Assessing Infrastructure and Workforce Predispositions for Nigeria's National Health Logistics Management Information System Adoption

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ABSTRACT

Background: The success of public health interventions in developing countries is often hindered by poor data quality and fragmented reporting systems. Nigeria's National Health Logistics Management Information System (NHLMIS) was developed to digitize supply chain data, yet its success depends on the intersection of infrastructure and workforce readiness. This study evaluates pre-implementation readiness among health workers to inform evidence-based rollout strategies.

Methods: A cross-sectional descriptive survey was conducted in 2019 among 514 health facility representatives across four states: Kogi (n=175), Taraba (n=143), Cross River (n=99), and Kano (n=97). Data were collected via a paper-based tool prior to the NHLMIS training to capture authentic predispositions. A digital readiness index (0–4) was constructed based on personal and facility hardware ownership, mobile phone access, and prior training. Data was analyzed using descriptive statistics and cross-tabulations in Python.

Results: High individual readiness was observed, with 92.1% mobile phone ownership and 62.5% having prior computer training. However, a significant institutional gap exists; only 40.1% of facilities possessed a functional computer. Despite high mobile penetration, 64.6% of participants preferred computer-based data entry, citing a superior user interface (55.4%) as the primary driver. The readiness index revealed disparities by facility level (Tertiary: 2.58 vs. Primary: 2.21) and ownership (Private: 3.12 vs. Public: 2.31).

Conclusion: The study identifies a "readiness paradox" where health workers possess the necessary skills and personal tools, but lack the institutional hardware required for sustained digital reporting. To ensure the sustainability of digitized systems in resource-constrained settings, implementation must move beyond software training to prioritize hardware availability at all levels of health facilities and a software with optimized mobile interfaces for complex logistics tasks. These findings provide a blueprint for closing the last mile infrastructure gap in digital health transitions.

INTRODUCTION

Successful implementation of public health interventions is highly dependent on the quality of data used for decision-making; however, documentation and reporting challenges have plagued public health interventions, especially in developing countries. Nigeria has encountered several challenges in the implementation of information systems for its public health interventions over the years. According to Adegboye and Musa (2019), some of the challenges associated with public health management information systems include poor record keeping, ineffective medical records policy, overburdened staff, and the lack of record-keeping tools such as paper registers and electronic devices, among others. Another study on the challenges to documentation among community pharmacists in Lagos, Nigeria, by Okoye, Aina, and Joda (2019), mentioned that inadequate time, poor power supply, lack of training for health workers, and inadequate staff were key challenges that affected documentation.

A logistics management information system forms one component of an organization's broader information system. It relies on records and reports that collect, analyze, and verify data across all tiers of the logistics chain, supporting informed supply-chain decisions. As a result, logistics records are essential elements of any logistics system. They capture key data at each level of the health system, which is then consolidated into logistics reports.

These reports guide important decisions such as resupply quantities, forecasting, and procurement (Tiye and Gudeta, 2018).

Electronic logistics management information systems (eLMIS) improve stock visibility, reporting timeliness, and data-driven decision-making. Nigeria's NHLMIS aims to standardize and streamline reporting on health commodities, enabling supply chain responsiveness and accountability. Despite the potential, successful LMIS adoption depends on workforce readiness (skills, preferences) and facility readiness (functional hardware, connectivity) (Umoh et al., 2023).

Evidence on pre-implementation readiness in Nigeria has been limited. This manuscript analyses a 2019 survey of health workers across four states—Taraba, Kogi, Cross River, and Kano—to quantify ICT access, data-entry preferences, and digital adoption signals, and to construct a simple readiness index. Findings are intended to guide future electronic information system rollout, capacity building, and monitoring.

Objectives:

1. Estimate the availability of digital tools for public health documentation and reporting

2. Assess reporting readiness using a simple index and compare across states, facility levels, ownership, and cadres.

3. Offer programmatic recommendations for future digitized information system roll-out.

LITERATURE REVIEW

The successful provision of public health services, particularly in resource-constrained settings, is dependent on the quality and timeliness of data used for operational and strategic decision-making. Transitioning of Management Information Systems from paper-based to electronic systems in developing nations is recognized as a key strategy to strengthen health systems, improve data quality, and reduce documentation burden on the frontline staff. However, this transition is fraught with challenges related to infrastructure, workforce capacity, and organizational readiness. This literature review explores the documented state of public health documentation and reporting, the strategic importance of Logistics Management Information Systems (LMIS), the possible barriers to health information system adoption in Nigeria, and the critical factors that determine health worker readiness for digital transformation (Umoh et al., 2023), (Nnebue et al., 2014).

