

Assessment of Data Quality and Reporting Consistency in Maternal Health Services at Rural Sub-Saharan Africa: The Challenges in Decision-Making

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ABSTRACT

Background: Maternal health remains a critical public health issue, particularly in low- and middle-income countries, with sub-Saharan Africa experiencing disproportionately high maternal mortality rates. Bayelsa State, Nigeria, faces significant challenges in maternal health service delivery, including inadequate infrastructure and poor data management systems, which hinder effective decision-making and resource allocation.

Objective: This study aimed to assess the quality and reporting consistency of maternal health data at primary health centres in Bayelsa State, utilizing DHIS2, primary healthcare registers, and structured key informant interviews to generate evidence-based recommendations for improving data practices.

Method: A convergent mixed-methods design was employed, combining quantitative analysis of maternal health data from DHIS2 and primary healthcare registers over a 24-month period with qualitative data from structured questionnaires administered to health workers and stakeholders. The study sampled 83 primary health centres and 308 health workers across selected Local Government Areas to ensure representation of diverse contexts.

Results: The findings revealed significant gaps in data quality, characterized by issues of completeness, accuracy, timeliness, and consistency. For instance, discrepancies were noted between DHIS2 and primary healthcare registers, with a Cohen's kappa value of 0.1036 indicating poor agreement on data verification. Additionally, logistic regression analysis identified the role of health workers and experience in data management as significant factors influencing data entry compliance.

Conclusions: The study highlighted critical deficiencies in maternal health data quality and reporting practices in Bayelsa State, emphasizing the need for targeted interventions to enhance data accuracy, completeness, and timeliness. Strengthening training and supervision, along with improving data management systems, was essential for achieving better maternal health outcomes and effective health service delivery.

Keywords

Maternal health, Data quality, Reporting consistency, Health information systems, Health data management.

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Introduction

Maternal health remains a critical component of public health, especially in low- and middle-income countries where maternal

mortality rates are disproportionately high. According to the World Health Organization (WHO), an estimated 295,000 maternal deaths occurred globally in 2017, with sub-Saharan Africa

accounting for approximately two-thirds of these deaths [1]. Nigeria, in particular, bears a significant burden, with an estimated maternal mortality ratio (MMR) of 512 per 100,000 live births as of 2017 [2], one of the highest globally. Bayelsa State, located in the Niger Delta region of Nigeria, faces unique challenges in maternal health service delivery. The state's geographical landscape, characterized by numerous riverine communities, often hampers access to healthcare facilities, especially for pregnant women [3]. Despite efforts to improve maternal health through the State Emergency Maternal Child Health Coordinating Program and the implementation of the Basic Health Care Provision Fund, maternal mortality remains unacceptably high in Bayelsa, partly due to systemic issues such as inadequate infrastructure, shortage of skilled health personnel, and poor data management systems [4]. Accurate and reliable health data were essential for monitoring, evaluating, and improving maternal health services. Data quality encompasses aspects such as completeness, accuracy, timeliness, and consistency—elements critical for decision-making and resource allocation [5]. However, in many Nigerian primary health care settings, data quality deficiencies hinder effective program evaluation and policy formulation. Challenges include inconsistent reporting practices, lack of standardized recording tools, and limited capacity among health workers to manage and utilize data effectively [6]. In Bayelsa State, efforts had been made to strengthen health information systems; however, reports suggest persistent issues with data reporting and quality at the primary healthcare level [7]. Given that primary health centres serve as the first point of contact for most pregnant women, ensuring high-quality data and reporting consistency at this level was vital for improving maternal health outcomes. Understanding the current state of data quality and reporting practices in Bayelsa's primary health centres was critical to identifying gaps and implementing targeted interventions. Reliable data facilitate the tracking of maternal health outcomes, such as antenatal care attendance, delivery methods, and maternal mortality rates, which were vital for assessing progress toward national and international health targets, including the Sustainable Development Goals [2]. Moreover, consistent reporting ensures that health information systems reflect true service patterns, reducing discrepancies that could lead to misinformed policies or resource misallocation. Accurate and timely data also support resource planning, allowing for better forecasting of supplies, personnel, and infrastructure needs, which directly impacts the quality of maternal health services [8]. Additionally, maintaining data integrity fosters accountability among health workers and administrators, promoting transparency and adherence to clinical standards, ultimately improving patient safety and care outcomes. Furthermore, robust data systems underpin evaluation and research efforts aimed at identifying effective interventions and scaling up successful strategies, thus enhancing overall health system efficiency. Conversely, poor data quality and inconsistent reporting undermine these benefits, leading to misinformation, inefficient resource use, and compromised maternal health outcomes. Therefore, strengthening data quality and ensuring reporting consistency were critical steps toward improving health service delivery, particularly in resource-

constrained settings where every data point could influence life-saving decisions [9]. Data management at primary health centres faces numerous challenges that hinder the effective use of health information systems and compromise service delivery. One of the primary issues was inadequate infrastructure, including unreliable electricity, poor internet connectivity, and insufficient hardware such as computers and data storage facilities, which limit the ability to collect, store, and transmit data accurately and promptly. Additionally, many health workers lack adequate training and capacity in data management practices, leading to errors, incomplete records, and inconsistent reporting [10]. Human resource shortages further exacerbate these issues, as overburdened staff prioritized clinical duties over meticulous data recording, resulting in data inaccuracies and delays. Moreover, the absence of standardized data collection tools and protocols contributes to variability in reporting practices, making data less reliable and comparable across facilities [11]. Challenges in supervision and quality assurance also play a role, as infrequent monitoring and feedback reduce motivation and accountability among health workers. Furthermore, systemic issues such as lack of political commitment and insufficient funding hinder investments in robust health information systems, perpetuating gaps in data quality and management. Collectively, these challenges undermine the potential of health data to inform decision-making, ultimately affecting maternal health outcomes and the efficiency of primary healthcare services. Despite efforts to enhance maternal health outcomes, challenges related to poor data quality and reporting inconsistencies persist, impeding the ability to accurately monitor progress, allocate resources effectively, and implement targeted interventions [12]. Existing literature highlights that data inaccuracies and inconsistencies at the primary health level contribute to misinformed decision-making especially for the communities it serves, which could result in ineffective resource utilization and suboptimal maternal health outcomes. Moreover, in the context of Nigeria's decentralized health system, reliable data were essential for evaluating program performance and ensuring accountability among health workers and administrator [13]. The findings were expected to serve as a basis for targeted interventions aimed at improving data management practices at the primary healthcare level, which was crucial for advancing maternal health initiatives in Bayelsa State and similar settings. The National Health Management Information System (NHMIS) was pivotal for data quality and reporting in Primary Health Centres in Bayelsa State, serving as the backbone that connects accurate data generation with timely, actionable reporting for health system strengthening and research. At the heart of this system was standardization: NHMIS provides uniform data definitions, coding schemes, and reporting formats across all primary healthcare centres, which reduces heterogeneity arising from local practices and enables valid comparisons across facilities, LGAs, and time. This standardization directly supports data quality dimensions critical for credible reporting and analyses—completeness, accuracy, timeliness, and consistency. Completeness benefits because essential data elements (patient identifiers, visit dates, service type, maternal and child health indicators, immunizations, stock status)

were defined and prioritized within the NHMIS data dictionary, guiding data clerks to capture all required fields during every encounter. Accuracy was enhanced through validated data entry rules, code sets, and built-in checks that minimize entry errors and misclassification, ensuring that reported figures reflect true clinical activity. Timeliness improves because standardized reporting calendars and submission workflows within NHMIS help primary healthcare centres align their local data capture with state and national reporting cycles, enabling timely dashboards and periodic reviews that supported rapid decision-making and public health responses. Consistency across primary healthcare centres was crucial for aggregation; when all facilities adhered to the same indicators and data structures, the aggregates measure such outcomes as immunization coverage, antenatal care completion, and service utilization which forms the basis for decision-making as the reliable inputs for LGA and state-level planning, budget allocation, and performance assessment. Data quality and reporting were tightly interwoven with governance, privacy, and accountability. NHMIS embedded data provenance, audit trails, and role-based access didn't only protect patient confidentiality but also enable researchers and auditors to trace data lineage from source documents through transformation to final reports. This traceability supported reproducibility of analyses and integrity of published findings, which was essential for credible evidence informing policy and resource distribution in Bayelsa. The context of Bayelsa's geography—with dispersed riverine communities and variable connectivity—necessitates offline data capture capabilities, robust synchronization, and reconciliation processes within NHMIS to maintain data quality and ensure timely reporting even when network access was intermittent. Training and capacity building for health workers, data clerks, and facility managers were indispensable; ongoing education on data definitions, entry validation, and the importance of timely reporting strengthens both data quality and the reliability of NHMIS-generated reports. Governance mechanisms—quality dashboards, routine data quality audits, feedback loops, and performance reviews—create accountability and a culture of continuous improvement, encouraged facilities to address gaps, implement corrective actions, and sustain high-quality reporting practices. For research purposes, NHMIS data quality underpin reporting was essential: researchers depend on well-documented data dictionaries, standardized indicator definitions, and version control to reproduce analyses, compare results across sites and time, and draw valid inferences about program effects and health outcomes. Conversely, reporting quality problems—missing data, delays, inconsistent coding, or inaccurate aggregates—could affect bias findings, misinform policy, and erode trust among stakeholders. Therefore, prioritizing data quality within NHMIS—encompassing completeness, accuracy, timeliness, consistency, provenance, privacy, and robust reporting workflows—was essential to harness Bayelsa State primary healthcare's setting as a trustworthy, efficient source of health information for service delivery improvement, surveillance, governance, and research. Data quality within health information systems at primary health centres was fundamental to effective healthcare delivery and policy formulation. Four primary

dimensions—accuracy, completeness, timeliness, and consistency—were widely recognized as critical indicators of data quality. Accuracy refers to the degree to which data correctly reflects the real-world events or conditions they intended to represent. Accurate data was essential for reliable decision-making; inaccuracies could lead to misdiagnosis, inappropriate resource allocation, and flawed policy interventions [14]. Completeness pertains to the extent to which all required data elements were recorded and available within the given timeframe. Incomplete data could obscure true health trends, hinder monitoring efforts, and compromise service delivery, particularly in maternal health where comprehensive records were vital for assessing outcomes [15]. Timeliness involves the promptness of data entry, reporting, and availability for decision-makers. Delays in data reporting could result in outdated information, which impairs timely responses to emerging health issues and affects the planning and evaluation of health programs [16]. Lastly, consistency refers to the degree of uniformity in data reporting across different facilities and over time. Inconsistencies could arise from variations in data collection methods, definitions, or reporting protocols, leading to discrepancies that complicate data interpretation and trend analysis. The importance of data quality and reporting consistency in primary health centres cannot be overstated, as these elements were fundamental to the effective delivery of healthcare services and the achievement of health system goals. High-quality data—characterized by accuracy, completeness, and timeliness—were essential for informed decision-making, enabling health managers and policymakers to monitor service delivery, evaluate program performance, and allocate resources effectively. These dimensions were interconnected and collectively influenced the reliability of health data. For example, a study in Nigeria found that inaccuracies and inconsistencies in maternal health data significantly hindered program evaluation and policy planning [14]. Similarly, research in low-resource settings emphasized that poor data completeness and timeliness often result from inadequate training, resource constraints, and lack of standardized reporting protocols. Therefore, improving these core dimensions was crucial for strengthening health systems, especially at the primary care level, to ensure data-driven decision-making that could improve maternal health outcomes. Addressing these challenges requires targeted interventions, including capacity building, resource allocation, and implementation of standardized data management protocols. Reliable data on maternal health outcomes at primary care level was vital for ensuring effective healthcare delivery and advancing maternal health initiatives especially for the underserved communities. Accurate and dependable data enable health authorities to monitor progress toward national and international targets, such as the Sustainable Development Goals (SDGs), particularly Goal 3, which was aimed at reducing maternal mortality [1]. When data accurately reflect maternal health outcomes—such as antenatal care coverage, delivery methods, complications, and maternal mortality rates—health systems could identify high-risk populations, allocate resources appropriately, and tailor interventions to address specific community needs [17]. Moreover, reliable data serves as the foundation for evaluating the

impact of maternal health programs, guiding policy adjustments, and ensuring accountability among healthcare providers and policymakers [14]. In settings like primary health centres, where resources were often limited, the importance of data integrity couldn't be overstated, as it influences decision-making that directly affects maternal and neonatal survival rates. Inaccurate or incomplete data could lead to misguided policies, inefficient use of resources, and missed opportunities for intervention, ultimately compromising maternal health outcomes. Additionally, dependable data fosters community trust and encourages greater utilization of maternal health services, as populations become confident that their health needs were being recognized and addressed effectively. Therefore, strengthening data collection and management at the primary care level is essential for improving maternal health outcomes, reducing maternal mortality, and achieving sustainable health system improvements [1]. Existing literature indicates that significant data quality gaps persist at primary health centres in Bayelsa State, Nigeria, which impede effective health service delivery and policy implementation. Despite efforts to improve healthcare information systems, studies such as those by Bayelsa State Ministry of Health reveal ongoing issues with incomplete and inaccurate data recording, largely attributable to inadequate training of health workers, high patient loads, and limited supervision [7]. Furthermore, reports suggest that timeliness of data submission remains a challenge, with delays in reporting reducing the usefulness of data for timely decision-making. Specific to Bayelsa, infrastructural challenges such as unreliable electricity supply and poor internet connectivity hinder the adoption of electronic health record systems, leading to continued reliance on paper-based records that were prone to errors, misplacement, and loss [15]. Additionally, there was evidence of inconsistent data definitions and lack of standardized reporting protocols across facilities, resulting in discrepancies and difficulties in aggregating data for regional or national analysis [7]. These gaps highlight the critical needs for targeted strategies to strengthen data management practices, improve training, and implement standardized, digitized systems tailored to the unique infrastructural realities of Bayelsa State. Addressing these specific data quality issues was essential for enhancing maternal health outcomes and ensuring evidence-based policymaking at the primary healthcare level.

