Adoption, Utilization and Challenges of Digital Health Technologies for Monitoring and Evaluation of Primary Health Care Programs in Rivers State, Nigeria

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Abstract

Background: *Digital health technologies are increasingly integrated into primary health care (PHC) systems to strengthen routine data collection, reporting, programme monitoring and evidence-informed decision-making. Effective implementation depends on health-personnel adoption, routine utilization, supportive infrastructure and organisational capacity. In Nigeria, evidence on their adoption and use for monitoring and evaluation (M&E) at PHC level remains limited, particularly in Rivers State.*

Methods: *A cross-sectional study was conducted among 602 PHC personnel involved in health-data collection, reporting, supervision and programme monitoring. Participants were recruited through multistage sampling, and data were collected using a structured questionnaire developed from the study objectives. Descriptive statistics, Spearman's rank-order correlation, group-comparison tests, Chi-square tests and multivariable regression were used; significance was set at $p<0.05$*

Results: *DHIS2 was most commonly used (84.7%), followed by NHLMIS (73.1%), electronic data-capture/reporting tools (65.8%), ODK (62.1%), NDARS (59.5%) and OpenMRS (42.0%). Mean adoption breadth was 4.34±1.25 technology categories; 75.6% used at least four categories. Routine utilization was extensive, averaging 8.95±1.10 of 10 M&E activities, while 38.4% reported frequent or very frequent digital use across all ten activities. Perceived M&E contribution was high (mean=3.61), with 99.2% positive endorsement. However, implementation challenges remained evident (mean=3.09). Adoption breadth was not significantly associated with perceived M&E contribution ($\rho=-0.006$, $p=0.882$), and UTAUT-related factors did not significantly predict adoption or continued use ($R^2=0.008$; $F(4,597)=1.150$; $p=0.332$)*

Conclusion: *Digital health technologies are widely adopted and routinely used for PHC M&E in Rivers State and are perceived to contribute substantially to routine information processes. However, greater adoption alone did not improve perceived M&E contribution, and technology-acceptance factors did not independently explain utilization.*

Recommendation: *Strengthening interoperability, infrastructure, workforce development, technical support, sustainable financing and institutional ownership is essential for resilient,*

scalable and effective PHC M&E systems.

Keywords: *Adoption, digital health technologies, monitoring and evaluation, primary health care programme, utilization, Rivers State*

Introduction

Primary health care (PHC) is the foundation of a health system that seeks to deliver essential, accessible and equitable services close to where people live and work. Consequently, its performance depends not only on the availability of services but also on the capacity of health systems to generate, analyze and use reliable information for planning, quality improvement, accountability and resource allocation (WHO and UNICEF, 2022; Leon et al., 2020). Digital health has increasingly been positioned as a means of strengthening these information functions. Globally, its expansion reflects efforts to improve health-system efficiency, sustainability, equity and access (WHO, 2025). Within sub-Saharan Africa, however, implementation remains uneven, with persistent weaknesses in coordination, integration and equitable distribution of digital investments (Karamagi et al., 2022; Mamuye et al., 2022). Nigeria has made important progress through the national deployment of the District Health Information System 2 (DHIS2), which strengthened electronic reporting and programme monitoring (Shuaib et al., 2020). More recently, the Federal Ministry of Health and Social Welfare inaugurated the Nigeria Digital in Health Initiative in 2024 to support transformation of the national digital-health architecture and improve health-data management (FMOHSW, 2024). At the primary health care level, however, successful digitalisation depends on healthcare workers having access to functional systems, possessing the competencies required to use them and integrating them into routine work (Ojo et al., 2022; Edo et al., 2023). Digital health technologies are increasingly used to support routine health information activities, including data collection, reporting, information retrieval, analysis and programme monitoring. Nevertheless, infrastructural and operational barriers remain evident. Babalola et al. (2025) identified insufficient computers (90.8%), inconsistent power supply (87.0%), hardware or software failure (85.7%) and poor internet connectivity (84.7%) as barriers to electronic medical-record use among healthcare workers in Lagos State. Such challenges highlight the importance of examining not merely the availability of digital platforms but also their actual adoption and integration into routine healthcare activities. Importantly, adoption and utilisation are distinct concepts. Adoption may indicate that a worker or programme uses one or more digital platforms, whereas utilisation reflects the extent to which those technologies are incorporated into routine activities such as data entry, reporting, information retrieval, supervision, performance monitoring and decision-making (Byrne & Sæbø, 2022). Consequently, the number of technologies adopted does not necessarily indicate the extent to which they are routinely used across monitoring and evaluation activities. Beyond adoption and utilisation, the perceived contribution of digital health technologies to health information processes is equally important. Their relevance to PHC monitoring and evaluation lies in their potential to strengthen data collection and quality, facilitate data analysis and information access, improve reporting and timeliness, and support decision-making and programme monitoring. However, the availability and use of digital platforms do not automatically establish the extent to which healthcare personnel perceive improvements in these functions. In Rivers State, Atikpe and Onyeabor (2026) found marked differences in digital-health availability between rural and urban primary healthcare facilities, with only 37.9% of participants reporting high utilisation. Although informative, that study focused specifically on public health nurses and general digital-