The Pervasive Challenge of Data Quality and Documentation in Public Health

The foundation of effective public health intervention lies in reliable documentation and accurate reporting. Several studies continue to highlight that poor health data quality remains a significant obstacle to strengthening health systems and achieving positive patient outcomes, especially in sub-Saharan Africa. The challenges are multifaceted, encompassing human, operational, and structural deficiencies (Mphatswe et al., 2012), (Kinyondo and Pelizzo, 2018), (Gimbel et al., 2017).

At the operational level, studies in Nigeria and across the region consistently identify poor record-keeping practices, an ineffective medical records policy, and a lack of essential record-keeping tools, such as both paper registers and electronic devices, as core issues (Adegboye and Musa, 2019). This reality is compounded by an overburdened staff, whose increased workload due to high patient admissions often translates directly into a lack of time for comprehensive documentation (Okoye, Aina, and Joda, 2019), resulting in incomplete, illegible, or missing documentation, which hinders communication among healthcare professionals and compromises the continuity and quality of care.

This systemic failure of adequate record-keeping extends beyond clinical care, negatively impacting the overall quality of service delivery and public health project implementation, including the logistics and supply chain systems. This lack of complete and accurate documentation and reporting severely limits the health system's capacity to respond effectively to public health regular and emergency needs. The fragmented nature of data

collection, coupled with inadequate infrastructure, perpetuates a cycle of data integrity issues, including problems with accuracy, validity, and completeness (Adeleke et al., 2015). Addressing these foundational data quality issues is a prerequisite for the successful implementation of any digitized system.

The Strategic Imperative of Logistics Management Information Systems (LMIS)

Within the broader public health information system, the Logistics Management Information System (LMIS) plays a singular and vital role in ensuring the availability of essential health commodities. The LMIS is defined by its reliance on records and reports that systematically collect, analyze, and verify data across all tiers of the logistics chain (Tiye and Gudeta, 2018). These logistics records are the essential building blocks that capture key supply chain data, which is then consolidated into reports to guide crucial managerial decisions, including resupply needs, accurate forecasting, and effective procurement strategies (John Hans Wasswa et al., 2023).

Globally, electronic LMIS (eLMIS) adoption, particularly in developing countries, is crucial for mitigating significant inefficiencies in health supply chain management that often lead to limited access to essential medicines. By providing real-time data and insights, an effective LMIS enhances inventory management, reduces costs, minimizes stockouts, and optimizes the distribution and transportation of medical supplies. In a study by John Hans Wasswa and his colleagues (2023) on leveraging electronic logistics management information systems to enhance and optimize supply chain response during public health emergencies: lessons from COVID-19 response in Uganda, it was discovered that eLMIS can significantly improve resource allocation, patient care, reduce stockout and wastages, and improve the overall supply chain efficiency.

Digitization of LMIS: Potential and Infrastructural Barriers

The shift to eLMIS—such as Nigeria's National Health Logistics Management Information System (NHLMIS)—promises significant improvements, notably in enhanced stock visibility, reporting timeliness, and the institutionalization of data-driven decision-making. According to Bekele and Anbessa (2021), a logistics management information system enables decision-makers to gain the right data, in the right quantity, in the right quality, at the right time, to the right place, and for the right cost however, the successful rollout and adoption of these digital systems depend on two critical components: facility readiness (functional hardware and connectivity) and workforce readiness (skills and preferences) .

In Nigeria, the journey towards eLMIS is characterized by substantial infrastructure limitations that pose formidable barriers to technology adoption. The most frequently cited infrastructure challenges include an unreliable power supply and limited internet penetration, making the roll-out of electronic systems challenging. Furthermore, an assessment of health institutions in the country revealed a low overall technological and infrastructural readiness, characterized by inadequate devices, unstable internet access, and a lack of power reliability (Babatope et al., 2024). The urban-rural divide exacerbates this issue, with primary health centers in rural areas often lacking basic electricity and computer equipment, rendering even minimal LMIS functionality unattainable.

Beyond the purely technological hurdles, policy and organizational barriers further obstruct widespread digitalization. These include the high costs associated with the initial setup and maintenance of Electronic Health Records (EHRs) and other digital systems, fragmented guidelines, weak data privacy laws, and inconsistent funding mechanisms. The absence of comprehensive national policies and political commitment leads to fragmented implementation efforts, often leaving digital health initiatives reliant on unsustainable external funding (Egwudo et al., 2025). These systemic issues demonstrate that successful LMIS adoption requires not just the introduction of new technology, but a fundamental overhaul of the underlying physical, financial, and policy environments.

