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Evaluation of the Quality and Performance of Nigeria Health Logistics Management Information System in Anambra State, Nigeria

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ABSTRACT

Background: The Nigeria Health Logistics Management Information System (NHLMIS) was established to report achievements and trends in key health indicators across Nigeria, with need for assessing the precision and reliability of data emanating from the NHLMIS. Government of Nigeria launched Nigeria Health Logistics Management Information System in 2018 for end-to-end visibility into health commodities management. However, since after its operationalization, no research has been done to verify the quality of data generated through the system and track the overall system performance. This study aims to assess the accuracy and quality of health data generated through the NHLMIS and to understand the major data quality limitation factors in Anambra State, Nigeria with a view to recommending appropriate improvement strategies.
Method: This study was facility-based, cross-sectional mixed-method study that utilised 98 systematically selected health facilities in Anambra State. Data from stock-keeping records, consumption records, and Logistic Management Information System reports were retrospectively extracted and used. Key informant interviews were conducted with 70 health workers inputting data into the Nigeria Health Logistic Management Information System. Descriptive statistics were employed for analyzing quantitative data, and thematic analysis was performed on the qualitative data.
Results: Findings from the study revealed that 25% of HIV/AIDS, 90% of family planning, and 88% of tuberculosis-supported sites did not have stock-keeping tools as at the time of the study. Additionally, 38% of HIV/AIDS sites and 88% of tuberculosis sites had no consumption records while 100% of tuberculosis sites and 20% of family planning sites lacked other reporting tools. Discrepancies existed between Stock-On-Hand, Consumption and Losses/Adjustment records in source documents and LMIS Reports submitted for the three programs. Data accuracy issues were observed, with discrepancies ranging from 15% to 39% in various categories. Qualitative findings identified human, material, and financial factors as the major factors affecting NHLMIS data quality.
Conclusions: The study revealed that the accuracy and quality of data in NHLMIS is poor due to multifaceted challenges that revolved around technology, transfer errors and other human and financial factors. Efforts to improve data quality should address these limitations as this will enhance the confidence on reported health data in Nigeria.

1. INTRODUCTION

The Health Management Information System (HMIS) is a framework in which health information is documented, stored, accessed, and analyzed to enhance decision-making process[1]. HMIS stands as one of the six fundamental pillars of the healthcare system and furnishes the essential data required for the functionality of other components, including service delivery, the healthcare workforce, access to vital medications, financing, and leadership[2]. The Logistics Management Information System (LMIS) is responsible for gathering and providing information regarding healthcare supplies regularly distributed to healthcare facilities. Its main objective is to efficiently oversee supply chain operations and generate data that prove valuable in tracking critical healthcare system performance metrics[3]. Hence, the LMIS is often referred to

as the heart of Logistics & Supply Chain Management Systems.

To ensure safe and reliable healthcare delivery, data quality is of utmost importance. The World Health Organization (WHO) outlines accuracy, validity, reliability, completeness, legibility, timeliness, accessibility, usefulness, and confidentiality as key dimensions of data quality[4]. Data quality issues cause organizations large losses in money, time, and missed opportunities[5]. The causes of data quality problems include processes bringing data from outside to the database, processes changing data from within, and processes causing data decay[6]with missing values, bias, measurement errors and human error in data entry and computation identified as data quality limitation. Although achieving data quality may not be easy, however, errors associated with this could be mitigated.

The Nigeria Health Logistics Management Information System (NHLMIS) was developed by the Nigeria Product Supply Chain Management Program (NPSCMP) under the Department of Food and Drug Services of the Federal Ministry of Health Abuja, Nigeria in 2018. Its purpose is to provide visibility into the country's stock situation down to the last mile and encourage ownership of quality Logistics Management Information System (LMIS) data by the Government of Nigeria to aid decision making in the health system. HIV/AIDS, Family Planning (FP), Tuberculosis & Leprosy (TBL), and Malaria programs are currently using the system. This reporting system is coordinated by the Logistics Management Coordinating Units (LMCUs) in all the 36 States Ministry of Health and Federal Capital Territory, Abuja. The States LMCUs report to both National and State supply chain stakeholders as well as implementing partners/donors.

Anambra State LMCU was inaugurated in February 2015 while the 21 Local Government Area (LGA) Logistics Management Coordinating Unit (LLMCU) in Anambra State were inaugurated in October 2017. The LLMCU collects data from healthcare facilities lacking electronic capabilities and transmits them to State LMCUs via NHLMIS while the secondary and tertiary facilities directly use NHLMIS for data submission.

Despite significant advancements and training of LLMCU officers and some health facility officers on the use of the NHLMIS and health logistics and supply chain management, challenges such as data accuracy issues, delayed reporting, incomplete reports and low stock reporting rates persists in the state[7].