health utilisation. Consequently, there remains a need for an assessment among the broader primary healthcare workforce involved in monitoring, reporting, programme coordination, records and logistics. Furthermore, there is insufficient Rivers State-specific evidence on the types of digital health technologies currently used by PHC personnel, the breadth of their adoption and the extent of their routine utilisation across monitoring and evaluation activities. There is also a need to establish how these personnel perceive the contribution of digital technologies to data collection and quality, data analysis and information access, reporting and timeliness, and decision-making and programme monitoring. Against this background, the present study assessed the adoption and utilisation of digital health technologies for monitoring and evaluation of PHC programmes in Rivers State, Nigeria. Specifically, it examined the types, breadth of adoption and extent of routine utilisation of these technologies, as well as their perceived contribution to key monitoring and evaluation information processes. The aim of this study was to assess the adoption and utilisation of digital health technologies for monitoring and evaluation of Primary Health Care programmes in Rivers State, Nigeria, and their perceived contribution to routine health information processes. The specific objectives were to determine the types, breadth of adoption, and extent of routine utilisation of digital health technologies for monitoring and evaluation of Primary Health Care programmes in Rivers State; and assess the perceived contribution of digital health technologies to data collection and quality, data analysis and information access, reporting and timeliness, and decision-making and programme monitoring in Primary Health Care programmes. Geographically, the study was conducted in Rivers State, Nigeria, among personnel involved in primary healthcare programme monitoring, reporting, information management, logistics, coordination and related service-delivery functions. Conceptually, it focused on digital health technologies relevant to PHC monitoring and evaluation, including DHIS2, the National Health Logistics Management Information System (NHLMIS), Open Data Kit (ODK), the Nigeria Data Repository/related digital reporting systems (NDARS), OpenMRS/electronic medical-record systems and electronic data-capture tools. Analytically, the study examined the types and breadth of technology adoption, extent of routine utilisation and perceived contribution to data collection and quality, data analysis and information access, reporting and timeliness, and decision-making and programme monitoring. The study relied on respondents' perceptions and self-reported practices and did not directly measure objective system effectiveness, clinical outcomes, server performance or independently audited data quality.

Methods:

Study Design and Setting

The study employed a mixed-methods cross-sectional design comprising complementary quantitative and qualitative strands. The cross-sectional component was appropriate because the study examined existing implementation conditions without manipulating exposure to digital technologies. The study was conducted in Rivers State, Nigeria, in the South-South geopolitical zone. The state comprises 23 Local Government Areas (LGAs) and contains urban, peri-urban, rural and riverine communities with substantial variation in transport accessibility, electricity supply, telecommunications infrastructure, health-workforce distribution and access to information and communication technology (ICT).

Study Population and Eligibility Criteria

The quantitative population comprised primary healthcare personnel involved in the generation, management, reporting, supervision or use of routine health information within selected LGAs and primary healthcare facilities. These included facility heads/officers-in-charge, monitoring and evaluation and data personnel, nurses and midwives, community health officers and community health extension workers, programme focal persons, immunisation and cold-chain personnel, records personnel and other eligible staff whose routine responsibilities involved primary healthcare data or digital reporting. The inclusion criteria were primary healthcare personnel working in government-managed primary healthcare facilities or relevant LGA primary healthcare structures within the selected study areas; personnel whose routine duties involved health-data collection, entry, reporting, retrieval, supervision, programme monitoring, records management or commodity/logistics reporting; personnel with at least one year of relevant primary health or health-information experience; and personnel who provided informed consent to participate.