Health Worker Readiness and the Dynamics of Digital Adoption

Even where infrastructure exists, the human factor—the readiness of the health workforce—is the ultimate determinant of a digital system's success. Readiness encompasses not only the material access to digital tools

but also the health workers' skills, preferences for data entry, and willingness to integrate new technologies into their established workflows.

Digital Literacy, Training, and Resistance

Digital literacy among healthcare professionals in Nigeria is often uneven, with some regions reporting a significantly low proficiency level among health workers in using computer tools effectively. This skills gap is directly tied to a reported lack of structured training for health workers (Okoye, Aina, and Joda, 2019). Without adequate capacity building, staff may struggle with the perceived disruption to their workflow when transitioning from familiar paper-based systems, leading to strong resistance to change. Studies on eHealth adoption identify that inadequate staff and insufficient training are major barriers, underscoring the necessity of continuous professional development to foster confidence and competence (Okeke et al., 2025).

Factors Influencing Technology Acceptance

Theoretical models of technology adoption, such as the Unified Theory of Acceptance and Use of Technology (UTAUT), are critical for understanding how health workers integrate new digital tools like LMIS (Williams, Rana, and Dwivedi, 2015). These models highlight that adoption is primarily driven by:

- **Perceived Usefulness (PU):** The degree to which a user believes that using the system will enhance their job performance. In the LMIS context, this means the system must demonstrably improve their ability to manage inventory, avoid stockouts, and reduce manual reporting time. Perceived usefulness is often cited as the most common facilitating factor for ICT adoption.

- **Perceived Ease of Use (PEOU):** The degree to which a user believes that using the system will be free of additional effort. Systems that are complex, difficult to navigate, or prone to technical issues will severely limit adoption, regardless of their utility.

- **Facilitating Conditions and Social Influence:** These factors refer to the organizational and environmental support available, including technical support, robust infrastructure, and the endorsement and encouragement from peers and leadership.

For a system like NHLMIS to be successful, managerial efforts must prioritize not only the technical soundness but also these social and organizational factors, ensuring the system is embedded within a supportive environment with reliable technical assistance and consistent leadership commitment.

The Critical Gap in Pre-Implementation Readiness Data

The existing literature clearly establishes a foundation for understanding the challenges in public health documentation and the importance of eLMIS, particularly in a developing country such as Nigeria. There is strong evidence detailing the infrastructural deficiencies, the policy vacuum, and the necessity of targeted training to address low digital literacy.

However, a recurring theme is the need for granular, context-specific data to guide implementation efforts. The literature highlights general readiness assessments and macro-level challenges, but often lacks the specific, comparative, pre-implementation readiness data that can inform tailored rollout strategies. There is a limited evidence base that quantifies:

1. The specific availability of digital tools (hardware and connectivity) across different levels of the health system (e.g., Primary, Secondary, Tertiary facilities).

2. The variation in readiness across different geographical regions, facility ownership types, and specific health worker cadres (e.g., doctors versus nurses versus record officers).

3. The prevailing data entry preferences of the target users (e.g., mobile devices versus desktop computers), which are crucial for optimizing system design and training.

The study aims to address this critical gap by analysing a 2019 survey across four diverse states—Taraba, Kogi, Cross River, and Kano—to quantify ICT access, data entry preferences, and digital adoption signals, and to construct a simple, comparative readiness index. The findings from such an analysis are essential to move beyond generalized recommendations and provide the programmatic, evidence-based guidance required for a successful and scalable future rollout of the digital MIS tools in Nigeria and other developing countries (Umoh et al).

METHODOLOGY

Study Design

A cross-sectional descriptive survey was used to establish a baseline for the acceptance and digital readiness of health facility staff regarding the National Health Logistics Management Information System (NHLMIS) platform. This design was chosen to capture the pre-intervention state of participants before they were influenced by formal training.

Study Setting and Population

The study was conducted across four states in Nigeria—Cross River, Kano, Kogi, and Taraba—during the first batch of the NHLMIS roll-out training. The study population consisted of a total of 514 health facility representatives (N=514), including Doctors, Pharmacists, Nurses, and Monitoring and Evaluation (M&E) Officers.

