reminder programmes, views on SMS and telephone reminders, and recommendations for improving follow-up.

Interviews were conducted primarily in English, with code-switching where necessary to maintain effective communication. Additionally, consent was sought from the participants before recording, and the audio recordings were transcribed and checked against the recordings. In the event that speech was translated or subtly edited for readability, the meaning was retained. To maintain anonymity, direct identifiers were removed during preparation of the transcribed data.

2.5 Data analysis

An inductive thematic analysis focused on the explicit meanings within participants' accounts. In order to familiarize themselves with the datasets, the research team repeatedly read the transcripts. Key parts of the interview were grouped with initial codes to identify similar patterns, and codes were grouped into candidate themes. Furthermore, the full dataset was reviewed against the candidate themes; thereafter, the themes were subsequently reviewed and refined to ensure internal coherence, clear distinction between themes and alignment with the study questions. In addition to the analysis phase, the research team took cognizance of opinions that were common and contrasting, including divergent views from different facilities and whether SMS or telephone calls would be more suitable.

To ensure balanced representation of all facilities and to avoid treating each facility as a single voice, a respondent-level coding matrix was used. Coding was conducted manually without employing any thematic analysis software. The matrix allowed for each participant to be assigned to each code and supported comparison within and across facilities. To strengthen the credibility of the results, the transcripts were reviewed separately; there were comparisons with positive and negative cases; quotes from participants at different health facilities

were used; and the results were discussed together as a research team.

2.6 Reflexivity

Before data collection, interviewers were trained to maintain neutrality and use non-leading prompts. Clarification questions were used where necessary to support participants' understanding without suggesting preferred responses. During analysis, the research team remained aware that interviewer-participant interactions could have influenced some accounts. Interpretations therefore prioritised recurring patterns across facilities while also considering divergent and contrasting views.

2.7 Ethical considerations

Ethical approval for the study was obtained from the Federal Capital Territory Health Research Ethics Committee with Approval Number: FHREC/2026/01/151/15-04-2026, dated 30/03/2026. Administrative permission to conduct the study in Primary Healthcare facilities within the Abuja Municipal Area Council (AMAC) was obtained from the AMAC Primary Health Care Department with reference no: AMAC/PHC/HSS/0495 dated 05/05/2026 before commencement of data collection.

Prior to each interview, participants were informed about the purpose of the study, the voluntary nature of participation, their right to decline participation or withdraw from the interview at any time without consequence, and the measures taken to ensure confidentiality and anonymity. The participant information and consent statement contained in the interview guide were read aloud to each participant, and verbal informed consent was obtained before the interview and audio recording commenced. No personal identifiers were included in the transcripts or analytical dataset, and all data were handled confidentially throughout the study.

3. Results

Twenty-eight health workers from 14 primary healthcare facilities participated. Two respondents were included from each facility. Reported experience ranged from one year to approximately 25 years. Table 1 presents the participant profile.

Seven interrelated themes were identified through thematic analysis. The themes and illustrative participant quotations are presented below.

Table 1: Participants' Profile from 14 Primary Healthcare facilities in AMAC Abuja

Characteristic	Category	Summary
Designation	Community Health Extension Workers (CHEWs)	11
	Routine Immunisation focal persons	6
	Officers-in-charge/Unit heads	2
	Nurses/Midwives	4
	Records/Data personnel	4
	Medical Laboratory Technician	1
Immunisation experience (years)	<5 years	6
	5 – 10 years	12
	>10 years	10
Years at current facility	<5 years	8
	5–10 years	11
	>10 years	9

N.B: Participant characteristics. "NR" indicates information not clearly reported in the transcript.