Sample Size Determination and Sampling Technique

The quantitative sample size was estimated using Cochran's formula for a single population proportion. In the absence of a sufficiently precise prior estimate of the principal adoption outcome in the study setting, a proportion of 50% was used to maximise the required sample size. At 95% confidence and 5% absolute precision, the initial estimate was 384.16 (approximately 384). A design effect of 1.5 was applied to account for clustering within the multistage sampling structure, giving 576.24. Allowing 10% for non-response or unusable questionnaires produced a recruitment target of approximately 640 participants. Following fieldwork, screening and data cleaning, 602 participants had sufficiently complete information for the verified final quantitative analysis. A multistage sampling procedure was used to recruit the quantitative sample. Within participating facilities, eligible personnel were identified according to their routine involvement in data generation, reporting, supervision or programme monitoring. Key data-responsible roles were represented, while probability-based selection was used where the number of eligible personnel exceeded the required allocation.

Data Collection Instrument and Procedure

Quantitative data were collected using the researcher-developed Digital Health Technology Adoption and Monitoring Challenges Questionnaire (DHTAMCQ). The questionnaire contained six sections. Section A assessed demographic and professional characteristics; Section B assessed technologies adopted and routine utilisation; Section C assessed perceived contribution to primary healthcare monitoring and evaluation. A semi-structured topic guide was used for the qualitative strand. Questions were aligned with the five objectives and explored platforms used and patterns of use; perceived contribution to data collection, reporting, programme monitoring and decision-making. Quantitative data collection was conducted over a period of approximately six weeks among eligible primary healthcare personnel in the selected study locations. The researcher was assisted by trained research assistants during data collection. Written informed consent was obtained before administration of the questionnaire. The questionnaire was primarily self-administered, allowing respondents to complete the items independently. Qualitative data were collected through in-depth interviews (IDIs) and focus group discussions (FGDs) using a semi-structured qualitative interview guide developed in accordance with the study objectives and the quantitative domains investigated in the study.

Validity and Reliability of the Instrument

Content validity focused on relevance, comprehensiveness, clarity and contextual appropriateness. The draft questionnaire was reviewed by persons with relevant expertise in public health, primary healthcare, health information/monitoring and evaluation, digital health and research methodology. Comments were used to refine wording, remove duplication and improve correspondence between items and study objectives.

The questionnaire was pre-tested among primary healthcare personnel with characteristics similar to those of the intended respondents but excluded from the main study. Pre-testing assessed comprehensibility, response options, completion burden, sequencing and item non-response. Internal consistency was considered for multi-item scales where a composite score was analytically justified.

Data Management and Analysis

Quantitative data were analysed using IBM SPSS Statistics, version 27. Categorical variables were summarised using frequencies and percentages. Continuous or count variables were described using means and standard deviations when appropriate and medians and interquartile ranges where distributions warranted non-parametric summaries. All inferential tests were two-sided with $\alpha = 0.05$, and effect or association measures were reported where appropriate.

For Objective 1, individual technologies were summarised using frequencies and percentages, while adoption breadth and routine utilisation extent were analysed as distinct indicators. For Objective 2, item- and domain-level statistics described perceived contribution to monitoring and evaluation, and appropriate correlation/association analyses examined relationships with adoption and utilisation. Qualitative data were analysed thematically, using NVivo Version 14. Analysis involved familiarisation with the interview/FGD material, systematic coding of segments relevant to the research questions, examination of relationships among codes, development and refinement of candidate themes, definition and naming of themes, and selection of illustrative quotations. Integration occurred after separate analysis of the quantitative and qualitative strands. Findings were compared objective by objective using narrative weaving and a joint display.