This study is important because despite the enormous work that had been done in this area, it was found out that little of the studies were carried out in Nigeria. Secondly, the study will help to broaden the knowledge of the researcher and contribute to his professional development. Thirdly, the study will help to solve the problem of entering poor quality data into NHLMIS. Moreover, If the accuracy and quality of data entered into NHLMIS is not improved, it may affect the availability of the public health commodities in the health facilities in Anambra state and Nigeria in general. The health facilities may not get sufficient supplies which will lead to stock out of those commodities, unsatisfactory service delivery and increase in morbidity and mortality caused by those diseases. Above all, if the health facility officers are not making maximum use of NHLMIS, the original aim of setting up the system will be defeated. Thus there is need to identify barriers to effective and timely reporting of accurate and quality public health commodities consumptions in NHLMIS so as to remedy the situation.

This study was designed to assess data accuracy, data quality, and performance of health facility and LLMCU officers in NHLMIS in Anambra State, Nigeria as well as to determine the factors militating against data quality in NHLMIS in the State and proffer solutions. These identified challenges and solutions could be useful to policy makers in the supply chain industries.

METHODS

Study Design and Setting

The study was a facility-based cross-sectional descriptive design, complemented by qualitative study. This was done to evaluate the accuracy and quality of data as well as the performance of health officers within the Nigeria Health Logistics Management Information System (NHLMIS). The study spanned from November 2022 to June 2023. Anambra State is in South-Eastern Nigeria and has 21 Local Government Areas (LGA). Anambra State Ministry of Health formulates policies guiding healthcare management. The population of Anambra state based on 2006 Census is about 4.18 million. Anambra State has about 630 public primary healthcare centers, 35 public secondary health facilities, 3 tertiary health facilities and about 1056 registered private health facilities that provide services to the citizenry[8].

Population and Sampling Procedure

Anambra State platform in NHLMIS showed that about 1,058 health facilities supported by the 3 public health programs (91 HIV/AIDS Sites, 306 TBL sites and 661 FP sites) utilized the NHLMIS in the state before the

commencement of the study. These facilities were first stratified into facility types including; Tertiary health facilities (THF), Secondary health facilities (SHF), Primary healthcare centers (PHC), Health Posts (HPs), Public health facilities (PuHF), and Private health facilities (PrHF) to ensure the inclusion of all cadre. However, only health facilities that had their data inputted into the NHLMIS for at least one year were eligible for inclusion in the study with only 803 health facilities(217 HPs, 435 PHCs, 33 PuSHF, 33 PrSHFs, 2 THFs and 83other PrHFs) meeting this criteria. Using the 803 health facilities and 10% margin of error at 95% confidence level, 89 facilities (8 HIV/AIDs sites, 25 TBL sites and 56 Family Planning sites) were selected for inclusion in the study using Yamen's sample size formula[9]. An additional 10% of the total calculated sample size (89) distributed in the ratio of 1:3:5 to HIV, TBL and FP respectively were included to accommodate for unforeseen circumstances. Therefore, 98 facilities were selected through stratified simple random selection using Dr. Mads electronic sampling method[10]and proportionately distributed according to the facility types.

A purposive sampling approach was implemented in selecting 70 health facility officers for the qualitative study. This comprised all 36 focal persons from the 18 selected HIV/AIDS supported comprehensive health facilities, and LLMCU focal officers conveniently chosen from all the 21 LGAs. All selected officers had a commendable track record of more than one year of active involvement in NHLMIS data entry.

Study Eligibility:

Inclusion Criteria:

For Health Facilities,

- All supported public and private health facilities in Anambra State that are offering HIV/AIDS, TB and Family Planning services whose data are entered into NHLMIS.
- All supported health facilities in Anambra State that are offering HIV services and which staff have been trained to report direct into NHLMIS
- All supported public & private health facilities which their data have been reported into NHLMIS for up to one year.

For LGAs LMCUs,

- All LGAs LMCUs in Anambra State that collect public health program (e.g. Malaria, HIV/AIDS, Tuberculosis & Family Planning) data from public and private health facilities either primary healthcare centers (PHCs) or secondary health facilities and report them into NHLMIS

Exclusion Criteria,

For Health Facilities,

- All primary, secondary & tertiary health facilities in Anambra State that are offering HIV/AIDS, TB and Family Planning services but whose data are not entered into NHLMIS.
- All supported health facilities in Anambra State that do not want to participate in the study.
- All supported health facilities in Anambra State that have capacity to enter data direct into NHLMIS but are not willing to participate in the study.
- All health facilities that are offering HIV/TB/FP services in Anambra State but are not supported with free commodities by donors/partners.
- All health facilities that are inaccessible due to security reason or flooding.
- All supported health facilities which data have not been reported into NHLMIS for up to one year.

For LGAs LMCUs,

All LGAs LMCUs in Anambra State that collect public health programs' data from either public or private PHCs or secondary health facilities but are not willing to participate in the study.

Ethical Approval

Ethical approval with number MH/PRS/987 dated 18th August, 2022[11]was obtained from the Ethics Committee of the State Ministry of Health, Awka, Anambra State, Nigeria before the study commenced. Verbal informed consent was also obtained from participants for their participation in the study as well as publication of the study.