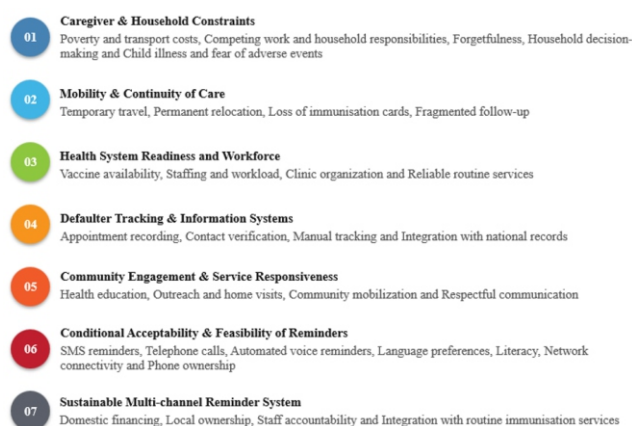


Figure 1: Implementation Theme and Key Components

3.1 Caregiver and household constraints

The most common reason cited by participants for not attending an appointment was competing responsibilities and limited household resources, rather than an intentional decline to immunisation. Forgetfulness was frequently mentioned, especially in cases where there were long interval visits. For working-class mothers who were privately employed, it was reported that they encountered difficulty trying to obtain permission to attend. Other factors reported to interrupt attendance were market and business activities, taking care of several children, unforeseen family events, bereavement, and travel.

"Most of the time, it is working-class mothers. If the person works in a private organisation, it is not easy for them to be released." (Aleyita_01)

"The major reasons are forgetfulness and financial difficulties. Most of them explain that they either forgot the appointment date or did not have transport fare." (Gwa-Gwa_01)

Caregivers who were living farther away from facilities or relied on their husbands for money considered transport costs particularly important. Low household support and spousal opposition were also noted by some participants. Some mothers were said to have attended without the knowledge of their husbands, and some mothers gave their husbands their telephone numbers and relied on their husbands to send reminders.

"Some women attend immunisation services without their husbands' knowledge because their spouses do not support vaccination. Working mothers may also find it difficult to attend scheduled appointments." (Garki 02)

Low literacy and lack of knowledge or understanding of the schedule were consistently associated with missed visits, but this was not the case in all situations. Some participants emphasised that caregivers with little formal education were still attending consistently after proper health education, while some educated caregivers with demanding jobs were not making the visits due to job responsibilities. In some facilities, first-time mothers and younger mothers were seen to be vulnerable, especially if they did not receive practical assistance after giving birth.

"Young mothers are more likely to miss appointments, particularly those recovering from caesarean section deliveries who may lack adequate support at home when their spouses are unavailable." (Gosa-02)

In addition, child illness was another notable finding. In some cases, participants recommended that vaccinations should be delayed when a child was ill. This shows how providers and caregivers perceive contraindications and can contribute to delayed vaccination. Some caregivers expressed fear of post-vaccination fever or pain, making them reluctant to return following previous doses.

3.2 Mobility, travel and continuity of care

There was a wide array of reports of travel and relocation, with varied effects. Participants identified several reasons why caregivers travelled. For some, it was for funerals, festivals, or visiting a distant relative and they inadvertently left the child's immunisation card behind. Others moved back to their family homes for delivery and then moved again after taking the initial doses. Seasonal migration affected attendance during holidays and

festivals, and permanent relocation led to a loss of follow-up by the concerned facilities.

"Some of them travel because of emergencies. In the process of gathering things, they may forget to carry the immunisation card." (Aleyita_02)

"Some will come and put to bed here. At the end, maybe they will do Penta 1. After Penta 1, they will go and may not come back for two or three months." (Karu_02)

"They might say, 'I travelled, I forgot my immunisation card, so I missed this, I missed that.'"

(Gwarinpa 02)

Participants reported that most caregivers understood that with Nigeria's child immunisation card, vaccination can continue in other public facilities. Health workers routinely gave caregivers advice to take the card with them and use the nearest primary or secondary facility. However, this discouraged continuity, as cards were lost in the process, and caregivers could not tell what doses were given in previous visits, or there was no universal electronic database to reconcile records from another facility. Cross-facility attendance may thus prevent the child from being lost to follow-up and drop-out but undermine the completeness of facility-level follow-up and drop-out estimates.

3.3 Vaccine, workforce and clinic-organisation barriers

Participants spoke of supply-side factors which might prevent a child from receiving a scheduled dose if the caregiver was present. Some facilities reported vaccine/antigen stock-outs, sometimes due to a lack of delivery/transportation to the local cold store, or because the cold store itself had not received supply. The caregivers were then directed to other places or asked to return at a later time. This was concerning for low-income families, who experienced increased transportation costs and a greater tendency for delays.