Ethical Considerations

The study was conducted in accordance with accepted ethical principles for research involving human participants. Ethical approval was given by the Faculty of Basic Medical Sciences, Rivers State University with the approval number_RSU/FBMS/REC/26/443. Administrative permission was obtained from the relevant primary healthcare authorities. Participation in both strands was voluntary, and participants were informed about the study purpose, procedures, confidentiality and their right to decline or withdraw without penalty. Informed consent was obtained before questionnaire administration, interview or FGD participation. Quantitative data were reported in aggregate form, while qualitative quotations were anonymised.

Results

Quantitative Findings

The quantitative findings are based on 602 respondents with sufficiently complete data for the verified analysis. Results are presented according to the five study objectives. Descriptive findings are reported first, followed by the relevant bivariable and multivariable analyses. Statistical significance was assessed at $p < 0.05$. Formal decisions on H_{01}–H_{05} are consolidated in

Section 4.4 to avoid duplicating the detailed quantitative tables. To make the quantitative results self-contained, table-specific notes define constructed indicators, constituent questionnaire items, scoring ranges, response coding, reference categories and statistical abbreviations where applicable. These notes form part of the interpretation of each table and should be read together with the corresponding results narrative.

Table 1: Sociodemographic and professional characteristics

Sociodemographic and professional characteristics of respondents (N = 602)

Characteristic	Category	N	%
Gender	Male	270	44.9
	Female	332	55.1
Age (years)	20–29	112	18.6
	30–39	203	33.7
	40–49	176	29.2
	≥50	111	18.4
Education	Certificate	22	3.7
	Diploma/NCE	75	12.5
	HND/Bachelor degree	334	55.5
	Postgraduate degree	143	23.8
	Other	28	4.7
Designation	M&E Officer	107	17.8
	Health Records Officer	81	13.5
	PHC Coordinator	81	13.5
	Cold Chain Officer	88	14.6
	CHEW	107	17.8
	Programme Focal Person	105	17.4
	Other	33	5.5
PHC experience	<5 years	155	25.7
	5–10 years	211	35.0
	11–15 years	139	23.1
	>15 years	97	16.1
Programme	Immunisation	119	19.8
	Maternal, Newborn and Child Health	94	15.6
	Malaria	67	11.1
	HIV/AIDS	41	6.8
	Family Planning	52	8.6
	Health Information/Records	63	10.5
	Monitoring and Evaluation	67	11.1

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	Health Commodity/Logistics Management	70	11.6
	Other	29	4.8

N = 602. Values are frequency (n) and percentage (%) unless otherwise stated. Percentages may not total exactly 100.0% because of rounding. PHC = Primary Health Care; M&E = Monitoring and Evaluation; CHEW = Community Health Extension Worker; HIV/AIDS = Human Immunodeficiency Virus/Acquired Immunodeficiency Syndrome.

Females constituted 55.1% of respondents. The largest age category was 30–39 years (33.7%), and 55.5% had an HND or Bachelor degree. M&E Officers and CHEWs each represented 17.8% of the sample, while Programme Focal Persons accounted for 17.4%. The largest experience category was 5–10 years (35.0%). Respondents therefore represented diverse professional cadres, experience levels and programme areas.

Table 2: Types, Breadth of Adoption and Extent of Routine Utilisation
Digital health technologies currently adopted for PHC monitoring and evaluation (N = 602)

Digital health technology	Currently used, n	Adoption prevalence (%)
DHIS2	510	84.7
NHLMIS	440	73.1
Electronic data-capture tools	396	65.8
ODK	374	62.1
NDARS	358	59.5
Other digital-health platforms	280	46.5
OpenMRS	253	42.0

"Currently used" indicates that the respondent reported present use of the technology in the facility or in routine work. The seven assessed technology categories were: DHIS2; NHLMIS; ODK; NDARS; OpenMRS; electronic data-capture tools; and other digital-health platforms. Multiple responses were permitted; therefore, percentages are not mutually exclusive and do not sum to 100%. DHIS2 = District Health Information System 2; NHLMIS = National Health Logistics Management Information System; ODK = Open Data Kit; OpenMRS = Open Medical Record System. NDARS is retained as recorded in the study instrument and should be expanded in the List of Abbreviations only after its official platform name has been verified.