The distribution of participants by state was as follows:

- Kogi: 175 participants
- Taraba: 143 participants
- Cross River: 99 participants
- Kano: 97 participants

A census sampling technique was used to include every facility representative invited to the Phase 1 training. This ensured that the results provided a comprehensive overview of the early-adoption cohort across different geopolitical zones.

Data Collection Instrument

The study utilized a structured, paper-based questionnaire designed to assess variables that influence the Technology Acceptance Model (TAM). The tool was divided into four thematic areas:

- Demographics: Professional designation, years of experience, and educational level.

- Infrastructure Access: Availability of functional computers at the facility level versus personal ownership of mobile devices.

- Digital Literacy: Prior formal computer training and current proficiency with mobile applications (e.g., WhatsApp, LinkedIn).

- System Expectations: Preferences for data entry tools (Mobile vs. Computer) and the underlying reasons (Availability, Interface, or Cost).

Data Collection Procedure

Data collection was strategically timed to occur before the start of the first training module. This timing was critical to ensure that the responses reflected the participants' authentic predispositions and perceived ease of use before they gained technical familiarity with the NHLMIS interface.

- Participants were handed the paper tool upon arrival and registration.

- Completed tools were collected before the first technical presentation was delivered.

Ethical Considerations and Consent

Participation in the study was entirely voluntary. Ethical transparency was maintained by including a preamble on the tool stating that the completion and submission of the form constituted informed consent. Participants were assured that their responses would be anonymized and used strictly for the improvement of the NHLMIS roll-out strategy.

Data Management and Analysis

Once collected, the qualitative and quantitative data from the paper forms were manually transcribed into a specialized Microsoft Excel database. Data cleaning protocols were applied to identify and correct transcription errors. The data was then processed to generate descriptive statistics using Python 3 on Google Colab, allowing for a comparison of acceptance levels across different professional cadres and facility levels.

Study Limitations

A few limitations were identified for this study. Geographically, the focus on four states may not represent the unique infrastructural challenges across the rest of Nigeria. Additionally, the use of a census from the first set of trainees introduces a selection bias, as these participants often come from higher-performing facilities. Furthermore, because the survey was conducted pre-training, results reflect expectations and perceptions rather than hands-on experience with the NHLMIS.

RESULTS

Socio-demographic and Facility Profile

The study included 514 participants, with the highest representation from Kogi (34.1%) and Taraba (27.8%). The workforce was predominantly male (60.9%) and between the ages of 25 and 49 (73%). Nearly all respondents had a tertiary education (98%) and over five years of work experience (89%). In terms of professional cadre, "Others" (which includes community health workers and record officers) made up 50.7%, followed by M&E officers (16.9%) and Pharmacists (16.1%).

Most participants worked in public facilities (93.8%), with primary health centers (PHCs) accounting for over half of the facility types (55.6%).

Table 1: Socio-demographic and Facility Characteristics (N=514)

Variable	Category	Frequency (n)	Percentage (%)
State	Kogi	175	34.1%
	Taraba	143	27.8%
	Cross River	99	19.3%
	Kano	97	18.9%
Gender	Male	313	60.9%
	Female	201	39.1%

Designation	Others	258	50.7%
	M&E Officer	86	16.9%
	Pharmacist	82	16.1%
	Nurse	72	14.1%
	Doctor	11	2.2%
Facility Level	Primary	286	55.6%
	Secondary	178	34.6%
	Tertiary	50	9.7%
Ownership	Public	482	93.8%
	Private	32	6.2%

ICT Accessibility and Digital Literacy

There is a significant gap between personal technology ownership and facility-level infrastructure. While 92.1% of health workers own a functional mobile phone, only 43.3% own a personal computer. More critically, only 40.1% of health facilities have a functional computer available for use. Despite low hardware availability at the workplace, 62.5% of the respondents had received prior computer-related training.

Table 2: ICT Access and Digital Literacy

Indicator	Yes (n,%)	No (n,%)
Personal Mobile Phone Ownership	469 (92.1%)	40 (7.9%)
Prior Computer Training	318 (62.5%)	191 (37.5%)
Personal Computer Ownership	221 (43.3%)	289 (56.7%)
Facility Computer Availability	206 (40.1%)	308 (59.9%)

Reporting Preferences and Expectations

When asked about their preference for NHLMIS data entry, the majority (64.6%) preferred using a Computer over a Mobile Phone (35.4%). The primary reason cited for this preference was the "Better Data Entry Interface" (55.4%), followed by "Availability of computers" (37.7%). Interestingly, the participants' intentions aligned with their preferences, with 62.6% expecting to use a computer for reporting at their facility.