"The mother may be ready, but the facility may not have all the vaccines. She has to move from one facility to another, and that costs a lot of money." (Apo_02)

Another recurring source of disruptions was industrial action. Some caregivers temporarily transferred to private facilities, while increased charges made it impossible for other caregivers to continue immunisation for their ward(s). Some caregivers temporarily sought immunisation

services from private facilities, while others were unable to afford the associated fees. Participants also reported staff shortages, reliance on volunteers, inadequate compensation, and an inability to reach out or systematically follow up. In some PHCs, the officer-in-charge was one of the very few permanent employees.

"Vaccine stock-outs and shortages of certain antigens can affect service delivery. In addition, many staff members are volunteers, which can limit the capacity for systematic follow-up." (Gosa 01)

"We have only two permanent staff. It is only me and the person that is giving immunisation. The others are volunteers, and they can go at any time." (Damagasa_01)

Clinic organisation also affected attendance. Some of the facilities were characterised by crowding, very few chairs, long documentation processes, small rooms for immunisation, and limited clinic days that could increase waiting time. In response, some facilities decided to add specific immunisation days, divide vaccines across days or introduce auxiliary staff when attendance was high. Participants also reported moving to facilities with fewer wait times and more welcoming staff.

"Immunisation needs more hands... We stay about three or four hours for them just to collect the vaccine and go." (Jikwoyi 01)

One participant reported a lot of overlap of partner registers and national reporting tools. The participant stated that it would be hard to sustain if they introduced separate registers, data-entry demands and reporting formats. The integration with national immunisation records was therefore considered an implementation requirement and not an administrative wish.

3.4 Uneven and unsustainable defaulter-tracking systems

There were significant variations between the tracking systems at various facilities. Detachable tracking cards or tickler boxes by appointment date were actively used at some facilities. The staff identified cards of children who were not at a clinic session and called the registered numbers at the end of the clinic session. Participants who used these systems viewed them as effective when the cards were changed regularly.

"You cannot track people by memory. With the tickler box, everything is arranged according to months and

dates. The owner of any card who did not come, we call the phone number." (Aleyita_01)

Other facilities did not report having a formal follow-up system; in some cases, follow-up systems existed, but they were not consistent and did not involve much outreach or reminders, except for word-of-mouth. As reported in several facilities, staff members, devices, automated platforms, or airtime were provided by a previous partner-supported programme. However, these activities declined or stopped once partner support ended. This made some health workers call caregivers using personal airtime, which was not financially sustainable.

"When that organisation left, he also left because they were the ones paying him. Now there is nothing like that." (Aleyita_02)

"There is currently no formal system for tracking or following up caregivers who miss childhood immunisation appointments." (Durumi 01)

"We once had an NGO that was responsible for tracking defaulters and making automated phone calls to caregivers who missed their appointments. After their contract ended, we continued the follow-up ourselves, but we have experienced many challenges." (Kuchingoro 01)

"Key informants in the community were our most effective trackers because they knew almost everyone and were well respected." (Iddopada 02)

"We do it from our pocket. When we do not have it, that particular week we cannot reach out to them." (Damagasa_02)

The findings provide sufficient evidence that tracking can work, but its success hinges on securing enough funding and having enough staff to support it. Systems rely largely on commitments made by individuals, donor support, or the presence of capable staff.

3.5 Conditional acceptability of mobile reminders

Most participants believed that SMS reminders could reduce forgetfulness and help caregivers prepare for appointments. Health workers who had firsthand experience with automated or partner-supported reminder programmes expressed greater confidence. They recalled caregivers coming after receiving messages, and that reminders assisted those who were aware of the schedule but not conscious of the date.

"The woman will come and say, 'I forgot, but I saw the message and started running here.' It was very

effective.” (Damagasa_01)

“SMS reminders may be more effective because even if a caregiver misses a phone call, the text message remains available and can be read later.” (Gosa 01)

“It is better than nothing. As human beings, it is normal to forget certain things so SMS reminders would be a welcome development.” (Apo_02)

Acceptability was nevertheless conditional. Many participants preferred telephone calls because they allowed direct communication, immediate feedback and communication in a language familiar to the caregiver. Others found SMS preferable, as a message is still available after a missed call and can be read subsequently. A substantial number of respondents agreed that both methods should be combined, i.e., sending SMS 1 or 2 days before the appointment and initiating a call to caregivers who have difficulty reading, did not receive the message, or missed the appointment.