Data Collection Procedure

Quantitative Study

A Pro forma evaluation instrument adapted from the United States Agency for International Development (USAID) Logistics Indicators Assessment Tool (LIAT)[12] was used for the quantitative study (Appendix 1). The Pro forma evaluation instrument has 4 sections which comprise sections with questions on health facility data,

demographic data, availability of commodities, LMIS tools and their usage for the programs as well as sections on assessment of discrepancies between data in source documents and reports developed from such data including stock on hand (SOH), consumption data, and losses and adjustment. Whereas the source documents utilized included stock card, daily family planning register, and pharmacy worksheet; the reporting documents used were HIV Combined Requisition, Issue and Report Form (CRIRF), TBL Quarterly Requisition, Issue & Report Form (QRIRF), andFP Requisition, Issue & Report Form (RIRF). The data collection tool was validated based on findings from a pilot study with nine (9) health facilities spread across tertiary, secondary, primary, public and private health facilities that did not participate in the final study.
Another Pro forma evaluation instrument (Appendix 2) was developed and used to ascertain the accuracy of data in the health facilities' LMIS reports and the NHLMIS.

Qualitative Study
Key-informant interviews were performed using a 36-item structured interview guide adapted from the USAID Logistics System Assessment Tool (LSAT) [13](Appendix 3). A face-to-face interview method that lasted for about 30 minutes per participant was used for the selected 70 health facility officers.

Data Analysis
Quantitative data were analyzed with Microsoft Excel (Version 2013). Descriptive statistics were used to present data as frequencies, percentages and averages and results presented in charts and tables. Data quality and accuracy were determined from the percentage discrepancies between data from the source documents and generated reports as adapted from the USAID LIAT documents.

Formula for Calculating the Quantitative Data Quality

Percentage Discrepancy on Stock-On-Hand (SOH)
=(SOH on stock keeping records during a reporting period
-SOH in the LMIS report in the same reporting period)
÷SOH on stock keeping records during the reporting period ×100

Percentage Discrepancy on Consumption
=(Consumption on daily consumption record during a reporting period
-Consumption in the LMIS report in the same reporting period)
÷Consumption on daily consumption record during the reporting period×100

Percentage Discrepancy on Losses and Adjustment
=(Losses and adjustment on stock keeping record during a reporting period
-Losses and adjustment in the LMIS report in the same reporting period)
÷Losses and adjustment on stock keeping record during the reporting period×100

Formula for Calculating Data Accuracy

Percentage Discrepancy on Stock-On-Hand (SOH)
=(SOH on LMIS report during a reporting period
-SOH entered in NHLMIS in the same reporting period)
÷SOH on LMIS report during the reporting period ×100

Percentage Discrepancy on Consumption
=(Consumption on LMIS report during a reporting period
-Consumption entered in NHLMIS in the same reporting period)
÷Consumption on LMIS report during the reporting period×100

Percentage Discrepancy on Losses and Adjustment
=(Losses and adjustment on LMIS report during a reporting period
-Losses and adjustment entered in NHLMIS in the same reporting period)
÷Losses and adjustment on LMIS report during the reporting period×100
The qualitative data were then analyzed using NVIVO softwareQRS 2011, employing a thematic content approach. Relevant themes were identified through careful analysis of the transcripts, and a data-coding scheme was established. The coding scheme was validated independently by the researcher, and project supervisor.

RESULTS

Demographic Characteristics of Respondents
The demographic characteristics of respondents in the study are summarised in Table 1. The results showed that respondents in HIV/AIDS facilities were predominantly aged between 25 to 30 and above 46 years; TBL facilities mostly aged between36 to 40 and over 46 years while the age of respondents in FP facilities are mostly over 41 years. The ages of health workers in LLMCUS also range mostly from 41 years to above 50 years.

Over half of the respondents were married across all the programs and all workers in the facility had degree exceeding secondary school qualification.

Additionally, there were mixes of different professions in the study areas including Pharmacists, Laboratory Scientists, Nurses, Pharmacy Technicians and Community Health Extension Workers (CHEW).