Statement of the Problem

Despite policy attention and investments aimed at reducing maternal morbidity and mortality, data used to monitor and improve maternal health services at the primary health-care level in Bayelsa State were not reliably available. Primary health centres in Bayelsa largely rely on paper-based registers and routine forms to record antenatal care (ANC) visits, delivery outcomes, postpartum care, and related stock and referral information. Across facilities, data quality was compromised by incomplete registers, missing or duplicate entries, misclassification of maternal events, and inconsistent patient identifiers. Timeliness and completeness of reporting were further weakened by staff shortages, logistics disruptions, and weak supervisory and feedback mechanisms. The use of multiple, non-harmonized registers for maternal

health, immunization, and other programs creates fragmented data that challenge comparability across facilities, LGAs, and national dashboard. As a result, key indicators—such as ANC initiation and completion, skilled birth attendance, postpartum follow-up, and maternal referral outcomes—could be inaccurately captured, delaying corrective actions and leading to inefficient resource allocation and weakened program evaluation at the primary healthcare level. Bayelsa's particular context intensifies these challenges. The state comprises dispersed, often riverine communities with limited electricity and internet connectivity, high staff turnover, and frequent stockouts of National Health Management Information System (NHMIS) registers, forms, and supplies. These conditions hinder reliable data capture, timely transmission to local government area and state systems, and consistent data use for decision-making. However, there was a paucity of research specifically assessing the quality and reporting practices of maternal health data within Bayelsa State's primary health centres, despite the state's unique geographical and infrastructural challenges which could influence data management practices. There was currently limited empirical evidence detailing the magnitude, drivers, and consequences of data quality gaps in Bayelsa primary healthcare centres, and no robust assessment of reporting consistency for maternal health data in this setting. This knowledge gap constraint's efforts to strengthen the health information system and to monitor progress toward maternal health objectives. Therefore, this study was justified as it aims to fill this critical gap by systematically evaluating data quality and reporting consistency, providing evidence that could inform policy formulation, strengthen health information systems, and ultimately improve maternal health outcomes in the state. The study was aimed to assess data quality dimensions (completeness, accuracy, timeliness, and consistency) and the reporting coherence of maternal health service data at Bayelsa primary healthcare centres, identify determinants of data quality gaps, and generate evidence-based recommendations to improve data reliability, use, and ultimately maternal health outcomes.

General objective

To assess the quality and reporting consistency of maternal health data at primary health centres in Nigeria, using DHIS2, primary healthcare registers, and structured key informant data, and to generate evidence-based recommendations to strengthen data capture, transmission, and use for improved maternal health planning and service delivery.

Specific objectives

- Quantify data quality dimensions (completeness, accuracy, timeliness, and consistency) for key maternal health indicators (e.g., ANC initiation and visits, skilled birth attendance, delivery outcomes, postpartum follow-up, referrals) recorded in primary healthcare registers and reported in DHIS2 over a defined period.
- Assess the coherence, comparability, and cross-facility consistency of maternal health data across primary healthcare centres, LGAs, and states (where feasible) to identify variation

in reporting.

- c. Evaluate concordance between DHIS2-reported maternal health data and corresponding data in primary healthcare registers and monthly reports to identify and characterize discrepancies.
- d. Identify determinants of data quality gaps and reporting delays, including governance, supervision, data management practices, training, infrastructure (electricity, internet), and workforce constraints.
- e. Explore stakeholders' perceptions and experiences related to data-use culture, feedback mechanisms, and supervision through structured key informant interviews to understand factors shaping data quality.
- f. Develop actionable recommendations to strengthen data capture, validation, transmission, and data use at the primary healthcare and LGA levels, with attention to improving DHIS2 data quality and its utility for decision making.
- g. If data permit, compare data quality and reporting patterns across different primary healthcare contexts (e.g., urban, rural, and resource-constrained settings) to inform context-specific improvements.

Significance of the Study

This study offers practical and strategic value for Bayelsa State, the Nigerian health system, and the broader health information literature by examining data quality and reporting consistency in maternal health services at primary health centres. It addresses a critical bottleneck for evidence-based decision making, as reliable data on antenatal care, skilled birth attendance, postpartum follow-up, and referral outcomes which were essential for monitoring progress toward maternal health goals and guiding policy and program responses at the primary healthcare centres, LGA, and state levels. By identifying dimensions of data quality—completeness, accuracy, timeliness, and consistency—and the drivers of reporting variation, the study provides a robust foundation for targeted improvements in data capture, transmission, and use. The findings could inform the design and integration of data quality assurance (DQA) and data quality reviews (DQRs) into primary healthcare supervision, supporting routine checks that prevent recurring errors and enhance data use for decision making. Harmonizing registers and definitions across maternal health and related programs improves comparability over time and across facilities, enabling more reliable district and state planning, budgeting, and accountability. The study guided capacity-building efforts in accurate record-keeping, coding, and data validation, and strengthen supervision and feedback mechanisms that incentivize data quality enhancements. Improved data quality and consistent reporting enhance forecasting for essential commodities (e.g. medications, supplies for obstetric care), staffing needs, and logistics, reducing stockouts and misallocation, particularly in Bayelsa's riverine and dispersed primary healthcare networks where reliable data were essential for outreach, referrals, and equitable maternal health service delivery. From a scholarly standpoint, the research would contribute to health information systems by offering a contextualized framework for measuring data quality in maternal

health indicators that could be adapted to other Nigerian states or similar settings, and by illuminating how data use and feedback loops shape data quality. Finally, the study supports national and international health objectives by strengthening maternal health data reliability, contributing to progress toward SDG targets on maternal mortality and health equity and aligning with Nigeria's health information system strengthening agendas.

Scope and Limitation of the Study

Scope

The study examines data quality and reporting consistency for maternal health services at primary health centres in Bayelsa State, Nigeria, with explicit integration of structured key informant questionnaires, DHIS2-reported data, and primary healthcare data. It encompasses primary healthcare centres across selected Local Government Areas (LGAs) that reflect urban, rural, and riverine contexts in Bayelsa. The focus was on maternal health data captured in routine health information systems, including antenatal care (ANC), skilled birth attendance, delivery outcomes, postpartum follow-up, and related supply and referral information recorded in primary healthcare registers and reported through DHIS2. The study employed a retrospective design, extracting DHIS2 data and primary healthcare-recorded data for the most recent complete 24-month period of January to June starting from 2022-2025 each year. In addition, structured key informant questionnaires were administered to primary healthcare in-charges, routine health information system officers at the LGA and state levels, data clerks, and frontline maternal health providers to capture governance, supervision, data management practices, training, infrastructure, and data-use culture. The study triangulated DHIS2 data with primary healthcare registers and reports to assess concordance and to better understand drivers of discrepancies. The outcome included an inventory of data quality gaps, analyses of determinants of reporting inconsistencies, and evidence-based recommendations to strengthen data capture, transmission, and use at the primary healthcare centres and LGA levels, with particular attention to improving the utility of DHIS2-reported data for decision making.

Limitations

Generalizability was limited to Bayelsa State; findings might not be readily transferable to other states with different routine health information system, infrastructures, governance structures, or service delivery contexts. Dependence on multiple data streams (DHIS2, primary healthcare registers, and paper-based records) might constrain analyses. DHIS2 data quality hinges on upstream primary healthcare data entry, and discrepancies between DHIS2 and source registers complicated interpretation of data quality dimensions. Access and logistical constraints affected data collection, especially in remote, riverine, or flood-prone primary healthcare centres. Weather, flooding, or security issues delayed field activities and restrict facility access. Potential response and measurement biases exist in structured key informant data. Social desirability, recall bias, varying interpretation of questions, and nonresponse influenced questionnaire results and introduced bias.

While associations between determinants and data quality gaps were explored, causal inferences couldn't be established; temporal sequencing was difficult to disentangle. Temporal changes in routine health information system processes, DHIS2 configurations, and policy guidelines during the study period influenced data quality and reporting patterns, complicated trend analysis. Resource constraints, including time, budget, and personnel, might limit the breadth of primary healthcare sampling, the depth of qualitative data collection, or the number of LGAs surveyed, affecting comprehensiveness. Ethical and privacy considerations require careful handling of health data. Necessary approvals, data-sharing agreements, and anonymization procedures might constrain access to granular data and shape analytic approaches. Data harmonization challenges might persist. Differences in indicator definitions, coding schemes, or documentation practices across primary healthcare and DHIS2 modules could limit comparability.

Method

Study Design

This study employed a convergent mixed-methods design to comprehensively assess data quality and reporting consistency for maternal health services at primary health centres in Bayelsa State, Nigeria. The quantitative component analyzed routine maternal health data drawn from DHIS2 and corresponding primary healthcare registers and monthly summary/quarterly reports to quantify data quality dimensions—completeness, accuracy (concordance between DHIS2 and primary healthcare records), timeliness, and consistency—across a purposively selected set of primary health centres representing urban, rural, and riverine contexts. The qualitative component collected structured key informant data through questionnaires administered to primary healthcare in-charges, routine health information system officers at the LGA and state levels, data clerks, and frontline maternal health providers to elucidate governance structures, supervision practices, data-management norms, training, infrastructure, and the culture of data use that influence data quality and reporting. The study employed a multi-stage stratified sampling approach to ensure representation across Bayelsa's urban, rural, and riverine contexts, and all eligible staff at sampled primary healthcare centres were invited to participate in the structured data collection activities. This multi-stage, stratified sampling approach to select primary healthcare centres across LGAs was met to reflect the state's heterogeneity in geography and service delivery conditions. Within each stratum, primary healthcare centres were randomly selected to participate in the quantitative data collection, and purposive sampling identify respondents for the structured questionnaires to capture diverse roles in data capture, validation, and use. Retrospective data collection was targeted at defining 24-month window, drawing DHIS2 aggregates and the corresponding primary healthcare centres registers and monthly summary/quarterly reports to bolster reliability. Triangulation was conducted by comparing DHIS2 figures with paper-based records to understand discrepancies and drivers of data misalignment. Analysis was conducted in two parallel tracks and then was integrated. Quantitatively, data quality metrics was computed for

core maternal health indicators—such as antenatal care initiation and visit counts, skilled birth attendance, delivery outcomes, and postpartum follow-up—and was analyzed for completeness, accuracy (through concordance measures between DHIS2 and primary healthcare registers), timeliness, and cross-facility consistency; stratified analyzes by primary healthcare context to uncover contextual variations in data quality. Qualitatively, responses from structured questionnaires were summarized using descriptive statistics for closed items and thematic analysis for open-ended items, focusing on governance, supervision, training, infrastructure, and data-use culture. The integration phase synthesized quantitative and qualitative findings to identify actionable determinants of data quality gaps and to formulate practical recommendations for strengthening data capture, validation, transmission, and use at the primary healthcare and LGA levels, with a view to enhancing the reliability and utility of DHIS2 data for decision-making in Bayelsa. Quality assurance measures involved instrument piloting, training of data collectors, double data entry checks for critical variables, and cross-validation across data sources to ensure data integrity.