“When we call them, we don’t reach them all the time... But that SMS, when they come check their phone, they will see the message.” (Lugbe 02)

To further make the SMS effective, participants also suggested the use of messages in multiple languages, such as English, Hausa and Nigerian Pidgin, and some proposed automated voice messages. The selection of channel was repeatedly correlated with the peculiarities of the local catchment characteristics, rather than a general preference.

3.6 Access, literacy and operational barriers to digital reminders

Beyond general acceptability, health workers identified several access and operational barriers. Some caregivers did not have phones, shared with a spouse, did not know the provided number, changed numbers, had lost their phone, or had phones that were often turned off. Power outages could delay phone charging, while poor network coverage could prevent or delay message delivery. Also, bulk-message delivery failures due to certain phones on Do not Disturb (DND) or system failure could leave questions regarding whether or not a reminder was received.

“Some mothers don’t have phones... They don’t know their number. Even their husband’s number, they don’t know. So, we don’t know what number to call.” (Gwarinpa 02)

“Poor network coverage and unreliable message delivery may affect the success of SMS reminder

systems.” (Idu 01)

“The only challenge I noticed was knowing whether the SMS had actually been delivered. Sometimes bulk messages did not go through, and there was no feedback.” (Apo_02)

“The major challenges include limited access to mobile phones among some caregivers and electricity outages, which may affect phone charging and the receipt of reminder messages.” (Iddopada 01)

Literacy was still a significant drawback since some caregivers were unable to read English, Hausa or any written message. Family members or neighbours sometimes had access to read the message, but this was dependent on trust and timely access. Incorrect telephone numbers and shared phones, particularly where partners did not pass messages to caregivers, could reduce the effectiveness of reminders.

Operational requirements were equally important. Participants questioned who would enter appointment dates, update the telephone number, track delivery, respond to calls and send messages and pay any recurring expenses. They also warned that any intervention that will introduce a new registry or depend on staff personal phone usage will not be sustainable. Frequent funding of airtime, automation, platform funding, dedicated staff, data protection measures, and integration with existing national records were repeatedly suggested or explicitly requested.

3.7 Community Engagement and Service Responsiveness

Participants consistently identified community engagement and responsive service delivery as essential for improving attendance at childhood immunisation appointments. Health education was viewed as a cornerstone of routine immunisation services, with participants describing regular discussions on vaccine-preventable diseases, the importance of completing the immunisation schedule, expected minor adverse events following immunisation, and the need to return on scheduled appointment dates. Health talks also covered breastfeeding, nutrition, hygiene and oral rehydration therapy, providing additional health benefits to caregivers attending immunisation clinics.

“Education is very important. When mothers hear the benefits and the implications, they will not want

to miss immunisation.” (Aleyita_02)

Participants emphasised that health education alone was insufficient for caregivers facing barriers such as poverty, long travel distances, low literacy or limited trust in health facilities. In these situations, outreach activities and home visits were considered important strategies for reaching children who might otherwise become zero-dose or default from immunisation schedules. However, outreach implementation was frequently constrained by inadequate transport, fuel shortages, staffing limitations and inconsistent partner support.

Trusted community structures were also regarded as critical for mobilising caregivers and reinforcing reminder messages. Participants highlighted the roles of village health committees, ward development committees, traditional and religious leaders, community mobilisers and town announcers in promoting immunisation uptake. Some respondents also suggested providing incentives or "immunisation plus" items, such as mosquito nets or baby-care products, to encourage attendance, although they cautioned that such incentives should complement, rather than replace, reliable routine service delivery and should be sustainable over time.

“In advocacy, we go to the chief... We tell them the importance. When they go back to their communities, they should help us tell the people that mothers must not miss immunisation.” (Garki 01)

“Community mobilisers and town announcers should be engaged and provided with adequate logistical support. Community members trust and respect these individuals, making them effective channels for promoting immunisation attendance.” (Garki 02)

Beyond community engagement, participants consistently linked caregivers' willingness to return for subsequent immunisation visits to the quality of interactions they experienced at health facilities. Friendly communication, respectful treatment, efficient service delivery, flexibility when caregivers arrived late, and staff willingness to resolve problems were perceived as important factors encouraging continued attendance. Some facilities reportedly attracted caregivers from neighbouring communities because of reliable vaccine availability, shorter waiting times and positive staff relationships.