Table1. Facility/Socio-Demographic Characteristics

	Quantitative				Qualitative	
Facility/Demographic Characteristics					**Frequency n (%)**	
	All Programs	**HIV**	**TBL**	**FP**	**HIV/AIDS Health Facilities Focal Persons**	**LLMCU Program Focal Persons**
Health Post	26	0	2	13		
PHC	53	4	17	44		
Pub-SHF	4	1	3	2		
Pub-THF	1	1	1	1		
Pr-SHF	4	2	3	1		
Pr-Other	10	1	2	0		
Total	98	9	28	61		
Age (Years)						
25 – 30		2(22.2)	0(0.0)	0(0.0)	1(3.0)	0.0 (0)
31 – 35		1(11.1)	0(0.0)	4(6.5)	12(35.0)	0.0 (0)
36 – 40		1(11.1)	8(28.6)	0(0.0)	9(26.5)	0.0 (0)
41 – 45		1(11.1)	3(10.7)	13(21.3)	3(9.0)	10(28.0)
46 – 50		2(22.2)	9(32.1)	22(36.1)	8(23.5)	11(30.0)
> 50		2(22.2	8(28.6)	22(36.1)	1(3.0)	15(42.0)
Gender						
Male		0(0.0)	0(0.0)	0(0.0)	9(26.5)	0.0 (0)
Female		9(100.0)	28(100.0)	61(100.0)	25(73.5)	36(100.0)
Marital Status						
Single		1(11.1)	0(0.0)	0(0.0)	5(15.0)	0.0 (0)
Married		7(77.8)	25(89.3)	58(95.0)	29(85.0)	34(94.0)
Divorced		0(0.0)	0(0.0)	0(0.0)	0.0 (0)	0.0 (0)
Widowed		1(11.1)	3(10.7)	3(5.0)	0.0 (0)	2(6.0)
Educational Qualification						
Secondary School		0(0.0)	0(0.0)	0(0.0)	0.0 (0)	0.0 (0)
NCE/OND		1(11.1)	11(39.3)	37(60.6)	4(12.0)	13(36.0)
HND/PGD		2(22.2)	8(28.6)	6(9.8)	0.0 (0)	4(11.0)
Graduate		4(44.4)	8(28.6)	18(29.5)	22(65.0)	15(42.0)
MSc.		2(22.2)	1(3.5)	0(0.0)	8(23.0)	4(11.0)
PhD		0(0.0)	0(0.0)	0(0.0)	0.0 (0)	0.0 (0)
Profession						
Pharmacists		3(33.3)	0(0.0)	0(0.0)	14(41.0)	0 (0.0)
Nurses		3(33.3)	14(50.0)	27(44.3)	0 (0.0)	19(53.0)
Laboratory Scientist		0(0.0)	0(0.0)	0(0.0)	14(41.0)	0 (0.0)
Pharmacy Technicians		0(0.0)	0(0.0)	0(0.0)	4(12.0)	2(5.0)
CHEW		2(2.2)	11(39.3)	34(55.7)	1(3.0)	11(31.0)
Others		1(11.1)	3(10.7)	0(0.0)	1(3.0)	4(11.0)

Availability of Data Management and Reporting Tools

Availability of stock control records including the stock keeping records and the consumption records in the assessed facilities is shown in Figure 1. The study showed that most commodities in HIV/AIDs facilities had stock keeping records while those in Family planning and TBL facilities did not have stock keeping records. Consumption records were seen in all the FP health facilities visited, 65% of HIV/AIDs sites and only 12% of TBL facilities. Similarly, data reporting tools such as HIV/AIDs-CRIRF, FP-RIRF and TBL-QRIRF were available in 100%, 80% and 0% of the HIV, FP and TBL facilities visited respectively (Figure 2).

