



Readiness of R21 Malaria Vaccine Introduction in Tertiary Hospitals in Northern Nigeria

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Abstract

Context: The R21 malaria vaccine was introduced in Nigeria to augment the already existing malaria control and prevention strategies. However, there is scepticism regarding its implementation success, especially in the Northern region.

Aim: The study assessed the readiness of three (3) federal University teaching hospitals (Ahmadu Bello University Teaching Hospital (ABUTH), Jos University Teaching Hospital (JUTH), and University of Maiduguri Teaching Hospital (UMTH)) in Northern Nigeria to implement the R21 malaria vaccine.

Methodology: A cross-sectional facility-based study design was employed, and data were collected using a modified validated WHO Malaria Vaccine Readiness Assessment Tool on Google Forms. The data was analyzed using Microsoft Excel, and readiness was determined using domain-specific scoring criteria.

Results: None of the hospitals met the readiness threshold of $\geq 95\%$. ABUTH had the highest overall readiness at 51%, followed by UMTH (42%) and JUTH (33%). ABUTH was fully ready in training, UMTH was fully ready while JUTH was partially ready in vaccine, cold chain and logistics. However, all hospitals were off-track in advocacy and social mobilization, as well as monitoring and supervision.

Conclusion: The findings reveal critical gaps in institutional readiness for implementing the R21 malaria vaccine in Northern Nigeria. Without urgent investment and coordinated planning, the successful rollout of the R21 malaria vaccine in Northern Nigeria and other critical vaccines may be compromised. Therefore, it is recommended that the government strengthen planning, funding, advocacy, and community engagement to ensure the vaccine's impact and improve the broader immunization infrastructure.

Keywords: Malaria Vaccines; Malaria; Nigeria; R21; Readiness.

Introduction

Malaria remains a major public health challenge in Nigeria, with over 97% of its population at risk and the country bears the highest burden of the disease in sub-Saharan Africa¹. The country accounts for

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approximately 27% of global malaria cases and 31% of malaria-related deaths with the majority being children under five years of age^{2,3}.

The burden of the disease is disproportionately concentrated in the northern region, as it contributes over 50% of Nigeria's total malaria cases and

deaths, which is further exacerbated by ongoing challenges such as armed insurgency (Boko Haram), banditry, and widespread insecurity³. Furthermore, the cumulative deaths from malaria in the region surpass the combined mortalities from all other diseases¹. These statistics rendered the region a target for malaria control and eradication efforts. However, despite numerous strategies to combat infection, as of 2024, the nation still accounts for 32% of global malaria deaths, 60% of outpatient appointments and 30% of the country's admissions^{4,5}. This highlights the urgent need for sustainable and effective interventions to mitigate the impact of malaria. In this regard, Nigeria approved the rollout of the new malaria vaccine called R21 or Matrix-M on 17 April 2023 to augment efforts to eliminate malaria⁶. The vaccine, to be used in children aged 5-36 months, has demonstrated over 75% efficacy in clinical trials and offers promising effectiveness in controlling malaria in addition to other malaria control strategies².

However, despite the vaccine's prospects, there is skepticism about its implementation because the successful deployment of the vaccine hinges not only on its availability but also on the capacity of the healthcare system to deliver it effectively^{6,7}. Many concerns are also raised regarding the operational readiness of healthcare facilities, where systemic issues such as inadequate human resources, insufficient cold chain infrastructure, and logistical inefficiencies persist⁶.

Mboussou et al. conducted a similar study to assess the readiness of the RTS, S1/AS01 vaccine in Cameroon⁸; however, none was conducted on R21 in Nigeria. While most literature investigated the awareness and acceptance of malaria vaccines, limited attention was given to the institutional readiness of tertiary healthcare facilities in Nigeria, especially those situated in northern regions, to implement such large-scale immunization programs^{9,10,11,12,13}. Tertiary hospitals, as the apex referral centers, are expected to play a significant role in vaccine deployment, training of healthcare workers, and public health advocacy. Their preparedness could significantly influence the broader success of the R21 malaria vaccine rollout¹⁴. This study, therefore, aimed to address this critical knowledge gap by evaluating the readiness of

selected federal university teaching hospitals (ABUTH, JUTH and UMTH) in Northern Nigeria for the implementation of the R21 malaria vaccine. By assessing these institutions' infrastructural, administrative, and clinical preparedness, the study aims to inform policy decisions and strengthen strategic planning for vaccine deployment in regions most affected by malaria.