Study Area

Bayelsa State is located in the southern part of Nigeria, in the Niger-Delta region. It is bordered by Rivers State to the West and Delta State to the East with a long span of Atlantic Ocean at the south. The capital city is Yenagoa. Bayelsa has a population of about 2,537,400 with a landscape area of 9,391 km². Demographic data for Bayelsa State indicates that most of the population belongs to the Ijaw ethnic group, which is the dominant ethnic group in the state. Other minority ethnic groups include the Ogbia, Nembe, and Epie-Atissa. The main languages spoken in Bayelsa State are Ijaw, Epie-Attisa, Isoko, Urhobo and English. Bayelsa State has a predominantly Christian population, with Christianity being the major religion practiced in the state. However, there are also adherents of other religions, including traditional Africans religions and Islam. The economy of Bayelsa State is predominantly petroleum resources, as the state is in the oil-rich Niger Delta region. Bayelsa has one of the largest crude oil and natural gas deposits in Nigeria, with the Oloibiri Oilfield being the site of the country's first oil discovery. Other mineral raw materials found in the state include salt, agro raw materials include cassava, plantain, rice, and fish.

Study Population

The study population comprises two interrelated groups: the facility population and the human population. The facility population includes all primary health centres within selected local government areas (LGAs) of Bayelsa State that provide maternal health services—such as antenatal care, skilled birth attendance, delivery outcomes, and postnatal care—and participate in routine reporting to DHIS2 during the study period; these primary healthcare centres served as the units of analysis for the quantitative data drawn from primary healthcare registers and DHIS2. The human population includes health-system personnel who generate, validate, report, and use maternal health data, including primary

healthcare in-charges, data clerks and other front-line data-entry staff, and midwives delivering maternal health services, routine health information system officers at the LGA and state levels, and other stakeholders involved in data quality assurance and data use.

Sample Size Determination

The determination of the sample size for this study had two approaches. First, the finite population formula was used in the selection of primary health centres for sampling, while the infinite population proportion formula was used for the sample size determination of the human population.

STEP 1:

The sample size for primary health centres providing maternal health services was determined using the finite population correction formula.

Total primary health centres providing maternal health services = 105

Given that;

N = 105 (total number of primary health centres)

Confidence interval = 95% (Z = 1.96)

d = 0.05 (margin of error)

p = 0.5 (estimated proportion)

Using the finite population correction formula the number of primary health centres to be sampled;

$$n = \frac{N \times Z^2 \times p(1-p)}{d^2 \times (N-1) + Z^2 \times p(1-p)}$$

$$n = \frac{105 \times (1.96)^2 \times 0.5(1-0.5)}{(0.05)^2 \times (105-1) + (1.96)^2 \times 0.5(1-0.5)} = \frac{105 \times 3.8416 \times 0.5 \times 0.5}{0.0025 \times 104 + 3.8416 \times 0.5 \times 0.5}$$

$$= \frac{100.842}{1.2204} = 82.63 \approx 83$$

Rounding up the sample size gives me **83** primary health centres to be sampled

STEP 2:

To determine the sample size for the skilled birth attendants, data managers, and data end-users, the finite population formula was used to determine the sample size for the study while estimating the population proportion.

Given:

N = 1,542 (population size)

E = 0.05 (margin of error)

p = 0.5 (estimated proportion)

Confidence interval = 95% (Z-score = 1.96)

To calculate the sample size using finite population formula;

$$n = \frac{Z^2 \times p \times (1-p)}{E^2}$$

$$n = \frac{(1.96)^2 \times 0.5(1-0.5)}{(0.05)^2} = \frac{3.8416 \times 0.5 \times 0.5}{0.0025}$$

$$= \frac{0.9604}{0.0025} = 384.16$$

STEP 3: we applied the finite population correction (FPC) since

the population is small (Adjusted for finite population).

$$n_{\text{adjusted}} = \frac{n}{(1+(n-1)/N)} = \frac{384.16}{(1+(384.16-1)/1,542)}$$

$$= \frac{384.16}{(1+383.16)/1,542} = \frac{384.16}{(1+(383.16/1,542))}$$

$$= \frac{384.16}{(1+0.2485)} = \frac{384.16}{1.2485}$$

$$= 307.69 \approx 308$$

Final sample size is 308

In summary

Primary health centres (providing maternal health services) sample size = 83

Skilled birth attendants, data managers, and end-users sample size = 308

Sampling Technique

The sampling plan outlined the systematic approach for selecting facilities, personnel, and data sources involved in maternal health data management across Bayelsa State. The goal was to obtain a representative sample that allows for valid assessment of data quality, reporting practices, and data management processes at primary health centres, LGAs, and state levels. Given the hierarchical structure involving LGAs, primary health centres, data management and coordinating centres, and skilled birth attendants (SBAs), a multi-stage sampling technique was most appropriate. It allowed systematic, representative selection at each level and was efficient for large, multi-level populations.

Step-wise Breakdown

Stage 1: Selection of LGAs: Stratified random sampling or simple random sampling of the 8 LGAs were done to ensure geographic and administrative diversity. This was to ensure variability across different LGAs in maternal health data management.

Stage 2: Selection of Primary Health Centres: The selection of primary health centres was conducted using a simple random sampling technique to ensure representativeness and reduce selection bias. Given that there was a total of 105 Primary healthcare providing maternal health services across the LGAs in Bayelsa State, a sample of 83 centres were chosen, representing approximately 80% of the total health centres. This sample size was determined using the finite population correction formula, which accounts for the small population size and was aimed to achieving a 95% confidence level with a 5% margin of error. The comprehensive list of all primary health centres was obtained from the Health Department of the various LGAs' Heads of Department (HODs), and each facility was assigned a unique identifier. A random number generator sampling method was employed to select the centres across the LGAs, ensuring that facilities from different geographic locations and facility types were proportionally represented in the sample. This approach was aimed to capture the diversity and variability of maternal health service delivery within the state, thereby enhancing the validity and generalizability of the

study findings.

Stage 3: Selection of Data Managers and Skilled Birth Attendants (SBAs): The selection of skilled birth attendants (SBAs) and data managers were carried out through stratified random sampling, ensuring proportional representation based on the number of SBAs and data managers in each facility. Given that the total number of SBAs and data managers across the health centres was 860, and the sample size had been calculated to be 266 to ensure adequate statistical power, the SBAs were proportionally allocated to each facility according to their staff rosters. This meant that facilities with higher numbers of SBAs and data managers contributed more participants to the sample, maintaining proportionality across the state. The staff rosters obtained from the facilities served as the sampling frame, and within each facility, SBAs and data managers were randomly selected using simple random sampling techniques, using random number generators. This approach ensures that the sample accurately reflects the distribution of SBAs and data managers involved in maternal health service provision and data management, thereby capturing the variability in practices and experiences among providers across different facilities and LGAs. The selection of data management personnel, including those responsible for data entry, validation, and overall management at both the LGA and state levels, was conducted through purposive sampling. The aim was to include individuals with significant involvement and experience in maternal data management, approximately 10 to 15 key informants were purposively identified across the Local Emergency Maternal and Child Health Intervention Centres (LEMCHIC) and the State Emergency Maternal and Child Health Intervention Centre (SEMCHIC) responsible for the coordination of maternal and child health activities in LGA and state respectively. These informants were selected based on their roles, responsibilities, and familiarity with the data entry, validation, and management processes. The purposive sampling approach ensures that participants possess in-depth knowledge and insights essential for understanding systemic challenges, data quality issues, and reporting practices. This targeted selection facilitated comprehensive qualitative interviews and discussions, providing rich, contextual information that complements the quantitative data collected from facilities and frontline providers.

Stage 4: Sample Allocation: Given that Bayelsa State has 8 LGAs, with sample size of 83 selected primary health centres, and 266 skilled birth attendants, and data managers that was sampled, a summary table of allocation of unit was presented as below;

Level	Population Size	Sample Size	Allocation per LGA	Sampling Techniques	Notes
Health Centres	105	83	10-11	Random selection within each LGA	Ensure geographic and facility-type representation
Skilled Birth Attendants and data management personnel (SEMCHIC & LEMCHIC)	1542	308	38 per LGA plus 4	Stratified random sampling proportional to facility size	To capture variability among providers

Inclusion Criteria

This study included primary health centres located in Bayelsa State, Nigeria, that provided maternal health services (e.g., antenatal care, skilled birth attendance, delivery outcomes, postpartum follow-up, obstetric referrals) during the study window and maintained active routine reporting to DHIS2 with accessible primary healthcare registers and monthly summary/quarterly reports for cross-checks. Primary healthcare centres selection reflected Bayelsa’s urban, rural, and riverine (remotely connected) contexts and was operational for the majority of the study period, with facilities that cooperated with team and allowed access to records and staff for interviews and questionnaires. The study population for staff included primary healthcare in-charges, data clerks and other front-line data-entry personnel, and midwives providing maternal health services, routine health information system officers at the LGA and state levels, and other personnel involved in data quality assurance and data use; eligible staff that had direct responsibilities related to data capture, validation, reporting, or use that provided informed consent.

Exclusion Criteria

The exclusion criteria included primary healthcare centres that didn’t provide maternal health services or that had no DHIS2 reporting during the study window. Primary healthcare centres that were permanently closed, or were undergoing major renovation, or inaccessible for safety or logistical reasons for the majority of the study period. Primary healthcare centres that were unwilling to grant access to records or participate in data collection activities were excluded. Staff who hadn’t directly involved in data capture, validation, reporting, or use, or who didn’t provide informed consent, or who lacked sufficient exposure to data processes (e.g., temporary staff) were also excluded from participation. This ensured that the study focuses exclusively on those entities and individuals engaged in maternal health data management, thereby enhancing the relevance and applicability of the findings to the objectives of the research.

Method of Data Collection

The data collection method for this study employed a convergent mixed-methods approach, integrating both quantitative and qualitative data sources to comprehensively assess the quality and reporting consistency of maternal health services at primary health centres in Bayelsa State, Nigeria. The quantitative component involved the systematic extraction of maternal health data from the District Health Information Software 2 (DHIS2) and corresponding primary healthcare registers that generated the source data. This was focused on key maternal health indicators, such as outpatient

attendance, antenatal care (ANC) initiation and visits, skilled birth attendance, delivery outcomes, postpartum follow-up, and family planning. Data were collected retrospectively from January to June for 2025, 2024, 2023, and 2022 making it a complete 24-month period. The collection process included the use of standardized data abstraction forms to ensure uniformity in capturing relevant information from both DHIS2 and primary healthcare records. This quantitative data was allowed for the quantification of data quality dimensions—specifically completeness, accuracy, timeliness, and consistency—across the sampled facilities. In parallel, the qualitative component involved structured key informant interviews with health system personnel, including primary healthcare in-charges, data clerks, and frontline maternal health providers. A structured questionnaire was administered to gather insights on governance structures, supervision practices, data management norms, training, infrastructure, and the culture of data use that influenced data quality and reporting. Approximately 10 to 15 key informants were purposively selected from Local Emergency Maternal and Child Health Intervention Centres (LEMCHIC) and the State Emergency Maternal and Child Health Intervention Centre (SEMCHIC) to ensure that participants possess relevant knowledge and experience regarding maternal health data management processes. Additionally, the study employed triangulation methods, comparing data from DHIS2 with paper-based records to identify discrepancies and understood the underlying factors affecting data quality. This multi-faceted approach was aimed at capturing a holistic view of the data management landscape within the maternal health context in Bayelsa State.

Pre-testing

Validity test: The questionnaire and other instruments of measurement were subjected to testing in a community not selected for sampling. A statistically significant value of $p < 0.05$ and confidence interval of 95% was used to test the validity of study.