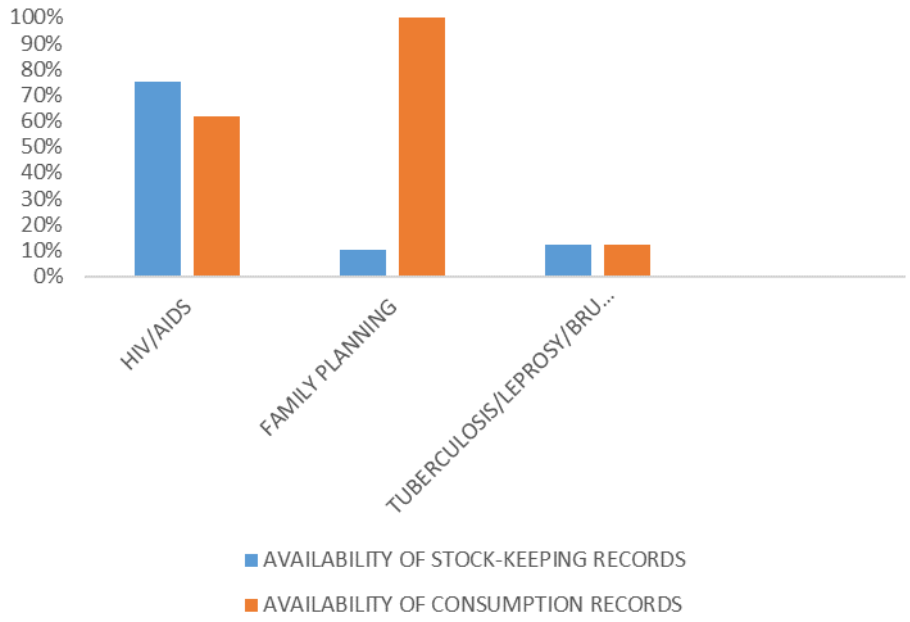

Figure 1: Availability of Data Management Tools

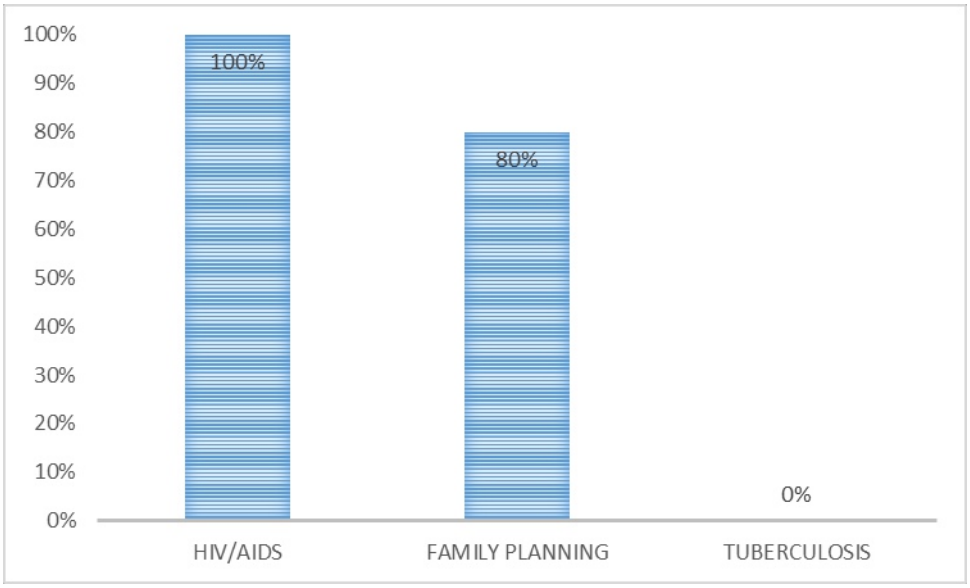

Figure 2: Availability of Reporting Tools

Data Accuracy and Discrepancies

Table 2 shows the discrepancies between the logistics essential data elements recorded on source documents and what was reported in the LMIS report tools. The study showed that discrepancies existed between the data on the three essential logistics data elements (stock-on-hand, consumption and losses/adjustment) from the source documents and what were entered into the three programs' LMIS reports as could be seen on Table 2.

DATA DESCRIPTION	SOH			CONSUMPTION			LOSSES/ADJUSTMENT		
	HIV	FP	TBL	HIV	FP	TBL	HIV	FP	TBL
Discrepancies between data in source documents and data in LMIS report of the same period for the 3 programmes	50%	100%	100%	50%	63%	100%	25%	100%	100%

SOH: Stock on hand; HIV: human immunodeficiency virus; FP: Family Planning, TBL: Tuberculosis & Leprosy

Furthermore, the discrepancies between the data in the LMIS report and what was entered into the NHLMIS are summarised in Figure 3. There was no discrepancy between SOH recorded in HIV CRIRF by the health facility officers and what was entered into NHLMIS but 15% and 23% discrepancies respectively existed between consumption data and losses/adjustment data entered in HIV/AIDs CRIRF and what were entered in NHLMIS. Besides, close to one-third of SOH and consumption data in family planning RIRF reports showed discrepancies with data entered into NHLMIS but there was no discrepancy between losses/adjustments in RIRF and what was entered into NHLMIS. Furthermore, close to half, more than half, and a quarter of the TBL QRIRF reports, showed discrepancies in SOH, consumption and losses/adjustments respectively from what were entered into NHLMIS.

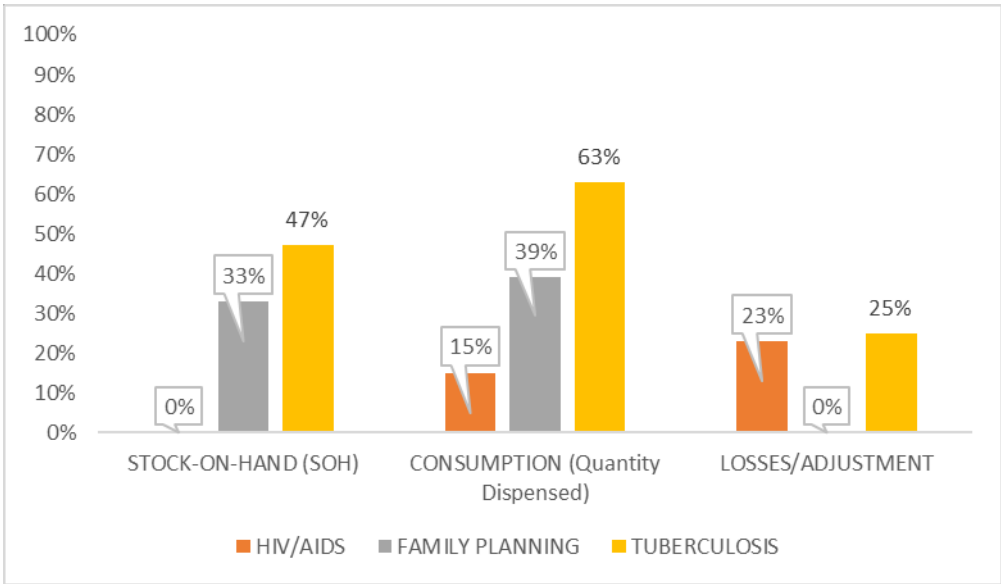

Figure 3: Discrepancies between the Logistics Essential Data Elements Recorded in the LMIS Hardcopy Reports and What Was Entered into NHLMIS