Methodology

Study Design

The study employed a facility-based cross-sectional study design using a checklist to obtain quantitative data about the hospitals' readiness to introduce the R21 malaria vaccine.

Study Area

The study was conducted in northern Nigeria, the country's largest region. It makes up over 70% of the country's land mass and has about 75,392,622 inhabitants. Northern Nigeria covers 281,872 square miles and shares a boundary with Chad and the Niger Republic to the north, the Benin Republic to the west, and Cameroon to the east¹⁵.

The states of Northern Nigeria are:

- **North Central:** Benue, FCT, Kogi, Kwara, Nasarawa, Niger, Plateau
- **Northeast:** Adamawa, Bauchi, Borno, Gombe, Taraba, Yobe
- **Northwest:** Kaduna, Katsina, Kano, Kebbi, Sokoto, Jigawa, Zamfara¹⁵.

Settings of the study

The study was conducted in a federal university teaching hospital in each of the selected states across the region. These include:

- **Ahmadu Bello University Teaching Hospital (ABUTH) from Kaduna State:** The Ahmadu Bello University Teaching Hospital, previously known as the Institute of Health, was established in 1968. It is a 1,000-bed capacity tertiary hospital located in Shika, Giwa Local Government Area, Kaduna State, Nigeria¹⁸.
- **Jos University Teaching Hospital (JUTH) from Plateau State:** The Jos University Teaching Hospital, located in Lamingo, Jos North, Plateau State, Nigeria, was established in June 1981. It has a capacity of 672 beds, 29

clinical and 13 non-clinical departments, two comprehensive health centers, and an outreach team. The hospital employs over 3,000 staff, including consultants, resident doctors, nurses, pharmacists, and other professionals¹⁷.

- **University of Maiduguri Teaching Hospital (UMTH) from Borno State:** The University of Maiduguri Teaching Hospital (UMTH), officially commissioned on July 23, 1983, is the largest tertiary healthcare institution in Nigeria. It has a capacity of 1,305 beds and offers world-class training, research, and medical services¹⁶.

Sampling method:

The three (3) tertiary hospitals for the study were selected in two (2) stages. In the first stage, a simple random sampling technique by balloting was used to select three (3) states (one from each geopolitical zone: North Central, Northeast and Northwest). They were Borno from the northeast, Plateau State from the central, and Kaduna State from the northwest. Then, census sampling was used to select all the federal university teaching hospitals from the selected states. They were selected based on their strategic public health service delivery roles, referral status, and regional representation.

Data collection instrument

The WHO-developed malaria vaccine introduction readiness assessment tool was used to collect data¹⁹. The district-level tool was slightly modified to filter out the intervals and used as a one-time assessment. The tool was designed on Google Forms for easy data collection. It was divided into five sections: planning and coordination, training, monitoring and supervision, vaccines, cold chain and logistics, and social mobilization and communication. Each component within the domains is scored as either 1 (Yes) or 0 (No), and aggregate scores are calculated as percentages. Readiness levels were categorized as:

- Fully Ready: $\geq 95\%$
- Partially Ready: 80–94%
- Not Ready / Off-Track: $< 80\%$

Validity and reliability of research Instrument

The WHO Malaria Vaccine Introduction Readiness Assessment Tool's validity and reliability have already been established. It comprehensively

captures the operational elements required for malaria vaccine introduction and aligns with WHO's global immunization framework¹⁹. To further ensure the instrument's validity, experts in the field verified its face and content validity.

Data Collection Procedure

Data was collected on Google Forms through structured interviews, facility walkthroughs, and document reviews. Respondents included program coordinators, immunization officers, and other key malaria control and vaccine delivery staff. The WHO tool guided the data collection process, and all responses were reviewed for completeness and consistency.

Data Analysis

The collected data was downloaded from the Google form as a Microsoft Excel file for cleaning and analysis. Scores were computed per domain and aggregated for each hospital. The percentage scores informed the classification of each facility's readiness level. Comparative analysis was conducted to assess variations in readiness across the three hospitals.

Ethical considerations

The research protocol was submitted for Ethical clearance to the Ethics Review Board (IRB) of all the selected federal university teaching Hospitals. The Health Research Ethics Committee of ABU Zaria (No. IRB00014024), JUTH Health Research Ethics Committee (05/10/22) and UMTH ethics committee (OHRP-IRB-FWA 00013572 UMTH/REC/24/009) gave ethical approval. Permission was obtained from the various hospitals before data on the various domains was collected.