Reliability test: The study was repeated in different selected communities using the same questionnaire and tools of measurement and comparative analysis was done. Results from these separate studies showed consistency with the results which established the reliability of the questionnaire and tools of measurement. The study showed that when the questionnaires and tools of measurement were subjected to use at various location and climatic condition it had proved to measure the same outcomes with minimal variation.

Data Management and Analysis

Data management and analysis for this study were conducted through a systematic approach utilizing Google Forms for data collection, Microsoft Excel along with SPSS version 23, and Mendeley Reference Manager for data management and analysis. The process began with the development of structured questionnaires administered via Google Forms, designed to capture various dimensions of data quality, including accuracy, completeness, timeliness, and consistency of maternal health data

reported at primary health centres in Bayelsa State.

Data Collection Process

The Google Forms platform was employed to facilitate efficient data harvesting from respondents, which included health workers, facility managers, and data clerks across selected primary healthcare centres. The use of Google Forms allowed for real-time data capture and minimized data entry errors, as responses were directly recorded in a digital format. Each questionnaire was carefully structured to include both closed and open-ended questions, enabling the collection of qualitative data with insights regarding the challenges faced in maintaining data quality and ensuring reporting consistency. The secondary data was collected from the facilities using a well-structured and design form that seamlessly collect and enter the ANC 1, ANC 4, ANC 8, ANC attendance, Postnatal visits, live births, and family planning data both from the monthly summary registers and the individual and source registers (outpatient registers, antenatal registers, postnatal registers, labour and delivery registers, and family planning registers).

Data Cleaning and Preparation

Once data collection was completed; the responses were exported from Google Forms into Microsoft Excel for preliminary data cleaning and organization. During this phase, the research team conducted a thorough review of the dataset to identify and rectify any inconsistencies, missing values, or outliers. Duplicate entries were removed, and responses that didn't meet the inclusion criteria were excluded from the analysis. The cleaned dataset was then prepared for further statistical analysis.

Data Analysis

For quantitative analysis, Microsoft Excel and SPSS version 23 was used to perform descriptive statistics, including frequency distributions, measures of central tendency (mean, median), and measures of variability (standard deviation). These analyses provided an overview of the data quality dimensions, allowing for the identification of trends and patterns in maternal health reporting across the sampled primary healthcare centres. Following the preliminary analysis in Excel, the dataset was imported into SPSS version 23 for more advanced statistical analysis. SPSS was utilized to conduct inferential statistical tests to assess the relationships between data quality dimensions and various influencing factors such as training needs, resource availability, systemic strengthening, and workload variables.

Specific analyses included:

Descriptive Statistics: Summarized the demographic characteristics of the respondents and the facilities, including the distribution of maternal health indicators such as antenatal care initiation, skilled birth attendance, and postpartum follow-up.

Reliability Analysis: Evaluated the internal consistency of the data collection instrument, ensuring that the items measured the constructs reliably.

Cohen's Kappa Test: Examined the categorical data for associations between data quality indicators and reporting practices across

different primary healthcare centres for consistency.

Chi-Square Test: Explored potential relationships between different dimensions of data quality (e.g., completeness and timeliness) and various determinants such as governance structures and training received by health workers.

Regression Analysis: Identified significant predictors of data quality gaps, assessing how various factors impact the reliability of maternal health data reported at primary healthcare centres.

For qualitative data derived from open-ended questions, thematic analysis was conducted to extract key themes and insights regarding the perceptions and experiences of health workers related to data quality and reporting practices. These qualitative findings were synthesized with the quantitative findings to provide a comprehensive understanding of the data quality landscape in maternal health services across Bayelsa State.

Timeline for the Study

Research Planning and Proposal Development

The study commenced in Week 1 of June 2025 with the research team defining objectives, developing the protocol, designing questionnaires, and planning logistics. This initial phase lasted through Week 2 and Week 3 of June, ensuring all preparatory activities were completed.

Ethical Approval

In Week 4 of June 2025 and Week 1 of July 2025, the research team prepared and submitted the study protocol, consent forms, and supporting documents to the relevant Institutional Review Board (IRB) or Ethics Committee of Bayelsa State Primary Healthcare Board for ethical clearance. The team actively followed up to address any questions or requirements from the review process. The goal was to obtain official ethical approval by Week 2 of July 2025, ensuring that all research activities adhere to ethical standards regarding participant confidentiality, privacy, voluntary participation, and data security and anonymization before commencing data collection.

Data Collection Preparation

During Week 3 and Week 4 of July 2025, activities included recruiting and training data collectors and supervisors, conducted pilot testing of questionnaires, and finalized data collection tools and schedules. This phase ensures readiness for data collection.

Data Collection

Data collection commenced officially in Week 1 of August 2025 and continued into Week 3 of September 2025. During this period, trained enumerators visited households and health facilities to gather data, with supervision and daily quality checks to ensure completeness and accuracy.

Data Entry, Cleaning, and Analysis

Following data collection, Week 4 of September 2025, and week 1 and week 2 of October 2025 was used for data entry, cleaning, and

preliminary analysis of data. This included verified data quality, resolving inconsistencies, and preparing datasets for final analysis.

Report Writing, Publication, and Dissemination

In the weeks of 3 and 4 of October 2025, the team drafted and finalized the study report for publication, prepared policy briefs, and disseminated findings through stakeholder meetings, workshops, and publications.

Ethical Considerations

The ethical considerations for this research on assessment of data quality and reporting consistency in maternal health services at primary health centres in Bayelsa State are outlined as follows:

Approval from Ethics Committee

This study received ethical approval from the Ethics Committee of the Bayelsa State Primary Health Care Board with reference number PHC/AD/126/Vol.1/p.33. This approval confirms that the research design and protocols adhered to ethical standards protecting the rights and welfare of participants.

Informed Consent

All participants involved in the study, including health workers, facility managers, and other stakeholders, were provided with clear and comprehensive information about the purpose, procedures, risks, and benefits of the research. Informed consent was obtained prior to participation, ensuring that participants voluntarily agreed to take part without any coercion.

Confidentiality and Anonymity

Participants' privacy were safeguarded throughout the study. Personal identifiers were removed from data collection instruments and replaced with unique identifiers, and were stored securely. Access to the data were limited to authorized research personnel only. Data harvested and findings were reported in aggregate form to ensure that no individual participant could be identified.

Right to Withdraw

Participants were informed of their right to withdraw from the study at any time without any negative consequences. This provision ensures that participation was entirely voluntary and that individuals don't feel obliged to remain in the study against their will.

Minimizing Harm

The research design had been structured to minimize any potential risks or harms to participants. The study didn't involve any invasive procedures or sensitive topics that may cause distress.

Data Integrity and Reporting

The research team was committed to maintaining the integrity of the data collected and to reporting findings honestly and transparently. Any potential conflicts of interest would be disclosed, and the research adhered to the highest standards of academic integrity.

Community Engagement

Efforts were made to engage with the stakeholders and local communities where these facilities were located throughout the research process. This included sharing study findings with the health facilities and relevant authorities to foster trust and collaboration for future health initiatives.

Compliance with Local and International Guidelines

The study complied with relevant local and international ethical guidelines, including the Declaration of Helsinki and the guidelines established by the World Health Organization (WHO) regarding research involving human subjects. By adhering to these ethical considerations, the research was aimed at protect the rights and welfare of all participants while contributing valuable insights to improving maternal health services in Bayelsa State.

Results

Table 1: Socio-demographic characteristics.

		Frequency	Percentage
Gender	Female	213	69.2
	Male	95	30.8
Age	18-30 yrs	22	7.1
	31-40 yrs	71	23.1
	41-50 yrs	147	47.7
	51 yrs and above	68	22.1

Table 1 presented the demographic profile of respondents and indicated a sample population with a predominant female representation, comprising 69.2% (213), while males account for 30.8% (95). In terms of age distribution, the largest age group was 41-50 years, representing 47.7% (147) of the sample. This was followed by the 31-40 years group at 23.1% (71), those aged 51 years and above at 22.1% (68), and the youngest group, 18-30 years, which constitutes 7.1% (22).

Role of Health Care Workers in Maternal Health Services

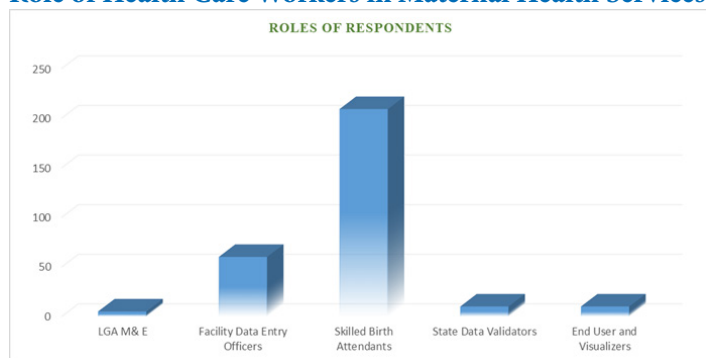


Figure 1: Roles of respondents.

Figures 1 and 2 presented data related to the roles of various health workers involved in providing maternal health services. It indicated that there were a total of 60 Facility Data Entry Officers and 10 State Data Validators, contributed to the monitoring and evaluation of maternal health services. Skilled Birth Attendants,

who played a crucial role in ensuring safe deliveries, number 209, with the breakdown showing 12 Nurses, 145 Community Health Extension Workers (CHEWs), 81 Community Health Officers (CHOs), and 8 Midwives. These category of health workers were considered skilled birth attendants, because they were trained on modified live saving skills, a training which equipped them with obstetric care to take deliveries at the facilities. Additionally, there were 45 non-skilled birth attendants, highlighting the presence of individuals whom lack formal training in maternal health care but were still involved in the process. Overall, this data illustrates the composition of health care workers dedicated to maternal health services, emphasizing the significant number of skilled birth attendants compared to others in the category.

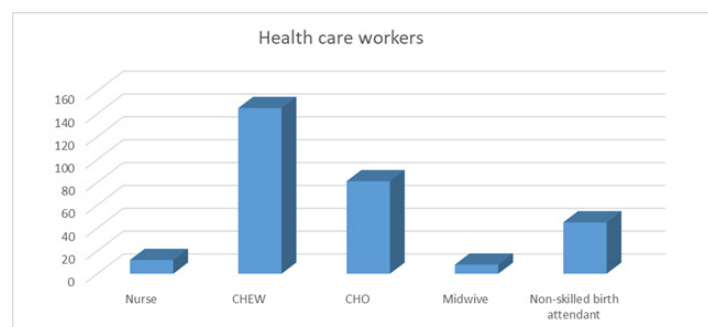


Figure 2: Health workers mix.

Data Entry Practices

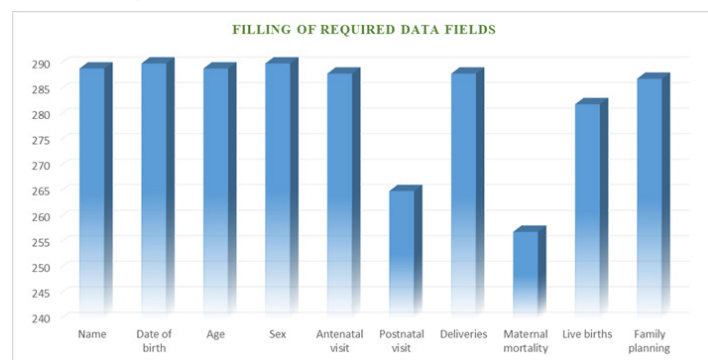


Figure 3: Health facility data entry practices.

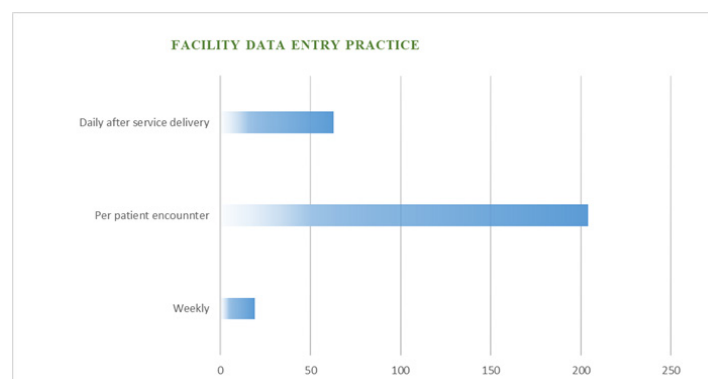


Figure 4: Filling out of required data fields in health facilities.