Identified Factors Militating Against Data Accuracy and Data Quality in NHLMIS

Thematic analysis of data obtained from interviewing key informants was conducted. The respondents highlighted many reasons as causes of poor quality and accuracy of data in NHLMIS. They are summarized in Table 3. Some of the factors identified as militating against data quality in NHLMIS borders on staff shortage, unskilled manpower, untimely reporting and incomplete data, lack of financial support to NHLMIS operators, as well as inadequate supervision and follow-up. Below are some of the responses of the participants.

Table 3: Factors Militating Against Data Accuracy and Data Quality in NHLMIS

THEMES	SUB-THEMES IDENTIFIED
Human Resources Issues	Inadequate trained staff Staff attrition Engagement of untrained volunteers at primary healthcare level Inadequate manpower Excess workload Computer illiteracy by some staff
Data Entry and Management Issues	No dedicated data entry clerk at health facilities Use of personal phones Late submission of data Submission of incomplete data Lack of guidelines for data entry into NHLMIS Data entered offline but forgot to upload later Omission of data Not making remarks when necessary Recording expired commodities as stock -on-hand Lack of feedback on quality of data
Resource and Financial Constraints	Lack of financial support for data bundle procurement Telecommunication network problems Lack of financial support to LLMCUs for calls or visits to primary healthcare centers to validate reports Lack of transport allowance support to health facilities focal persons that came for v alidation meetings at LGA headquarters Lack of recognition for excellence Poor supply chain coordination at the LGA level No reward system
Data Accuracy and Triangulation	Monitoring and evaluation officers supply inaccurate data for triangulation Some com munity testers do not submit data about test kits they collected from ART Comprehensive sites
Staff Movements and Changes	Staff attrition due to retirement, postings, resignations, migration outside Nigeria, staff rotation in hospitals, and posting of environmental health officers

Identified Factors That Will Promote NHLMIS Data Entry Accuracy and Quality

Respondents in the study unanimously agreed that NHLMIS is good and easy to use. Some suggestions to improve accuracy and quality of data in NHLMIS are summarized in table 4. The respondents stressed that the provision of LMIS tools, ICT equipment, training and capacity building of staff on supply chain management, accountability and transparency in commodities management, employment of more staff, financial support to NHLMIS operators as well as commitment on the part of health facility and LLMCU officers would help to improve data accuracy and quality in NHLMIS. Below are some of the extracts from the respondents' responses.

Table 4: Factors to Promote NHLMIS Data Accuracy and Quality

THEMES	SUB-THEMES IDENTIFIED
Training and Capacity Building	Training and re -training of health facilities officers and LLMCU members on logistics and supply chain management of health commodities
Data Veri fication and Quality Assurance	Conducting physical counts at both store and dispensaries on a monthly basis and accurate documentation and regular updating of stock-keeping and consumption records Cross-checking quantities received during the reporting period with proof of delivery (POD) before data entry Supported supervisory visits to health facilities and validation of perceived errors through phone calls
Inclusion of Additional Data Sources	Obtaining laboratory utilization data from community testers and mentor mothers and including them in the overall report
Timely Data Submission and Error Handling	Timely submission of data by testing points and health facilities officers as well as avoiding omission of data and adding remarks when there are losses or adjustments Checking for errors after entering data into NHLMIS and making corrections before final submission
Resource Allocation and Workload Management	Payment of transport fare to health facility officers to attend validation meetings at LG A headquarters Employing more staff to reduce excessive workload Financial support or training should be given directly to the actual people doing the data entry into NHLMIS instead of their superiors Transferring trained officers or posting them to where their knowledge and skills will still be used
Effective LGA LMCU Coordination	Assisting LLMCUs in conducting monitoring and supportive supervision visits to primary healthcare centers. Encouraging the participation of LGAs' Directors of PHC/HODs Health in all LLMCUs' activities and meetings due to their potential influence in advancing the LLMCUs' objectives Establishing dedicated WhatsApp platforms for each LLMCU to enhance coordination. Organizing quarterly state -level meetings involving both State and LGA LMCU representatives to provide data quality feedback and capacity building sessions by State LMCU officers. Furnishing LLMCU offices with comfortable amenities and supplying essential working tools such as computers, data bundles, recharge cards for communication, and LMIS tools. Providing financial support for transportation and refreshments during LLMCU monthly meetings and bimonthly data review sessions since most LLMCU officers double as health facility officers.

DISCUSSION

This study found that poor quality data were entered into NHLMIS in Anambra State and this calls for technical and financial support to health facility officers and LGA LMCU officers to improve the system.