Results

The results of the malaria vaccine introduction readiness assessment across five domains of ABUTH, JUTH, and UMTH are presented. Scores indicate key readiness components' presence (1 = Yes) or absence (0 = No). Furthermore, to determine the level of readiness, scores greater than 95% are fully ready, scores less than 95% and equal to or greater than 80% are partially ready. While scores less than 80% are off track or not ready.

Table 1 above shows that ABUTH is overall 60%

Table 1: Domain 1 for Planning and Coordination

Readiness Component	ABUTH	JUTH	UMTH
District-level operational plans developed	1	0	0
Coordination team established	1	0	0
Microplans finalized	1	0	0
Funds received	0	0	0
Funds distributed	0	0	0
Total (%)	3 (60%)	0(0%)	0(0%)

Source: Field Data, 2025.

ready in planning and coordination, while JUTH and UMTH are all not ready with 0%. This means that ABUTH is partially ready in terms of planning and coordination for introducing the malaria vaccine.

Table 2 shows that, regarding overall readiness for

Table 2: Domain 2 for Training of Health Workers, Community Health Volunteers (CHVs) and Supervisors

Readiness Component	ABUTH	JUTH	UMTH
Health workers trained	1	0	0
CHVs trained	1	0	0
Supervisors identified and trained	1	0	0
Total (%)	3(100%)	0(0%)	0(0%)

Source: Field Data, 2025.

training health workers, CHVs, and supervisors, ABUTH is 100% ready, while JUTH and UMTH are all lacking in this component, with 0%. This means that only ABUTH is fully ready for training for the introduction of the malaria vaccine.

Table 3 shows that for the monitoring and

Table 3: Domain 3 for Monitoring and Supervision

Readiness Component	ABUTH	JUTH	UMTH
Supervision plan developed	1	0	0
Monitoring tools received	0	0	0
Monitoring tools delivered	0	0	0
Total (%)	1(33%)	0(0%)	0(0%)

Source: Field Data, 2025.

supervision components, ABUTH is 33% across all the individual components, while JUTH and UMTH are all 0% on the readiness assessment. This means none of the tertiary hospitals is ready in terms of monitoring and supervision.

Table 4 shows that the overall readiness for vaccine,

Table 4: Domain 4 for Vaccines, Cold Chain and Logistics

Readiness Component	ABUTH	JUTH	UMTH
Cold-chain capacity confirmed	1	1	1
Refrigerators	1	1	1
Cold boxes	1	1	1
Vaccine carriers	1	1	1
Waste management assessment completed	1	0	1
Vaccines delivered	0	0	1
0.5ml AD syringes	0	1	1
2ml RUP syringes	0	1	1
Safety boxes	1	1	1
Additional commodities (if relevant)	0	1	1
Total (%)	6(60%)	8(80%)	10(100%)

Source: Field Data, 2025.

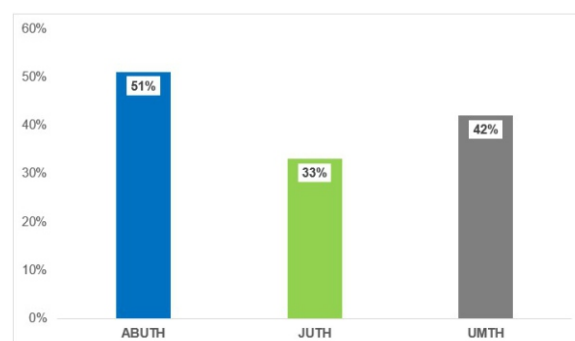
cold chain and logistic component, UMTH is 100% ready, JUTH is 80% ready while ABUTH is only 60%. This means that UMTH is fully ready, JUTH is partially ready, while ABUTH is not ready in terms of vaccine, cold chain and logistics.

Table 5 shows that none of the Tertiary Hospitals

Table 5: Domain 5 for Social Mobilization and Communication

Readiness Component	ABUTH	JUTH	UMTH
Advocacy, communication, and social mobilization (ACSM) materials delivered	0	0	0
ACSM activities implemented	0	0	0
Community awareness verified	0	0	0
Subtotal (%)	0(0%)	0(0%)	0(0%)

Source: Field Data, 2025.



Source: Field Data, 2025.

Figure 1: Overall Readiness Across Selected Hospitals

were ready regarding ACSM as all of them are 0% for the overall readiness score.

Figure 1 shows that ABUTH has an overall score of 51% across all 5 domains, JUTH has 33%, and UMTH has 42%. This means none of the hospitals is ready to introduce the malaria vaccine.