Figure 3 outlined the data entry practices of health workers at a health facility, emphasizing the importance of systematic and accurate data recording in order to enhance patient care and operational efficiency. It suggested that health workers were trained to follow specific protocols to ensure that all relevant patient information was captured consistently. This includes recording essential details such as patient demographics, visit types, and health outcomes. In contrast, figure 4 provided a qualitative overview of how health care workers filled out required data fields, reflecting the frequency and completeness of data entries in various categories such as antenatal visits, postnatal visits, deliveries, maternal mortality, live births, and family planning. The numbers indicated that while there was a structured approach to data entry, there might be variability in the recording of specific fields, which could point to areas needing improvement in data collection practices. For instance, the recorded figures showed a total of 19 entries for maternal mortality, highlighted a critical area for monitoring, while the larger numbers for live births and deliveries suggested a more robust data collection process in those categories. Overall, the interpretation of both figures illustrates the integral role of diligent data entry practices by health workers in ensuring comprehensive health records, ultimately contributed to better health outcomes and informed decision-making within the facility.

Challenges in Data Submission and Reporting



Figure 5: Availability of registers in health facilities.

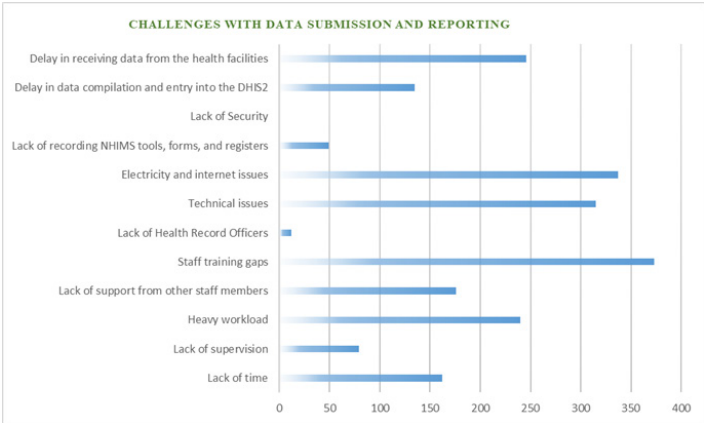


Figure 6: Challenges faced in data submission and reporting.

Figure 5 highlighted the availability of various health facility registers essential for capturing maternal health data, including registers for general attendance, outpatient, antenatal, postnatal, labor and delivery, family planning, birth, in-patient, and monthly summary, indicated a comprehensive framework for data collection in maternal health. However, figure 6 revealed significant challenges healthcare workers faced in data submission and reporting, which might undermine the effectiveness of these registers. The challenges included lack of time (162), lack of supervision (79), and heavy workload (240), which was indicative that staff were overwhelmed. Additionally, there was lack of support from other staff members (176) and considerable staff training gaps (373) which could hinder accurate data entry. The shortage of Health Record Officers (12) exacerbated these issues, while technical problems (315) and electricity and internet issues (337) further complicated the data management process. Furthermore, there were notable deficiencies in recording NHMIS data tools, forms, and registers (49) and security concerns (1), which might deter proper data handling. Delays in data compilation and entry into the DHIS2 system (135) and delays in receiving data from health facilities (246) was indicative of systemic inefficiencies. Together, these insights from figures 5 and 6 underscored a critical gap between the availability of essential registers and the operational challenges faced by healthcare workers, affecting the overall quality and timeliness of maternal health data reporting.

In Table 2, the data presented from the maternal health services highlighted several critical aspects regarding accuracy, completeness, internal consistency, and overall data quality. In January, the number of antenatal care visits for the first visit (ANC1) reported in DHIS2 was 2,298, while the monthly summary register recorded 2,374, indicated a potential reporting error or inconsistency in data entry practices. Such differences raised concerns about the accuracy of the data being used for decision-making, potentially leading to misguided health strategies and resource allocations. The dataset showed variations in attendance figures across different registers. In May, the individual registers reported 22 ANC1 visits, significantly lower than the DHIS2 and monthly summary figures. This could indicate incomplete data collection or underreporting in individual registers, which might fail to capture all cases of care received. The variations among the DHIS2, monthly summary, and individual registers suggested a lack of internal consistency. In March, the reported live births varied significantly: DHIS2 reported 981, while the monthly summary and individual registers reported 881 and 46, respectively. Such inconsistencies might indicate different interpretations of what constitutes a live birth or varying levels of diligence in recording events across the registers. Internal consistency was crucial for validating data and ensuring that it could be trusted for guiding health initiatives.

Table 3 presented a data that revealed several critical aspects regarding data discrepancies, inconsistencies, completeness, and overall data integrity, which were essential for effective decision-making in healthcare. Throughout the months listed, there were

Table 2: Comparison of maternal health service data source (2022-2025).

<i>MONTH</i>	<i>Aggregate data source</i>	<i>ANC1</i>	<i>ANC4</i>	<i>ANC8</i>	<i>ANC Attendance</i>	<i>Post-natal visits</i>	<i>Live Births</i>	<i>Family planning</i>
<i>JANUARY</i>	DHIS2	2298	1068	492	7714	2381	815	5230
	Monthly summary register	2374	1029	481	5614	2356	775	5371
	Individual registers	56	36	25	286	20	26	332
<i>FEBRUARY</i>	DHIS2	2163	1184	433	7857	2529	816	5874
	Monthly summary register	2319	1175	427	5529	1957	738	5962
	Individual registers	30	46	38	290	26	24	314
<i>MARCH</i>	DHIS2	2372	1368	656	8752	3237	981	5789
	Monthly summary register	2121	1203	654	6258	2648	881	5744
	Individual registers	54	44	39	340	38	46	240
<i>APRIL</i>	DHIS2	1879	1217	531	8212	3031	999	6400
	Monthly summary register	2114	1212	528	6039	2400	942	6715
	Individual registers	60	46	41	312	46	56	428
<i>MAY</i>	DHIS2	2036	1197	697	8650	3067	1117	6223
	Monthly summary register	2201	1175	692	5986	2049	1112	6626
	Individual registers	22	50	47	336	64	46	658
<i>JUNE</i>	DHIS2	2102	1128	645	8937	2849	1150	5898
	Monthly summary register	2104	988	643	5503	2113	966	6873
	Individual registers	62	30	27	272	26	20	392

Data source: Primary health centres and DHIS2

Table 3: Monthly overview of maternal health service utilization in rural sub-Saharan Africa.

<i>Year</i>	<i>Month</i>	<i>ANC1 Total</i>	<i>ANC4 Total</i>	<i>ANC8 Total</i>	<i>ANC Attendance Total</i>	<i>Post-natal visits Total</i>	<i>Live Births Total</i>	<i>Family planning Total</i>
2022-2025	January	4728	2133	998	13614	4757	1616	10933
2022-2025	February	4512	2405	898	13676	4512	1578	12150
2022-2025	March	4547	2615	1349	15350	5923	1908	11773
2022-2025	April	4053	2475	1100	14563	5477	1997	13543
2022-2025	May	4259	2422	1436	14972	5180	2275	13507
2022-2025	June	4268	2146	1315	14712	4988	2136	13163

Data source: Primary health centres and DHIS2

notable discrepancies in the totals concerning various service categories. For instance, the figures for ANC1 (first antenatal care visit) showed a fluctuation in attendance numbers, with January recorded 4,728 and June slightly decreased to 4,268. Such variations could raise questions about the reasons behind the changes—whether they stemmed from genuine fluctuations in healthcare access, reporting errors, or seasonal factors affecting maternal health services. While ANC attendance generally exhibited a correlation with the number of live births, the data showed inconsistent patterns. In March, there were 4,547 ANC1 visits, and the total live births recorded were 1,908. A closer examination revealed that while ANC attendance should ideally correlate with increased live births, the numbers do not always align. This inconsistency could indicate gaps in service delivery, patient follow-up, or data collection practices. Data integrity was crucial for making informed decisions in health services. The fluctuations in attendance and service delivery suggested potential issues with the accuracy and reliability of the data collection and entry method. If fewer women were attending ANC visits, it might reflect systemic barriers such as transportation issues, cultural factors, or healthcare staff shortages, rather than an actual decrease in the number of pregnant women. The integrity of the data can

also be compromised if there were lapses in training for healthcare personnel on data reporting protocols or if there were issues with data entry processes.

Table 4: Summary of maternal health service metrics: means, variability, and range in rural sub-Saharan Africa.

<i>Measure</i>	<i>Mean</i>	<i>Standard Deviation</i>	<i>Minimum</i>	<i>Maximum</i>
<i>DHIS2</i>	18853.43	17480.02	3454	50122
<i>Monthly</i>	16371	14021.46	3425	37291
<i>Individual</i>	770.14	921.48	217	2364

Table 4 datasets for DHIS, monthly summary registers, and individual registers presented a comparative analysis of consistency and variability in maternal health data. The DHIS dataset had a mean of 18853.43 with a standard deviation of 17480.02, indicative of high degree of variability relative to its mean, as evidenced by a minimum value of 3454 and a maximum of 50122. This substantial range suggested that while some facilities report significantly higher maternal health metrics, others lag considerably behind, highlighting inconsistencies in data reporting or service delivery across different health facilities. In contrast, the monthly summary registers dataset showed a mean of 16371 and a standard deviation

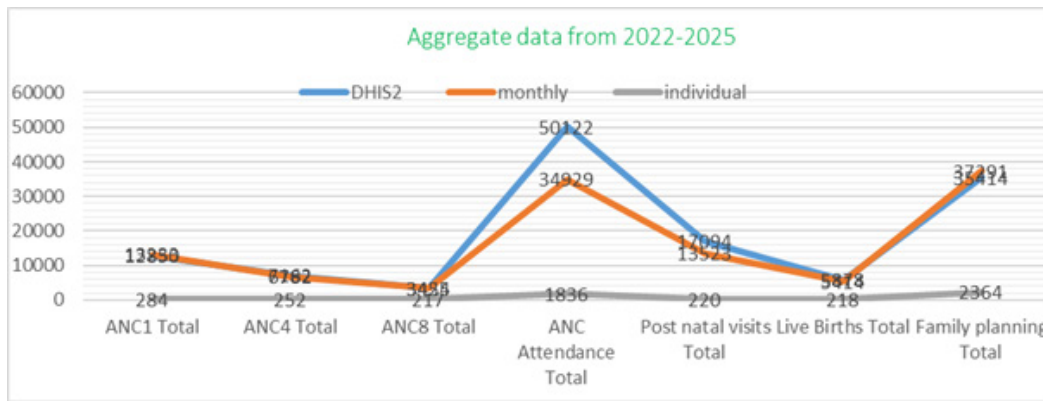


Figure 7: Trends in maternal health service utilization in rural sub-Saharan Africa.

of 14021.46, which also reflects considerable variability, albeit slightly less than that of the DHIS data. The minimum of 3425 and maximum of 37291 further underscored the disparities in reporting, although the overall range was narrower than that of the DHIS data. Lastly, the individual registers dataset presented a mean of 770.14 and a standard deviation of 921.48, indicative of the least variability among the three datasets. With a minimum of 217 and a maximum of 2364, the individual registers dataset showed a more consistent reporting pattern, suggesting that individual-level data might be more reliable or uniform compared to aggregate data. In summary, while all datasets exhibited variability, the DHIS and monthly summary registers datasets demonstrated greater inconsistency in maternal health data compared to the more stable individual registers dataset, which might reflect differences in data collection methods, reporting practices, or the nature of the data being captured.

In Figure 7, the trends for DHIS2, monthly registers, and individual registers data sources could be interpreted as DHIS2 showed varying figures across categories, with notable peaks in ANC attendance Total and Family planning, indicative of strong performance in these areas. The monthly summary registers data presents a generally lower trend compared to DHIS2, particularly in ANC8 Total and live births, suggesting potential issues in monthly register reporting or service delivery. Conversely, the individual registers data revealed the lowest overall figures, especially in ANC8 Total and live births, highlighting gaps in individual register reporting and possibly indicative of challenges in the collection and entry processes. Overall, the graph illustrates discrepancies between data sources, with DHIS2 reflecting the highest reporting figure and the individual registers data source indicated areas needed significant improvement.