Digital Readiness Index

A simple readiness index (0 to 4) was calculated based on four factors: personal PC ownership, facility PC availability, mobile phone ownership, and prior training. One point was assigned for each 'Yes' response to: personal PC ownership, facility PC availability, mobile ownership, and prior training, resulting in a score ranging from 0 to 4 for each participant which was then averaged to get the readiness index for each state.

- **State-wide Readiness**: Kano showed the highest readiness (2.85), while Kogi (2.13) and Cross River (2.16) scored lowest.

- **Ownership & Level**: Private facilities (3.12) were significantly more ready than public facilities (2.31). Tertiary (2.58) and Secondary (2.54) levels showed higher readiness compared to Primary Health Care levels (2.21).

DISCUSSION

The findings of this study highlight the readiness of the Nigerian health sector for technology uptake. While the workforce exhibits a high degree of individual readiness, characterized by high mobile phone penetration (92%) and a majority having formal computer training (62.5%)—there is a stark lack of institutional readiness, with 6 out of 10 health facilities lacking a functional computer. This suggests that the primary barrier to the NHLMIS and other technology rollout is not a lack of user skill, but a lack of physical infrastructure at the point of service.

The strong preference for computer-based data entry (64.6%) over mobile phones, despite the ubiquity of smartphones, is significant. Users specifically cited the "Better Data Entry Interface" as the driving factor. This implies that while mobile penetration is high among health workers, there is a perception that complex task of data reporting which involves large tables and multi-product data entry is easier on larger screens. Additionally, developers must ensure that the user interface of electronic reporting platforms is fully optimized for mobile reporting to overcome this perceived disadvantage.

The disparities across facility levels and ownership emphasize an equity gap. Private and tertiary facilities are substantially more ready for digitization than public primary health centers. This is particularly concerning as PHCs are the backbone of the last mile health delivery in Nigeria. A digital transition that does not prioritize hardware provision for public PHCs risks further marginalizing rural reporting and creating data gaps in the national supply chain.

Additionally, the geographical variation in readiness, with Kano outperforming states like Kogi and Cross River, indicates that a "one-size-fits-all" national rollout may be ineffective. States with lower readiness scores may require more intensive hardware investment and foundational digital literacy support before the software is deployed.

RECOMMENDATIONS

To improve the future rollout of digital health solutions in developing countries like Nigeria, some important steps are recommended for improved uptake and adoption. At the lowest delivery points (Primary health centers) where most people seek care, steps must be taken to equip them with the necessary hardware (computers and tablets) that aids technology use. This will address the 60% gap in facility computer availability, with a specific focus on public institutions.

Additionally, the development of hybrid reporting models is essential; leveraging the high personal ownership of mobile phones through robust offline mobile reporting capabilities can effectively bypass current deficiencies in facility computers and stable internet connectivity.

Furthermore, implementing tiered training strategies is necessary to address regional disparities. Readiness assessments should be conducted to determine the readiness of each state for the technology uptake resulting in more need-focused training in states where computer knowledge is low.

CONCLUSION

The findings of this study demonstrate that health facility staff in Nigeria possess a high baseline of digital literacy and personal technological readiness, yet they are significantly constrained by a lack of institutional infrastructure (Akhlaq et al., 2016), (Fraser and Blaya, 2010). The overwhelming preference for computer-based reporting driven by the need for a superior data entry interface highlights that users are not merely looking for any digital tool, but for professional tools that provide efficiency and ease of use for complex logistics tasks.

While the study is limited by its specific geographic focus on four states and a "first-batch" selection bias, it serves as a critical blueprint for the future of digital health interventions in developing countries. It proves that the "human element" of digital transformation is ready; however, the success of the NHLMIS and similar technology solutions hinges on the government and partners closing the "last mile" infrastructure gap (Mohamedi, Said Nassoro, 2025).

Ultimately, this research underscores that for public health technologies to be sustainable in low-resource settings, implementation strategies must move beyond software training to include the provision of functional hardware at the primary health care level (Matagi, 2025), conducting readiness assessment for each state and foundational training on basic computer use. Lessons learned from this rollout suggest that a tiered approach, prioritizing institutional support for rural facilities and optimizing mobile interfaces for those without computer access is essential (Ishijima et al., 2015). By addressing these foundational gaps, developing countries can ensure that digital health systems like the NHLMIS do not just exist, but actively improve the efficiency and reliability of life-saving supply chains.

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