“If the attitude of the health workers is bad, it will scare caregivers away. Because the attitude here is commendable, many who started elsewhere

complete their children's immunisation here.” (Aleyita_01)

“Every health facility should build good relationships with mothers... staff should remain friendly and understanding... Building good relationships helps a lot.” (Gwarinpa 01)

Conversely, participants observed that poor staff attitudes, long waiting times, repeated referrals and situations in which caregivers felt embarrassed after missing appointments discouraged future attendance and sometimes prompted caregivers to seek services elsewhere. Participants stressed that reminder systems should reinforce supportive rather than punitive communication. Reminder messages should reassure caregivers that missed appointments can be rescheduled without blame, thereby promoting trust and encouraging re-engagement with immunisation services.

4. Discussion

The findings demonstrate that missed childhood immunisation appointments in AMAC, FCT, arise from the interaction of caregiver, household, health system and programme-level factors rather than from forgetfulness alone. Although forgetfulness emerged as a frequently reported reason for missed appointments, it was often intertwined with broader socioeconomic and health system constraints, including transportation costs, competing work and household responsibilities, mobility, vaccine stock-outs, staff shortages, industrial actions and weak follow-up systems. This multidimensional pattern is consistent with previous Nigerian studies identifying maternal education, socioeconomic status, geographical access, functioning vaccination services and community context as major determinants of zero-dose and missed-dose vaccination.^{5,7}

The findings further suggest that SMS reminders should be viewed as one component of a broader implementation strategy rather than a stand-alone solution. Health workers recognised that reminders could effectively address forgetfulness by providing timely cues to caregivers who intended to attend immunisation appointments but failed to do so because of competing responsibilities. However, reminders cannot overcome structural barriers such as transport costs, lack of work permission, household decision-making, service disruptions or vaccine unavailability. Consequently, while

reminder interventions may improve attendance among willing caregivers, their effectiveness is likely to remain limited unless accompanied by broader health system strengthening.

These findings reinforce existing evidence supporting mobile reminder interventions. Previous Nigerian studies have demonstrated high caregiver willingness to receive mobile reminders, although preferences for communication channels, timing and language vary considerably.¹¹ Similarly, randomised controlled trials have shown that SMS reminders, automated telephone calls and combined reminder approaches improve immunisation completion and timeliness.^{8,10,14} The present study extends this evidence by providing an implementation perspective. Health workers with previous experience of functioning reminder systems expressed greater confidence in digital interventions, but also identified literacy limitations, shared phone ownership, changing telephone numbers, poor network coverage, staff workload and recurring operational costs as practical barriers to successful implementation.

The findings also suggest that no single reminder modality is likely to meet the needs of all caregivers. While many participants preferred telephone calls because they allow immediate clarification and communication in local languages, they also acknowledged that calls are labour-intensive, require dedicated staff time and may be missed or ignored. Conversely, SMS reminders are inexpensive, can be automated and remain accessible after delivery, but cannot ensure that messages are read by the intended recipient. These findings support a flexible multi-channel approach in which automated SMS or voice reminders are complemented by telephone calls or community-based follow-up for caregivers who miss appointments. Allowing caregivers to select their preferred language and communication channel, while documenting an alternative trusted contact where appropriate, may further improve programme effectiveness.

One of the most important implementation findings was the repeated collapse of reminder systems following the withdrawal of donor support. Participants consistently described previously successful reminder programmes that became unsustainable once external funding ended and dedicated personnel, airtime, devices or automated platforms were withdrawn. These finding highlights

that the principal challenge is not donor involvement itself, but the absence of sustainable institutional arrangements for financing, staffing and integrating reminder systems into routine service delivery. Sustainable implementation therefore requires recurrent domestic financing, integration within existing health information systems, local technical ownership and clearly defined transition plans before external support concludes.