Assessment of Data Accuracy

ANOVA TEST

ANOVA test was conducted with Microsoft Excel to determine the significant of the group means using Antenatal first visits for the DHIS2 dataset and monthly summary registers and individual registers such as the antenatal registers, post-natal registers, labour and delivery registers and family planning registers across 83

primary health centres providing maternal health services.

Table 5: Antenatal first visit (ANC-1).

year	Data source	January	February	March	April	May	June
2022-2025	Group 1 (DHIS2)	2298	2163	2372	1879	2036	2102
2022-2025	Group 2 (Monthly)	2374	2319	2121	2114	2201	2104
2022-2025	Group 3 (Individual)	56	30	54	60	22	62

Table 6: Anova table.

Source of Variation	SS	df	MS	F	P-value	F Critical
Between Groups	18095980	2	9047990	594.6674	5.189 x 10 ⁻¹⁵	3.68232
Within Groups	228228.2	15	15215.21			
Total	18324209	17				

Table 7: Paired wise T-test using post-Hoc test (Bonferroni corrected alpha).

Group	p-value (T test)	Bonferroni corrected	Significant
DHIS vs Monthly	0.479706712	0.01666667	No
Monthly vs Individual	6.84x10 ⁻¹³		Yes
DHIS vs Individual	6.41x10 ⁻¹¹		Yes

The Tables 5, 6 and 7 presents the maternal health data quality checks across three data categories of DHIS2, monthly summary registers, and individual registers. Data sources include DHIS2, monthly summary registers, and individual registers (antenatal, postnatal, labour & delivery, and family planning). The datasets that were collected spanned across 83 primary health centres providing maternal health services with a timeframe of 2022–2025, and the variable of interest was ANC first visit used as the key outcome for comparison across data categories. The analytical approach involved assessing data accuracy, completeness, consistency, and overall data quality checks, with an ANOVA (one-way) to compare mean levels (or proxies) of ANC first visit data across the three data categories, followed by a post-hoc analysis to identify pairwise differences using a Bonferroni correction. Statistical results showed F = 594.6674, F critical = 3.68232, p-value = 5.188x10⁻¹⁵, indicating

highly statistically significant differences in ANC first visit metrics across the three data categories and strong evidence to reject the null hypothesis of equal means, with the large F statistic reinforcing the difference among groups. This means data quality metrics (accuracy, completeness, consistency, integrity) vary greatly across health facilities. It therefore means that facilities perform differently, indicating some had much better data management than others. Post-hoc pairwise comparisons (three categories) yielded DHIS2 vs Monthly registers; $p = 0.4797$, DHIS2 vs Individual registers; $p = 6.41 \times 10^{-11}$, Monthly registers vs Individual registers; $p = 6.84 \times 10^{-13}$, with a Bonferroni-corrected significance threshold of 0.01666667. Interpretation of the post-hoc results showed that, after adjustment for multiple testing, only two pairwise comparisons were statistically significant: Monthly registers vs Individual registers ($p \approx 6.84 \times 10^{-13}$) and DHIS2 vs Individual registers ($p \approx 6.41 \times 10^{-11}$), while DHIS2 vs Monthly registers showed no significant difference ($p \approx 0.48$). This implies that the ANC first visit metrics recorded in Individual registers differ markedly from those in DHIS2 and Monthly registers, which themselves do not differ significantly from each other, meaning probably more accurate, but incomplete, suggesting similar aggregation or validation processes between DHIS2 and Monthly registers accounting for these discrepancies with a distinct recording pattern or data quality issue. Implications for data accuracy indicate that the significant difference between Individual registers and the other two sources raised concerns about accuracy heterogeneity; Individual registers might be more granular or timely but could introduce transcription errors, duplications, or misclassification, whereas DHIS2 and Monthly registers might share standardized aggregation and validation checks; which actions included data reconciliation across sources to quantify patient-level concordance, identify systematic biases, and adjust entry protocols accordingly. Implications for completeness considered potential gaps indicated by differences, such as missing events in one source or inconsistent visit dates.

Assessment of Data Consistency

Cohen's Kappa Agreement Test

In the realm of health data management, the accuracy and consistency of recorded information were paramount for informed decision-making and effective health program implementation. The reliability of such data was often assessed through various statistical measures, one of which was Cohen's kappa test. This statistical tool evaluated inter-rater agreement among multiple evaluators, providing insight into the level of agreement beyond what would be expected by chance. In this study, we aimed to assess the accuracy and consistency of antenatal first visit data across various registers, specifically focusing on the verification of required data fields and the matching of data entries across different systems. The assessment involved skilled birth attendants, data managers, and stakeholders who possess a deep understanding of the data collection processes. By employing Cohen's kappa, we sought to quantify the level of agreement between the various systems, namely DHIS2, monthly summary registers, and individual registers. The results of this assessment were encapsulated in a contingency table which grouped responses

into three distinct categories: "Yes", "Sometimes", and "Rarely". The observed agreement was calculated, followed by the expected agreement based on marginal totals derived from the contingency table. The subsequent calculation of Cohen's kappa revealed a value of approximately 0.1036, indicating poor to slight agreement among the evaluators regarding data verification on consistency. This introduction serves to present our findings and stimulate thoughtfulness among data managers and stakeholders regarding the implications of data quality in healthcare settings.

Cohen's kappa is a statistical measure of inter-rater agreement for qualitative (categorical) items. It is calculated as:

Where;

$$K = \frac{P_o - P_e}{1 - P_e}$$

P_o is the observed agreement among raters.

P_e is the expected agreement by chance.

To calculate Cohen's kappa for the two variables, a contingency table was created based on the responses.

Table 8: Contingency table for antenatal first visit.

Variables	Matching of collated data among registers			
Verification of required filled data field	Rarely	Sometimes	Yes, always	Grand Total
Rarely		1		1
Sometimes		8	5	13
Yes, always	1	17	260	278
Grand Total	1	26	265	292

For the two items "Verify Required Data Fields" and "Data Match for Registers", responses were categorized as; Yes, Sometimes, Rarely

Observed Agreement

To calculate the observed agreement (P_o), we sum the diagonal values (where both raters agree):

Total agreements = 260 (Yes-Yes) + 8 (Sometimes-Sometimes) + 0 (Rarely-Rarely) = 268

Total responses = 292

Expected Agreement

The expected agreement for each category was created based on the

$$P_e = \frac{268}{292} = 0.9178$$

marginal totals.

Total for "Verify: Yes" = 1 + 17 + 260 = 278

Total for "Verify: Sometimes" = 8 + 5 = 13

Total for "Verify: "Rarely" = 0 + 1 + 0 = 1

Expected Proportions

$$\text{Yes-Yes} = \frac{278}{292} = 0.9520$$

$$\text{Sometimes-Sometimes} = \frac{13}{292} = 0.0445$$

$$\text{Rarely-Rarely} = \frac{1}{292} = 0.0034$$

Total Expected Agreement (P_e) = $(0.9520 \times 0.9520) + (0.0445 \times 0.0445) + (0.0034 \times 0.0034) = 0.9083$

Cohen's Kappa Calculation

$$K = \frac{P_o - P_e}{1 - P_e}$$

Now, plugging in the values into the kappa formula:

$$K = \frac{0.9178 - 0.9083}{1 - 0.9083} = \frac{0.0095}{0.0917} = 0.1036$$

Interpretation

A Cohen's kappa value of approximately 0.1036 indicates poor or slight agreement between the three systems (DHIS2, monthly summary registers, and individual registers) for antenatal first visit data evaluators regarding data field verification and consistency of data matches in the registers. This implies that there were significant inconsistencies in the maternal health data reported across these systems, which might warrant further investigation and improvement efforts. The data consistency is low, indicating substantial discrepancies between systems and required urgent data quality checks and harmonization for decision-making. It required alignment of data collection and reporting processes.

Assessment of Timeliness on Data Submission

Observed Value

Table 9: Chi-Square Test of independence

SUBMISSION STATUS	Reported to DHIS2		
	2nd week of proceeding month	Not submitted by 2nd week	Grand Total
1st week of proceeding month	221	59	280
Not submitted by 1st week	16	12	28
Grand Total	237	71	308

Expected Value

SUBMISSION STATUS	Reported to DHIS2		
	2nd week of proceeding month	Not submitted by 2nd week	Grand Total
1st week of proceeding month	215.45	64.55	280
Not submitted by 1st week	21.55	6.45	28
Grand Total	237	71	308

p-value = 0.0091; Cramer's V = 0.123

A chi-square test of association between two categorical variables, whether a health facility submitted maternal health data in the first week of the proceeding month (Yes vs. No), and whether the LGA M&E entered and submitted maternal health data in the 2nd week (Yes vs. No) in the DHIS2 platform. A p-value of 0.0091 was determined. The p-value of 0.0091 was less than 0.05, indicating a statistically significant association between the timeliness of submission by health facilities in the first week and the timeliness/

behaviour of LGA M&E in the 2nd week. In other words, the pattern of data timeliness in the first week was not independent of whether LGA M&E entered and submitted data in the second week. This was evidence to suggest that facilities that submit data on time in the first week were related (in a non-random way) to timely data entry/submission by LGA M&E in the second week. This could imply that the chi-square test detected a non-random association between whether facilities submitted maternal health data in the first week or not and whether LGA M&E entered/submitted data in the second week of the proceeding month in the DHIS2. Because $p = 0.0091 < 0.05$, the observed pattern was unlikely due to chance, assuming the null hypothesis of independence was true. The timeliness was defined by two separate decisions (first week vs second week). A significant result simply means these decisions were related, but not to mean that both were timely themselves. However, the strength of association using Cramer's V test returned 0.123 which was an indication of weak association between the submission status and reporting to DHIS2.

Logistic Regression Analysis

Table 10: Logistic regression model.

	Coefficients	Standard Error	P-value	Odd Ratio
Intercept	3.7235	0.5071	2.1E-13	41.4083
Gender	0.4500	0.5064	0.374256	1.5683
Age	0.1005	0.2633	0.702507	1.1058
Role	-0.8200	0.1754	2.93E-06	0.4404
Experience	-0.8629	0.2901	0.002931	0.4219

Table 10 presented the logistic regression analysis examining the influence of various independent variables on whether health care workers filled out the required data fields in individual registers, and the results indicated that gender does not have a statistically significant effect on the outcome, as evidenced by a p-value of 0.374256, which was above the conventional threshold of 0.05, and an odds ratio of 1.5683, suggesting that being a different gender does not notably change the likelihood of filling out the registers. Age, with a p-value of 0.702507, whose significance was still above the threshold, implied that the potential relationship worth further exploration; the odds ratio of 1.1058 indicated that as age increases, the odds of filling out the required data fields also increase, although this finding was not conclusive. The role of the worker was highly significant, with a p-value of 0.00000293, far below the 0.05 threshold, and an odds ratio of 0.4404, suggesting that individuals in certain roles were less likely to complete the data fields compared to others, indicating a strong association between the worker's role and compliance with data entry. Experience in data management showed a significant impact with a p-value of 0.002931 and an odds ratio of 0.4219, signifying that greater experience was associated with lower odds of filling out the required fields, which might reflect either a disparity in responsibilities or priorities based on experience level. Overall, while gender and age show weak associations, the role of the worker and experience in data management were critical factors influencing the adherence to data entry protocols in maternal health services.