This study observed that TBL and FP programmes as well as LGA LMCUs had focal persons who are mostly Nurses and Community Health Extension Workers (CHEWs) and because of inadequate manpower, many of the Nurses and CHEWs are overseeing primary healthcare facilities hence they combine clinical work with supply chain management thus making them inefficient in health commodity supply chain management. This finding aligns with the results of two prominent studies[14, 15]. To address this issue, one potential solution is to employ individuals with the specific task of data entry, allowing them specialise in this role and potentially enhancing efficiency.

Following the quantitative analysis of the results from the

study, it was found out that there was scarcity of stock-keeping records and consumption records for health commodities at the health facilities for the three programs HIV/AIDs, Family planning and Tuberculosis. The quantitative analysis also showed that TBL reporting tools (QRIRF) were not available in 100% of the health facilities visited while they were available in 100% of HIV/AIDs sites and 80% of family planning sites. Non-availability of the data capturing and reporting tools at the health facilities shows lack of transparency and accountability in commodity management which will affect data quality and accuracy in the health facilities. This means that the quality of data in the NHLMIS cannot be guaranteed. This raises a huge concern as documentation plays a vital role in ensuring data quality. Provision of these records should therefore be prioritised to ensure that data is entered into them in a timely manner as quality data cannot be kept without the essential tools. These findings agree with another work carried out in Nigeria[16]which showed that challenges related to inefficient inventory control systems were consistently identified in several of the reviewed studies contributing largely to regular stock-outs of medicines. The findings in this study is in agreement with a study done in Nigeria[17]where they stated that data availability and reliability for Forecasting/decision-making is one of the major challenges with vaccines supply chain management in Nigeria. This study also agrees with another study carried out in Ethiopia[18] on the effect of unavailability of registers on the quality of data. The findings in this study concurred with a study in Awi zone in Ethiopia[19] which showed that availability of LMIS tools together with monitoring and supervision to ensure proper utilisation of the tools will enhance adherence to laid down standards which can positively improve quality and accuracy of data.

The quantitative study also revealed discrepancies among the logistics essential data elements (SOH, Consumption and Losses/Adjustment) recorded on source documents and what were recorded on reporting tools. Here, the quality of data is affected by human errors due to data transcription. Moreover, when the information is not right, the decision made from such information will also not be right. This will generally affect public health supply chain management in the State adversely including the sourcing of the commodities because wrong data would lead to sourcing of either wrong commodities or wrong quantities of the required commodities. This may lead to stock out of health commodities, poor service delivery at health facilities, increased morbidity and mortality due to the diseases.

On accuracy of data, this study showed that all the three programs have data accuracy problem though in different proportions with TBL program as the one with the worst accuracy issue. This study generally showed that the accuracy of the data entered into reporting tools and NHLMIS were poor and need to be improved upon as this is vital in decision-making with regards to quantities of commodities to be resupplied, how long the commodities will last, how many needs to be redistributed to reduce wastages and expiries etc. The finding of poor accuracy in this study agrees with earlier studies[14,20,2122 and 23] which showed that data quality and accuracy have been a persistent challenge in healthcare management systems.

From the quantitative study, lack of data quality and accuracy found in this study will affect the efficiency and responsiveness of the public health commodities supply chain management in the state in the sense that when the health facilities run out-of-stock too soon, it will cost more to replenish their stock through transport cost and the clients will not get what they want when they need them. The poor quality data will affect the cost of transportation of the public health commodities adversely because it might entail engaging third party logistics (3PLs) too often to resupply the system if it is to fulfill its logistics function of commodity security. On the other hand, when some health facilities are overstocked due to poor quality data, some of the commodities may expire which will be a loss to the system and a sign of inefficient supply chain management while some clients in other health facilities could not get the commodities to solve their problem which means that the system is not responsive. The implication of these is that the health facilities will not be able to fulfill the six rights of Logistics and as such could not satisfy all their clients.

The qualitative study found out a lot of factors that militated against data quality. Human resource challenges caused poor documentation at the health facilities and inadequate supervision of the health facilities by the LGA LMCUs which in turn leads to poor quality data, inadequate validation, insufficient feedback on data quality, lack of efficiency and unresponsiveness to clients.

Lack of dedicated data entry clerk implies that nobody should be held accountable and as such there will be no commitment to the data entry which will lead to untimely reporting, mistakes, omissions, incomplete reporting and finally poor data quality. When workers are entering data at their personal expense, it will lead to untimely reporting and incomplete data and this contributes to poor quality data. If remarks were not made when losses or adjustment were encountered and expired commodities were recorded as stock-on-hand, it will lead to poor data quality and wrong

supply chain decisions.

On resource and financial Constraints,lack of data bundle support, poor supply chain coordination at the LGA level and telecommunication network problems delay reporting into NHLMIS while lack of support for calls and visits to health facilities affected data cleaning and validation negatively which in turn leads to poor quality data. Again, lack of recognition for excellence and no reward system demoralised committed staff and affect data reporting.

The challenges identified with data accuracy and triangulation led to commodity insecurity in' such health facilities. This invariably caused stock out one way or the other and unsatisfactory service delivery to the clients.