The study further demonstrates that digital reminder systems cannot be implemented successfully without adequate service readiness. Reminders may increase attendance, but if caregivers encounter vaccine stock-outs, overcrowded clinics, insufficient staff or repeated referrals on arrival, trust in both the reminder system and the health service may be undermined. Effective implementation therefore requires reminder systems to be integrated with reliable vaccine supply, clinic scheduling, sufficient staffing and mechanisms for promptly rescheduling missed appointments. Reminder messages should also provide practical guidance for caregivers who travel, lose immunisation cards, miss appointments or have concerns about a child's illness.

Another important finding was the central role of community engagement and supportive service delivery. Participants consistently identified health education, community outreach and trusted community structures including village health committees, traditional and religious leaders, ward development committees and community mobilisers as essential complements to digital reminders, particularly for caregivers with low literacy or limited access to mobile phones. These findings reinforce the Immunisation Agenda 2030 emphasis on locally adapted, people-centred approaches and meaningful community engagement.¹⁴ Equally important was the quality of caregiver interactions within health facilities. Participants reported that respectful communication, positive staff attitudes, shorter waiting times and flexible service delivery encouraged caregivers to return for subsequent appointments, whereas negative staff attitudes, embarrassment following missed appointments and long waiting times discouraged continued utilisation of immunisation services.

Finally, the importance of respectful and responsive care extends beyond reminder systems alone. Caregivers were reportedly willing to travel longer distances to facilities perceived to offer reliable

vaccine availability, shorter waiting times and positive staff interactions. This observation is consistent with the Health Belief Model, which proposes that health-seeking behaviour is influenced by individuals' perceptions of the benefits associated with particular actions.¹⁵ Similar qualitative studies from Nigeria have also shown that poor treatment by health workers and inconvenient service delivery discourage immunisation utilisation.^{6,7} Taken together, these findings suggest that SMS reminders are most likely to improve immunisation attendance when implemented within responsive, well-resourced health systems that combine digital reminders with respectful care, effective community engagement and reliable service delivery. Taken together, these findings informed the development of a practical implementation framework illustrating the interrelationships between contextual, health-system and implementation factors that should be considered when designing sustainable SMS reminder programmes within routine childhood immunisation services (Figure 2).

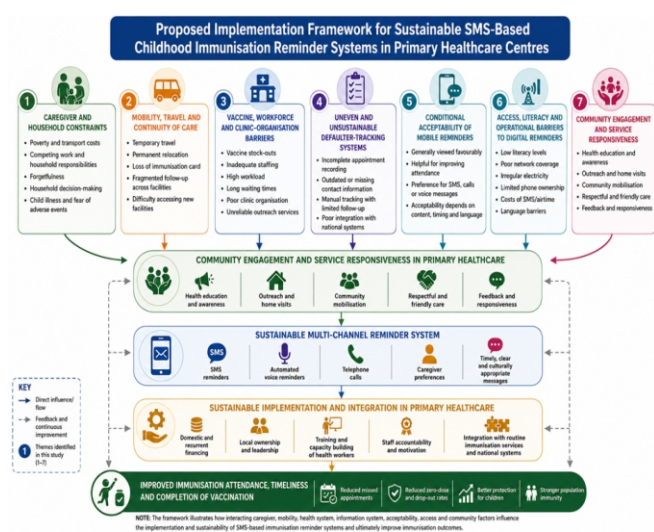


Figure 2. Proposed implementation framework for sustainable SMS-based childhood immunisation reminder systems derived from the findings of the present study.

The framework illustrates how caregiver, health-system and implementation factors interact to influence the successful implementation of sustainable reminder systems.

4.1 Strengths and limitations

A major strength is the inclusion of 28 participants from 14 facilities serving varied urban, peri-urban, resettlement and pastoral catchments. The study captured both clinical and records perspectives and included respondents with direct experience of manual and digital tracking systems. Analysis of divergent accounts avoided presenting SMS acceptability as uniform.

There are several limitations to this study. Participants were purposively selected, and the findings reflect health workers' perceptions rather than independently established causes of missed childhood immunisation appointments. The study did not include caregivers' perspectives or independently collected routine service data. Reports of vaccine shortages, cold-chain challenges, partner-supported programme performance and private-facility practices were based on participants' accounts and were not independently verified. As all participants were drawn from primary healthcare facilities within AMAC, the transferability of the findings beyond Abuja, particularly to rural or other health-system contexts, should be considered cautiously. Furthermore, the cross-sectional qualitative design does not allow conclusions to be drawn about the effectiveness of SMS reminders after implementation. These limitations should be considered when interpreting the findings.