Discussion

Socio-demographic characteristic (Table 1)

The demographic profile presented in Table 1 illustrates a significant gender imbalance among the respondents, with a predominance of female participants (69.2%). This skewed towards a female representation might reflect broader societal trends or specific recruitment strategies that favour female involvement in the study. Understanding the implications of this gender disparity was crucial, as it might influence the generalizability of the findings. Future studies should consider exploring the reasons behind this gender imbalance and whether similar patterns exist in other populations. The age distribution of respondents revealed that the majority fall within the 41-50 years age group, accounting for 47.7% of the sample. This suggested that middle-aged individuals were more engaged or available to participate in the study, which might be indicative of their life stage—often characterized by increased responsibilities and a greater interest in the subject matter being investigated. The second-largest group, those aged 31-40 years (23.1%), also reflects a significant proportion of the sample, suggesting that younger middle-aged individuals actively participated in the study. Conversely, the youngest age group (18-30 years) was notably underrepresented, comprising only 7.1% of the respondents. This could imply lack of employment, or a lack of interest or availability among younger individuals, potentially due to competing priorities such as education, early career development, or other life commitments. Understanding the barriers that prevented younger individuals from participating in such studies was essential for future research, as their perspectives and experiences were vital for a comprehensive understanding of the issues at hand. The representation of older participants (51 years and above), which accounted for 22.1% of the sample, indicates that there was also significant engagement from this demographic. Their inclusion could provide valuable insights, especially regarding generational differences and how perspectives on the topic might evolve with age. Overall, the demographic characteristics of the sample suggested a well-defined, albeit skewed representation that could influence the findings of the study. Future research should aim for a more balanced representation across genders and age groups to enhance the validity and applicability of the results. Addressing these demographic disparities would not only enrich the data but also ensure that the findings reflect the diverse experiences and viewpoints of the broader population.

The roles of health care workers (Figures 1 & 2)

The provision of maternal health services was a critical component of public health that directly impacts maternal and neonatal outcomes. The data presented in Figures 1 and 2 underscores the diverse roles and distribution of health care workers involved in these services, which is essential for ensuring effective maternal health care delivery. A key finding from the data was the predominance of skilled birth attendants, numbering 209, among the health care workforce. This group, which includes Nurses, Community Health Extension Workers (CHEWs), Community Health Officers (CHOs), and Midwives, was pivotal in ensuring safe deliveries and managing complications that might arise during

childbirth. The training these professionals received in modified life-saving skills equipped them with the necessary competencies to provide essential obstetric care. The significant number of skilled birth attendants reflected a commitment to enhancing the quality of maternal health services and reducing the risks associated with childbirth. The breakdown of skilled birth attendants revealed a varied distribution, with Community Health Extension Workers (CHEWs) making up the largest portion. This highlighted the important role that community-based health workers played in bridging the gap between formal health facilities and the communities they serve. Their familiarity with local contexts and the trust they build within communities could enhance the uptake of maternal health services. Conversely, the presence of 45 non-skilled birth attendants raised concerns about the quality and safety of maternal health services. Although these individuals might contribute informally to maternal care, their lack of formal training poses significant risks to maternal and neonatal health. It was crucial to address this gap by integrating non-skilled birth attendants into formal training programs, which could enhance their capabilities and ensure they work within a framework that prioritizes safety and quality of care. Moreover, the roles of Facility Data Entry Officers and State Data Validators, though not directly involved in clinical care, were vital for the monitoring and evaluation of maternal health services. Their contributions to data collection and analysis help inform policies and improve service delivery, ultimately leading to better health outcomes. In summary, the composition of health care workers dedicated to maternal health services illustrates a strong foundation of skilled professionals essential for improving maternal health. However, the presence of non-skilled attendants necessitated strategic interventions plans to ensure that all individuals involved in maternal care are adequately trained and supported. Strengthening the training and integration of all health workers, alongside continuous monitoring and evaluation, would be crucial in enhancing maternal health services and achieving better health outcomes for mothers and their newborns.

Data Entry Practice (Figures 3 & 4)

The findings presented in Figures 3 and 4 offer valuable insights into the data entry practices adopted by health workers at the facility. The systematic approach to data recording highlighted in Figure 3 underscores the critical importance of structured data entry protocols in improving patient care and operational efficiency. The training that health workers received to adhere to these protocols played a pivotal role in ensuring that comprehensive and accurate patient information was consistently captured. This training was essential, as the accuracy of health records directly impacts clinical decision-making, patient outcomes, and the overall effectiveness of health services. However, the data presented in Figure 4 revealed a more nuanced picture of data entry practices. While there appears to be a concerted effort to maintain structured data entry, the variability in the completeness of specific fields raised concerns about the reliability of the data collected for decision-making. The relatively low number of entries for maternal mortality (19) compared to the larger numbers for live births and deliveries

suggests a potential gap in the monitoring and reporting of critical health outcomes. This discrepancy points to the need for targeted interventions to enhance the accuracy and completeness of data in categories that were vital for maternal health tracking. The findings also indicated that certain areas, such as antenatal visits and family planning, might not be receiving the same level of attention in data recording as others in immunization. This could stem from either a lack of awareness among health workers regarding the importance of these data points or insufficient training in how to effectively capture this information. Addressing these gaps was essential for constructing a more comprehensive health profile of the population served by the facility. Moreover, the implications of these findings extend beyond the immediate context of the health facility. Accurate and complete data entry practices were crucial for broader public health initiatives and policy-making. Inconsistent data could lead to misguided health interventions and resource allocation, ultimately affecting the quality of care provided to patients. Therefore, it was imperative for health facilities to continuously assess and refine their data entry practices, ensuring that all relevant health metrics were accurately captured and reported. In summary, while the structured approach to data entry practices was commendable, the variability in specific data fields highlighted a critical area for improvement. By focusing on enhancing the completeness and accuracy of data entries, health facilities could better support health outcomes, inform decision-making, and contribute to the overall goal of effective health service delivery. Trainings, regular audits, and feedback mechanisms would be essential in fostering a culture of meticulous data entry that prioritizes both patient care and operational excellence.

Challenges in data submission and reporting (Figures 5,6,7 and Tables 2,3,4)

The findings presented in the data highlight a complex interplay between the availability of maternal health registers and the operational challenges faced by healthcare workers in rural sub-Saharan Africa. Despite the presence of essential registers designed to facilitate comprehensive maternal health data collection, significant hurdles impeded effective data submission and reporting. These challenges, as identified in the figures and tables, were crucial to understanding the systemic inefficiencies that could compromise the quality of maternal health data. One of the most pressing issues was the overwhelming workload experienced by healthcare staff, as indicated by the high frequency of reported challenges such as heavy workload (240 responses) and lack of support from colleagues (176 responses) especially the non-skilled birth attendants. This situation suggested that healthcare workers might be stretched thin, leading to potential burnout and decreased motivation to maintain accurate data records. The direct correlation between workload and data quality was well-documented; when staff were overburdened, the likelihood of errors in data entry increases, as seen in the discrepancies between the DHIS2, monthly summary registers, and individual registers. The observed inconsistencies in reporting—such as the variances in antenatal care visits and live births—underscore the need for a more balanced workload among healthcare personnel,

which could enhance their ability to dedicate time and attention to accurate data collection. Training gaps (373 responses) further exacerbated these challenges, indicating that healthcare workers might lack the skills necessary to navigate the data entry process effectively. The importance of training, supervision, and on-the-site mentorship could not be overstated; without adequate support and education, healthcare workers might struggle to understand data collection protocols, leading to errors and omissions. This was reflected in the data discrepancies, where figures from the monthly summary registers and DHIS2 often do not align, suggesting that inconsistent data entry practices might stem from inadequate training. Technical issues (315 responses), including problems with electricity and internet access (337 responses), present additional barriers to effective data management. In rural settings, where infrastructure could be lacking, these challenges could severely disrupt the flow of information and hinder timely reporting. The reliance on technology for data submission means that any technical breakdown could lead to delays in data entry and compilation, as evidenced by the reported delays in data received from health facilities (246 responses). This systemic inefficiency could not only affect the timeliness of data but also the overall integrity of the maternal health information system, as healthcare facilities might struggle to provide up-to-date and accurate data. The findings also point to notable deficiencies in the recording data tools of National Health Management Information System (NHMIS) forms and registers (49 responses), which could have far-reaching implications for data quality. If the tools and forms used for data entry are flawed or insufficient, the entire data collection process might be compromised. This highlighted a critical gap in the design and implementation of data management systems, where measures should be taken to ensure that healthcare workers had access to reliable and user-friendly tools.

In summary, the challenges faced in data submission and reporting reflect a multifaceted problem that requires a comprehensive approach to address. Strategies should focus on reducing the workload of healthcare workers, enhancing training and supervision, improving technical infrastructure, and ensuring that data management tools were available and effective. By addressing these challenges, healthcare systems in rural sub-Saharan Africa could improve the accuracy, completeness, and reliability of maternal health data, ultimately leading to better-informed health strategies and improved health outcomes for mothers and their infants.

Assessment of data accuracy (Tables 5,6,7)

The findings from the ANOVA test conducted on antenatal first visit data across three distinct data categories—DHIS2, monthly summary registers, and individual registers—underscore significant disparities in data quality metrics across primary health centres providing maternal health services. The statistical analysis revealed an F-statistic of 594.6674, with a corresponding p-value of 5.188×10^{-15} , indicating a highly significant difference among the group means and providing strong evidence to reject the null hypothesis. This suggested that the data collection and management

practices vary considerably among health facilities, highlighting disparities in data accuracy, completeness, consistency, and overall quality. The results of the post-hoc analysis further reinforced these findings, revealing that the individual registers significantly differed from both DHIS2 and monthly registers, while the latter two did not show significant differences from one another. This discrepancy suggested potential issues in data management practices, where individual registers may capture more granular data that, while potentially timelier, could introduce transcription errors or misclassifications, whereas DHIS2 and monthly registers appear to share standardized aggregation processes. Such findings raised critical implications for decision-making in the health sector, where accurate data was paramount for effective planning and resource allocation. The significant differences noted could reflect underlying challenges such as the lack of standardized data entry protocols across facilities, varying levels of staff training, and inconsistent adherence to data management guidelines, which complicated the ability to draw reliable conclusions from the data. Additionally, the health sector often grapples with limited resources and infrastructural constraints, which could impede the implementation of robust data collection and management systems. Issues such as missing events, inconsistent visit dates, and incomplete records could lead to misinterpretations of maternal health trends, which in turn could affect policy decisions and funding allocations. Moreover, the reliance on different data sources could create challenges in data reconciliation and integration, making it difficult to achieve a comprehensive understanding of maternal health service delivery. In this context, health managers must navigate these complexities by prioritizing data quality improvements, investing in staff training, and establishing standardized protocols for data collection and reporting. A focused effort on data accuracy not only supports informed decision-making but also enhances accountability and transparency within health systems, ultimately contributing to better health outcomes for mothers and infants. As the health sector continues to evolve and respond to emerging challenges, addressing these data quality issues would be crucial in ensuring that interventions were appropriately targeted and effective in improving maternal health services across diverse settings.

Assessment on data consistency (Table 8)

The findings from the assessment of data consistency through Cohen's kappa agreement test revealed a concerning level of agreement among the evaluators regarding the verification of antenatal first visit data across various health data registers. With a kappa value of approximately 0.1036, indicating poor to slight agreement, it became clear that significant discrepancies exist between the data recorded in DHIS2, monthly summary registers, and individual registers. This inconsistency in maternal health data could have profound implications for decision-making processes within the health sector. Reliable data was essential for informed decision-making, effective program implementation, and the allocation of resources in healthcare. In the context of maternal health, the accuracy of data was critical, as it directly impacts the quality of care provided to expectant mothers and their babies.

When data was inconsistent, healthcare providers might be unable to identify trends or areas needing improvement, leading to potential gaps in service delivery and the possibility of adverse health outcomes. Furthermore, the lack of alignment in data collection and reporting processes could hinder the ability of health managers and policymakers to make evidence-based decisions, ultimately affecting health outcomes at the population level. The challenges in achieving data consistency stemmed from various factors, including differences in data collection methodologies, variations in training and understanding among data collectors, and the complexity of integrating data from multiple sources. Additionally, the reliance on manual data entry and the potential for human error further exacerbated the issue. To address these challenges, it was essential to implement robust data quality checks, enhance training for data collectors, and promote harmonization of data collection processes across different health information systems. Only through these efforts could one hope to improve the consistency and reliability of health data, thereby enhancing decision-making capabilities and ultimately improving health outcomes in the community. The urgency for such improvements could not be overstated, as the consequences of poor data quality could reverberate through the entire health system, undermining the very foundation of effective healthcare delivery.