The problem of staff attrition called for the training of newly recruited staff thus increasing the cost of running the programs. This also left some health facilities with unqualified people to manage public health programs and commodities which might increase morbidity and mortality due to the public health diseases as well as commodities insecurity due to poor supply chain management.

These findings in the qualitative study agrees with similar studies in Rajasthan, India[24]; Tanzania[25]; Ethiopia[26, 27, 28, 23]; Morocco[29];Yaounde-Cameroon[30].

Although the cited factors were numerous, key informants had several useful strategies to address these issues and maintain data quality and accuracy, among which were staff training and capacity building, technological support and infrastructural enhancement, data verification and quality assurance amongst others. Implementing a number of these strategies will go a long way in ensuring data quality and accuracy. Additionally, lack of feedback on data status was cited as one of the factors affecting data quality and accuracy. If findings from this study are made available it may be a useful medium to pass across this feedback.

Since each facility has its own peculiar challenge, it is pertinent to address these challenges on a facility-based level before going down to an LGA level and eventually, to a State-based level. By understanding and addressing these identified challenges, NHLMIS can fulfill its mission more effectively and efficiently.

LIMITATIONS OF THE STUDY

The study encountered several limitations some of which were the insecurity in Anambra State. This posed challenges for collecting data as it impacted access to certain areas. However, the researchers have a good knowledge of the state and were able to visit the three senatorial districts for data collection at safe periods with good representations from all the zones. Another limitation arose from the absence of a resident implementing partner for family planning, as the State Ministry of Health assumed this role, potentially affecting data availability. We also had challenges with the respondents level of understanding and assimilation of the questions in the instruments used in data collection. To mitigate this, we utilized an interviewer-administered approach with possible explanations where necessary. Moreover, some sampled health facilities lacked comprehensive records and reports, which limited the completeness of data analysis. This study's findings should provide valuable insights into the challenges facing NHLMIS data quality and accuracy in Anambra State, Nigeria as well as the strategies to overcome them.

CONCLUSION

LMIS data recorded in NHLMIS by health officers and LLMCU teams in Anambra state exhibited deficiencies in both quality and accuracy owing to many militating factors. These identified militating factors are similar to those reported in similar research conducted in other regions.

The study showed that the accuracy of data entered into NHLMIS needs to be improved upon. Discrepancies were found between the data in source documents and what were entered into the hardcopy reports. The lack of records and reporting tools identified during the study might have supported the inaccuracies observed. Moreover, discrepancies were also identified between data in hardcopy reports and what the LGA LMCU officers entered into NHLMIS. This might be due to transfer errors.

A quality data is expected to be accurate, complete and delivered on a timely basis. However, the study showed that some data were inaccurate and reports were incomplete while some health facilities submitted their data late hence the quality of the data was poor. The study also found that some of the workers combined clinical management with supply chain management which might have affected the quality of data they reported.

Many factors militating against the accuracy and quality of data were identified by this study. They include human resource issues like staff shortage, unskilled manpower, excess workload etc.; and data entry and management issues such as late submission of data, lack of dedicated data entry clerk, lack of feedback on quality of data. Other factors identified are resource and financial constraints, as well as staff movement and changes.

The study recommends making LMIS tools available at all times, training and re-training of health facility officers and LLMCU officers on supply chain management, provision

of support for data bundle, calls and visit to health facilities for data validation to LLMCU; employment of more manpower, employment of at least one Pharmacist or Pharmacy Technician in each LGA; Support to LLMCUs for monthly supply chain coordination meetings and bimonthly data review meetings; and provision of comfortable LLMCU secretariat and working tools like work stations, computers and Wi-Fi etc. All these will facilitate the improvement of data quality and accuracy.

The researchers propose extending this study to other states within the South Eastern region and throughout Nigeria to assess the extent of the identified issues. Furthermore, it is advisable to replicate the research in a state where all four NHLMIS programs - Malaria, HIV/AIDS, Family Planning, and Tuberculosis - receive comprehensive support from partners for comparative analysis.

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Author Contribution

Ojukwu, O.N, Nduka, S.O. and F.B.C.Okoye conceptualized the study and did formal analysis of the findings. Ojukwu, O.N, Nduka, S.O. and F.B.C.Okoye did Visualization and writing-review & editing. Ojukwu, O.N. did investigation, methodology, and Project Administration while Ojukwu, O.N. and Nduka, S.O. wrote-original draft. Nduka, S.O. and F.B.C.Okoye did supervision and validation of the research work. All Authors have complete access to the study data that support this publication.

STATEMENTS AND DECLARATIONS

Ethical Consideration

This study was approved by the Ministry of Health, Awka, Anambra State, Nigeria Research Ethics Committee (approval number MH/PRS/987) on August 18th, 2022

Consent to participate

Informed consent to participate was obtained verbally from the participants.

Consent for publication

Not Applicable

Declaration of Conflict of Interests

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

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Data Availability

The datasets generated during and/or analyzed during the current study are available from the corresponding author on reasonable request.

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