Summary of Findings

- In planning and coordination, all the hospitals are not ready.
- In the training domain, ABUTH is fully ready, while all the rest are not ready.
- In the monitoring and supervision domain, all hospitals are off-track.
- In Vaccines, Cold Chain and Logistics, UMTH is fully ready, JUTH is partially ready, while ABUTH is not.
- In the Advocacy, Social Mobilization and Communication domain, all the hospitals were off track.
- Overall score, all of the hospitals were off track.

Discussion

This study assessed the readiness to introduce the malaria vaccine in three tertiary hospitals in Northern Nigeria across five domains. These include planning and coordination, training, monitoring and supervision, vaccine, cold chain and logistics, and social mobilization and communications. The results revealed that all three tertiary hospitals (ABUTH, JUTH, and UMTH) were off track, with some variations across the domains among the hospitals.

The study assessed the planning and coordination readiness of the three hospitals and revealed that none is fully ready. Individually, ABUTH is partially ready because there is a district-level operational plan, a coordination team, and finalized micro plans. However, they reported that they have not received any funding for the vaccination implementation. On the contrary, the remaining two hospitals (JUTH and UMTH) are not ready across all the domain components. This shows a lack of planning and coordination regarding introducing the R21 malaria vaccine. It is essential because failure in planning will lead to failure in implementation. Furthermore, adequate planning

for malaria vaccine introduction can optimize its impact, especially in reducing malaria morbidity, complications, and even deaths caused by malaria²⁰. This lack of readiness in planning and coordination could be attributed to the absence of Advocacy, communication, and social mobilization (ACSM). A recent study by Mboussou et al. conducted in Cameroon found that the national readiness for the malaria vaccine was 64% just one week after its introduction⁸. This finding aligns with the results of our study, indicating an overall lack of readiness for the vaccine rollout.

This study revealed an off-track readiness for training health workers, CHVs, and supervisors on the malaria vaccine in the JUTH and UMTH. However, for ABUTH, the result showed that all health worker categories were trained on the R21 malaria vaccine. Proper training is essential to ensure that healthcare workers are adequately equipped with the knowledge and skills to deliver the vaccine effectively. The disparity in training readiness highlights the uneven pace of implementation across tertiary hospitals. Training health workers to increase their knowledge on the various aspects of the malaria vaccine is essential because it will ensure the success and sustainability of the vaccine introduction²¹. This finding aligns with a study by Grant et al. who revealed inadequate training of health workers, CHVs and Supervisors during the planning of malaria vaccine introduction in Ghana²². Additionally, the study by Mboussou et al. in Cameroon revealed a 25% national readiness on training of health workers⁸.

The readiness for monitoring and supervision was the lowest across all three hospitals. ABUTH managed to develop a supervision plan but lacked essential monitoring tools, resulting in a readiness score of 33%. JUTH and UMTH recorded 0%, indicating complete off-track in this domain. Monitoring and supervising malaria vaccine rollout is important for ensuring successful implementation, identifying challenges, and maximizing public health impact through data-driven decision-making and quality improvement. In contrast, the lack of it impedes tracking vaccine uptake, identifying gaps, and implementing timely interventions³. This result is consistent with the Cameroon study, which reported only 40% readiness in the monitoring domain. Such deficits

suggest that weak monitoring systems could hinder vaccine program success even where training and logistics may be in place⁸.

Overall, the hospitals were partially ready for the vaccines, cold chain, and logistics domain, with UMTH fully ready and JUTH partially ready, while ABUTH was off track. A lack of readiness in ABUTH was due to the absence of the malaria vaccine, 0.5ml AD syringes, 2ml RUP syringes, and other relevant additional commodities. These are vital instruments for the vaccine administration. JUTH was partially ready because it lacked the malaria vaccine and Waste management mechanisms. This domain represents a relative strength in the overall readiness landscape and may reflect prior investments in cold chain systems used for other immunization programs. Nonetheless, gaps in commodity availability at some sites suggest the need for targeted supply chain strengthening to ensure uninterrupted vaccine delivery. This finding contrasts with a study conducted in Ghana, which shows a lack of functioning cold-chain equipment in health facilities, including insufficient and inadequate refrigerators, vaccine carriers and thermometers²². However, the finding is similar to a study by Mboussou et al. in Cameroon, showing 83% readiness in the vaccine, cold chain and logistics domain⁸. Notably, the vaccine, cold chain and logistic domain gap is worrisome not just for the malaria vaccine alone but for other important vaccines in the hospitals.