5. Conclusion

Health workers perceived missed childhood immunisation appointments as the result of a complex interplay of caregiver, household, mobility, and health-system constraints. Although SMS reminders were generally considered helpful, they were not viewed as universally accessible or sufficient on their own. Health workers regarded SMS reminder systems as a feasible component of routine immunisation programmes, provided they are integrated into adequately resourced health systems rather than implemented as isolated digital interventions. The study identified complementary strategies for caregivers with low literacy or limited access to mobile phones, including telephone calls, automated voice messages, health education, outreach, community mobilisation and reliable manual tracking. Sustainable implementation therefore requires more than a messaging platform; it depends on integration with health records, recurrent

financing, supportive message content, clearly defined responsibilities, accurate contact information, reliable vaccine availability, adequate staffing and responsive services.

6. Recommendations

i) Implement an integrated, sustainable multi-channel reminder system. Federal and State Ministries of Health, NPHCDA and relevant partners should integrate SMS, automated voice messages and telephone reminders into existing immunisation information systems, allowing caregivers to receive reminders in appropriate languages. Reminders should be sent before scheduled appointments, with telephone or community follow-up for missed visits.

ii) Strengthen implementation capacity, accountability and sustainable financing. Clear responsibilities should be assigned for maintaining caregiver contact information, monitoring reminders and following up defaulters. Governments and relevant health authorities should provide sustainable financing for airtime, platform maintenance, staff time and outreach, reducing dependence on short-term partner support.

iii) Link reminder systems to service readiness and community engagement. Reminder systems should be supported by reliable vaccine availability, adequate staffing, responsive services and appropriate health-worker training. Digital reminders should be complemented by community outreach and trusted community structures, particularly for caregivers who are difficult to reach through mobile phones.

iv) Monitor implementation, effectiveness and equity. NPHCDA, State Primary Health Care Boards and programme managers should routinely monitor reminder delivery, appointment timeliness, immunisation completion, caregiver experience, staff workload, costs and equity of access to inform continuous improvement.

Declarations

Ethics approval and consent to participate: Ethical approval was obtained from the Federal Capital Territory Health Research Ethics Committee with Approval Number: FHREC/2026/01/151/15-04-2026, dated 30th March 2026 and administrative approval was obtained from the Abuja Municipal Area Council (AMAC) Primary Health Care Department with reference number:

AMAC/PHC/HSS/0495 dated 05th May 2026 before commencement of the study. Verbal informed consent was obtained from all participants prior to participation after the study information and consent statement had been read and explained. Participation was voluntary, and confidentiality and anonymity were maintained throughout the study.

Consent for publication: Not applicable.

Availability of data and materials: The datasets generated and analysed during the current study are not publicly available because they contain qualitative interview transcripts and audio recordings that may compromise participant confidentiality. De-identified transcripts may be made available by the corresponding author on reasonable request, subject to approval by the Federal Capital Territory Health Research Ethics Committee and in accordance with applicable institutional and ethical requirements.

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Authors' contributions: Obianuju C. Ikeonu conceived and designed the study, coordinated the research, interpreted the findings, drafted the manuscript, and led the overall writing and revision process. Ikenna H. Ekeh coordinated data collection, contributed to qualitative data analysis and interpretation, and reviewed the manuscript. Awangom A. Izegebune facilitated engagement with participating health facilities, contributed to study implementation, and reviewed the manuscript. Atulomah O. Nnodimele provided methodological guidance, contributed to the study design and interpretation of findings, and critically reviewed the manuscript. Terna I. Nomhwange and Ikechukwu A. Orji provided technical and methodological support, contributed to interpretation of the findings, and critically reviewed the manuscript. Adebola T. Olayinka reviewed and critically revised the manuscript for important intellectual content. Chinedu M. Ikeonu supported transcription, data verification, and review of the qualitative data. All authors reviewed, approved the final manuscript, and agreed to be accountable for all aspects of the work.

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