Assessment on timeliness in reporting (Table 9)

The findings from the chi-square test revealed a statistically significant association between the timeliness of maternal health data submission by health facilities in the first week of the proceeding month and the subsequent data entry and submission by LGA M&E in the second week, with a p-value of 0.0091 indicating that the observed relationship was unlikely due to chance. This suggested that facilities that submit their maternal health data punctually were more likely to influence the timely reporting behaviour of LGA M&E, indicating a potential systemic link in the data submission process within the health sector. However, the Cramer's V value of 0.123 points to a weak association, suggesting that while there was a relationship, it was not particularly strong. This weak correlation might reflect larger systemic issues within the health data management and reporting structures, such as inconsistent communication between health facilities and LGA M&E teams, inadequate training on data submission protocols, or varying levels of prioritization of data reporting across different health facilities. Moreover, the health sector often faced challenges related to resource constraints, including limited staffing and funding, which could impact the capacity of health facilities to prioritize timely data submission. Additionally, the cultural and operational context in which these facilities operate might influence their reporting behaviours; workloads might vary significantly based on seasonal health trends or ongoing public health campaigns, affecting the availability of time and resources dedicated to administrative tasks like data reporting. There was also the challenge of data literacy among health workers, where differing levels of understanding regarding the importance of timely data submission could lead to inconsistent practices. These contextual factors highlighted the complexity of decision-

making in the health sector, where timely reporting was critical for monitoring health outcomes and guiding policy decisions. The results implied that strategies aimed at improving data submission practices must consider these challenges and the systemic nature of health information systems, perhaps by implementing targeted training programs, enhancing inter-departmental communication, and ensuring adequate resource allocation to support timely data management. Ultimately, fostering a culture that values data integrity and emphasizes the role of timely reporting in improving health outcomes might be crucial for enhancing the overall effectiveness of health information systems.

Logistic regression analysis (Table 10)

The findings from the logistic regression analysis indicated that certain demographic and professional characteristics significantly influenced the likelihood of health care workers filling out required data fields in individual registers, which was critical for maintaining accurate records in maternal health services. Notably, gender and age were found to have weak associations with compliance, as evidenced by their high p-values of 0.374256 and 0.702507, respectively, suggesting that these factors might not play a substantial role in decision-making regarding data entry. The odds ratio for gender indicated that being of a different gender does not significantly alter the likelihood of completing data fields, while the increase in odds with age, albeit not statistically significant, points to areas that might warrant further investigation to understand the nuances of how age impacts compliance. In contrast, the role of the health worker emerged as a highly significant factor with a p-value of 0.00000293 and an odds ratio of 0.4404, indicating that individuals in specific roles were significantly less likely to complete the required data fields. This suggested a strong association between the responsibilities tied to different positions within health care settings and their compliance with data entry protocols. Furthermore, experience in data management also demonstrated a significant impact on compliance, with a p-value of 0.002931 and an odds ratio of 0.4219, revealing that greater experience correlates with lower odds of filling out the required fields, which could reflect a potential disconnect between the expectations of experienced workers and their operational priorities. These findings highlighted the complexities of decision-making in the health sector, where various contextual aspects such as the distribution of roles, the training and support provided to health care workers, and the organizational culture surrounding data management practices came into play. Challenges in this environment included potential disparities in workloads, varying levels of training and support across different roles, and the prioritization of responsibilities that might lead to negligence in data entry. Furthermore, the pressure to deliver patient care often overshadows administrative tasks, creating a dilemma for health care workers who must balance clinical responsibilities with the necessities of accurate record-keeping. The insights from this analysis underscored the need for targeted interventions that address the significant factors influencing compliance, particularly focusing on enhancing support for specific roles and leveraging the experience of health care workers to foster a culture of thorough

data management, ultimately leading to improved health outcomes and more effective decision-making processes within the health sector.

Conclusion

In conclusion, the assessment of data accuracy, completeness, timeliness, and integrity within maternal health services at primary health centres in Bayelsa State underscores the critical importance of reliable health information systems for effective decision-making in the health sector. Accurate data was paramount, as it directly influences clinical decisions, resource allocation, and the formulation of health policies aimed at improving maternal health outcomes. The findings revealed significant discrepancies between different data sources, indicating that inaccuracies could lead to misguided interventions and ineffective health strategies, thereby compromising the quality of care delivered to mothers and their infants. Completeness of data was equally vital; incomplete records could obscure true health trends and hinder the monitoring of key maternal health indicators, potentially leaving high-risk populations unaddressed. Timeliness further enhances the utility of health data, as timely reporting enables prompt responses to emerging health issues and supports the planning and evaluation of health programs. However, persistent delays in data submission and varied reporting practices undermine the ability of health managers to make informed decisions. Data integrity was the foundation upon which the credibility of health information systems rests, as it fosters accountability and transparency among healthcare providers. The interconnection between these dimensions of data quality emphasizes the necessity for targeted interventions, including capacity building, standardized data collection protocols, and improved training for health workers, to strengthen data management practices and ensure that the health information systems reflected true service patterns. By addressing these challenges, the health sector could harness reliable data to inform decision-making processes, ultimately leading to enhanced maternal health outcomes and the achievement of national and international health objectives, including the Sustainable Development Goals (SDGs) related to maternal health. The study's findings highlighted the urgent need for systemic improvements in data management practices across primary health centres in Bayelsa State. This includes investing in infrastructural development that supports reliable data collection and reporting, such as ensuring consistent electricity supply and internet connectivity. Moreover, establishing a culture of data use within healthcare settings, where health workers understand the importance of accurate and timely data entry, would improve overall data quality. Furthermore, the implementation of standardized reporting formats and protocols across facilities could facilitate comparability and consistency of data, thereby enhancing the ability to aggregate findings for regional and national health assessments. Regular training sessions focused on data management, along with robust supervisory mechanisms, could empower health workers to prioritize data accuracy and completeness, thereby reducing the discrepancies observed between different data sources. In conclusion, strengthening the health information system through these targeted interventions

would not only improve the quality of data available for maternal health services but would also enhance the overall effectiveness of health systems in Bayelsa State. By ensuring that data accurately reflect maternal health outcomes, policymakers and health managers could make informed decisions that ultimately lead to better health services, improved outcomes for mothers and infants, and progress toward reducing maternal mortality rates in the region.

Recommendations

Recommendations for improving maternal health services

1. Enhancing Data Quality and Reporting Consistency

Standardize Data Collection Protocols: Implement uniform data collection protocols across all primary health centres to ensure consistency in how maternal health data should be recorded. This includes the use of standardized forms and definitions for key indicators, reducing discrepancies between different data sources.

Regular Training and Capacity Building: Establish regular training programs for healthcare workers focused on data management best practices, including the importance of accurate data entry, completeness, and timeliness. This should include hands-on workshops and refresher courses to keep staff updated on protocols.

2. Improving Infrastructure and Technological Support

Invest in Technological Solutions: Provide necessary infrastructure such as reliable internet access, uninterrupted power supply, and hardware (computers, tablets) to facilitate electronic data collection and reporting. Implement mobile health (mHealth) solutions to enable offline data collection in remote areas.

Develop User-Friendly Data Management Tools: Simplify the data entry process through the development of intuitive digital platforms that minimize the chances of error and streamline data submission to the DHIS2 system.

3. Strengthening Supervision and Governance Mechanisms

Enhance Supervisory Support: Establish regular supervisory visits and feedback mechanisms to encourage adherence to data collection standards and practices. Supervisors should provide constructive feedback and support to healthcare workers in data management.

Implement Data Quality Audits: Conduct regular data quality audits and reviews at the facility level to identify discrepancies and areas for improvement. Use these audits to inform training needs and resource allocation.

4. Addressing Workforce Challenges

Optimize Staff Workload: Assess and redistribute workload among healthcare workers to prevent burnout and ensure adequate time is available for data entry and reporting tasks. Consider hiring additional personnel or utilizing community health workers to share data collection responsibilities.

Encourage Team Collaboration: Foster a collaborative environment where data entry staff, skilled birth attendants, and other healthcare providers work closely together to ensure comprehensive and accurate data collection.

5. Promoting a Data-Use Culture

Engage Stakeholders in Data Utilization: Facilitate workshops and meetings with health workers to discuss the importance of data

in improving maternal health outcomes. Share success stories where data-driven decisions have led to positive changes in service delivery.

Develop Feedback Loops: Establish mechanisms for providing feedback to healthcare workers about the impact of their data submissions on maternal health policies and programs, reinforcing the value of accurate data collection.

6. Enhancing Community Engagement and Outreach

Educate Communities on Maternal Health Services: Implement community awareness programs to inform women about the importance of antenatal care, skilled birth attendance, and postpartum follow-up. Emphasize the role of data in enhancing service delivery and addressing community health needs.

Involve Community Health Workers: Utilize community health workers to facilitate communication between health facilities and the community, ensuring that maternal health services are accessible and responsive to the needs of local populations.

7. Monitoring and Evaluation of Interventions

Implement a Robust Monitoring Framework: Develop and maintain a robust monitoring and evaluation framework that tracks progress in data quality and maternal health outcomes. Use this framework to adjust strategies and interventions as needed based on real-time data.

Conduct Periodic Research and Assessments: Regularly assess the effectiveness of implemented strategies and interventions in improving maternal health data quality and service delivery. Use findings to inform future policy and program decisions.

By addressing these recommendations, maternal health services in Bayelsa State could be strengthened in their data quality and reporting practices, ultimately leading to improved health outcomes for mothers and infants in the region.

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References

1. WHO. Trends in maternal mortality 2000 to 2017.
2. <https://dhsprogram.com/pubs/pdf/SR264/SR264.pdf>
3. Olayinka OA, Achi OT, Amos AO, Chiedu EM, et al. Barriers and Awareness of Maternal Health Care Services Among Women of Reproductive Age in the Amassoma Community, Bayelsa State. *International Journal of Obstetrics and Gynecology*. 2025; 13(3): 001-006.
4. Nyangara F M, Hai T, Zalisk K, Ozor L, Ufere J, et al. Assessment of data quality and reporting systems for underserved populations: The case of integrated community case management programs in Nigeria. *Health Policy Plan*. 2018; 33(4): 465-473.
5. Faster Capital. Effective Decision Making: Resource Allocation: Optimizing Resource Allocation for Effective Decision Making. 2025.
6. Lasim OU, Ansah EW, Apaak D, et al. Maternal and child health data quality in health care facilities at the Cape Coast Metropolis, Ghana. *BMC Health Serv Res*. 2022; 22(1): 1102.
7. <https://ngfrepository.org.ng:8443/bitstream/123456789/3246/1/Bayelsa%20State%20Strategic%20Health%20Development%20Plan%202010-2015.doc.pdf>
8. Nejad B, Abrampah NM, Neilson M, et al. Technical Series on Primary Health Care. In *European Society for Quality and Safety in Family Practice-EQuiP*. Andrew Likaka Ministry of Health. 2018.
9. Idan Novogroder. How to Improve Data Quality? Strategies and Challenges. 2024.
10. Nwankwo B, Sambo MN. Can training of health care workers improve data management practice in health management information systems: A case study of primary health care facilities in Kaduna State, Nigeria. *Pan Afr Med J*. 2018; 30: 289.
11. Totten V, Simon EL, Jalili M, Sawe HR, et al. Acquiring data in medical research: A research primer for low- and middle-income countries. *Afr J Emerg Med*. 2020; 10(2): S135-S139.
12. <https://www.vldb.org/conf/2007/papers/research/p315-cong.pdf>
13. WHO. Standards For Improving Quality Of Maternal And Newborn Care In Health Facilities. 2016.
14. Omole G. Health Management Information System for Decision-Making in Nigeria: Challenges and Resolutions. *Inter J Scie Res*. 2015.
15. https://www.countdown2030.org/wp-content/uploads/2023/02/Overall-Country-Report-Template-NGA_updated-July-2022-final_submitted.pdf
16. Oladoyin V, Adedini S, Ijadunola K, Ogunwemimo H, Folorunso O, et al. The assessment of routine health information system performance towards improvement of quality of reproductive, maternal, newborn, child and adolescent health services in Ondo and Ekiti States, Nigeria. *PLoS One*. 2025; 20(1): e0318010.
17. Ryan GW, Bloom EW, Lowsky DJ, Linthicum MT, Juday T, et al. Data-driven decision-making tools to improve public resource allocation for care and prevention of HIV/AIDS. *Health Affairs*. 2014; 33(3): 410-417.