All the hospitals were completely unprepared, scoring 0% in ACSM. This is an unfortunate finding because of the importance of awareness and advocacy, as a previous study by Ajayi and Emeto revealed a low (40%) awareness of malaria vaccine in Northern Nigeria. The study also pointed out that understanding, trust, and acceptability could threaten the country's successful administration of the malaria vaccine⁹. More so, Effiong et al., in a study on the anticipated challenges of the malaria vaccine in Nigeria, pointed out the need to address misinformation and vaccine hesitancy in Nigeria because of low awareness of the malaria vaccine^{23,24}. This finding aligns with a study by Mboussou et al. in Cameroon, which shows 17% readiness in ACSM⁸. However, it contrasts with the report of strong community advocacy and awareness campaign in Kebbi and Bayelsa States²⁵.

Overall readiness across the three facilities was off-track, with ABUTH scoring 58%, UMTH 42%, and JUTH 33%. These figures underscore that none of the hospitals met the full or partial readiness threshold. The fragmented state of preparedness points to broader systemic issues, including coordination failures, inadequate funding flows, and poor integration of readiness components. It also suggests that despite prior experience with large-scale immunization programs, tertiary hospitals may still face challenges in scaling up for new vaccines without dedicated planning and support. Additionally, the current readiness of hospitals indicates that the implementation of other vaccines may also be affected.

Strengths and Limitations of the Study

This study employed the WHO Malaria Vaccine Readiness Assessment Tool, which is the globally recognized standard for evaluating preparedness for malaria vaccine introduction. The strength of the study lies in its comprehensive assessment of malaria vaccine readiness across five critical domains: planning and coordination, training, monitoring and supervision, vaccine cold chain and logistics, and ACSM. This multidimensional approach offers a targeted understanding of the preparedness landscape. The use of this validated tool enhances the credibility, comparability, and reliability of the findings. Additionally, the study's qualitative nature allowed for in-depth exploration of the contextual situation of the readiness, enabling the identification of specific gaps and variations among facilities. Furthermore, the study strategically selected tertiary healthcare facilities from the three geopolitical zones of Northern Nigeria, ensuring regional representation and capturing variability in readiness across different administrative and operational contexts. This geographical spread adds value by providing a broader understanding of systemic challenges and strengths in the region.

However, the study has some limitations. The study did not explore patient or community perspectives, particularly concerning ACSM, which could have provided further depth on the dimension of social readiness.

Recommendations / Lessons Learned

1. **Strengthen Central Coordination and Funding:** The national and state governments must establish robust coordination mechanisms with timely disbursement of funds to tertiary hospitals. Ensuring hospitals are financially equipped is essential for achieving operational readiness regarding vaccine rollout.
2. **Standardize and Expand Training Programs:** Health worker training should be uniformly implemented across all facilities, with ongoing capacity-building initiatives tailored to different cadres. Training must include both clinical and operational aspects of malaria vaccine delivery.
3. **Develop Comprehensive Monitoring Systems:** Introducing standardized tools and supervision frameworks is vital to strengthen monitoring and feedback mechanisms. Digital tools for real-time monitoring could improve transparency and responsiveness during rollout.
4. **Invest in Supply Chain Strengthening:** Ensuring uninterrupted availability of vaccines, syringes, and other essential commodities must be prioritized. A regular (Quarterly) facility assessment for cold chain capacity should be conducted, and equipment should be provided where necessary.
5. **Prioritize Advocacy and Community Engagement:** The complete lack of ACSM highlights an urgent need to develop strategic communication and social mobilization campaigns. Engaging communities, addressing misinformation, and building vaccine trust should be central to rollout efforts.
6. **Another Research targeting primary health Center:** More studies should be conducted on primary health centres in northern Nigeria to ascertain their readiness to implement the vaccine.

Conclusion

This study highlights significant gaps in the readiness of tertiary hospitals in Northern Nigeria to implement the malaria vaccine, with all three facilities assessed as off-track. While some strengths were noted in the cold chain and logistics domain, critical deficiencies in planning, training, monitoring, and especially ACSM threaten the

successful rollout of this life-saving intervention. The findings consolidate the urgent need for targeted investments, coordinated planning, and systemic reforms to ensure readiness at all levels of healthcare delivery. Bridging these gaps is essential not only for the malaria vaccine rollout but also for enhancing Nigeria's broader immunization infrastructure. Proactive, equity-focused and multidisciplinary strategies must be adopted to ensure that the malaria vaccine reaches its intended populations efficiently and effectively.

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