Table 3: Breadth of digital health technology adoption (N = 602)

Adoption indicator	Result
Mean ± SD	4.34 ± 1.25
Median (IQR)	4 (4–5)
Observed range	0–7
Using ≥4 technology categories	455 (75.6%)

Adoption breadth was operationalised as the number of the seven assessed digital-health technology categories currently used by each respondent: DHIS2, NHLMIS, ODK, NDARS, OpenMRS, electronic data-capture tools, and other digital-health platforms. Possible score = 0–7; a higher score indicates use of a greater variety of digital-health technologies and does not, by itself, indicate more frequent use, better integration, or greater effectiveness. IQR = interquartile range; SD = standard deviation.

Table 4: Extent of routine digital-health utilisation for PHC monitoring and evaluation (N = 602)

No. of 10 M&E activities performed frequently/very frequently	n/statistic	%
5	4	0.7
6	19	3.2
7	39	6.5
8	112	18.6
9	197	32.7
10	231	38.4
Mean ± SD	8.95 ± 1.10	
Median (IQR)	9 (8–10)	

Routine utilisation extent was operationalised as the number of ten routine digital-health activities for which the respondent reported use as Frequently or Very Frequently (possible score = 0–10). The ten indicators were: (1) DHIS2 for routine PHC data reporting/monitoring; (2) NHLMIS for commodity requisition/reporting; (3) NHLMIS for vaccine/commodity stock monitoring; (4) ODK for field data collection, supervision, surveys or programme monitoring; (5) NDARS or related systems for routine programme reporting; (6) OpenMRS or other electronic medical-record systems for patient-information management; (7) electronic data-capture tools instead of paper forms; (8) routine integration of digital technologies into M&E activities; (9) digital-platform retrieval of information for monitoring programme performance; and (10) digital submission of routine reports within the required reporting period. Response options were Very Frequently = 4, Frequently = 3, Rarely = 2 and Never = 1. Adoption breadth measures the range of technologies currently used, whereas routine utilisation extent measures the range of M&E activities performed frequently/very frequently using digital technologies; the two indicators are not interchangeable. IQR = interquartile range; SD = standard deviation.

DHIS2 was the most commonly reported platform, with 510 respondents (84.7%) reporting current use. This was followed by NHLMIS (73.1%), electronic data-capture tools (65.8%), ODK (62.1%) and NDARS (59.5%). OpenMRS had the lowest prevalence among the specifically named platforms (42.0%), as indicated in Table 4.2. Because respondents could use more than one platform, the technology-specific percentages are not mutually exclusive. Similarly, respondents used a mean of 4.34 ± 1.25 of the seven assessed technology categories, with a median of 4 (IQR 4–5), as indicated in Table 4.3. Three-quarters of respondents (75.6%) reported current use of at least four technology categories, indicating that digital-health adoption was distributed across multiple platforms.

Furthermore, routine utilisation was concentrated towards the upper end of the 0–10 activity count, as indicated in Table 4.4. Respondents reported frequent or very frequent digital use for a mean of 8.95 ± 1.10 activities, with a median of 9 (IQR 8–10). A total of 231 respondents (38.4%) reported frequent or very frequent use across all ten activities (Table 4.4). Adoption breadth and routine utilisation extent were weakly positively correlated, but the relationship was not statistically significant (Spearman's $\rho = 0.061$, $p = 0.137$).

Table 5: Perceived Contribution to Primary Health Care Monitoring and Evaluation

Table 4.5. Perceived contribution of digital health technologies to primary health care monitoring and evaluation (N = 602)

Contribution domain	No. indicators	Average positive endorsement (%)
Data collection and quality	3	98.9
Data analysis and information access	2	99.3
Reporting and timeliness	2	99.2
Decision-making and programme monitoring	3	99.3
Overall perceived contribution	10	99.2

Responses were rated on a four-point agreement scale: Strongly Agree = 4, Agree = 3, Disagree = 2 and Strongly Disagree = 1. Positive endorsement represents Agree or Strongly Agree. The ten indicators assessed perceived: (1) improvement in data accuracy; (2) improvement in data completeness; (3) improvement in reporting timeliness; (4) reduction in manual data-entry/reporting errors; (5) ease of data analysis; (6) timely information from digital dashboards/reports; (7) efficiency of routine M&E activities; (8) feedback on PHC programme performance; (9) evidence-based decision-making; and (10) availability of information for programme planning/resource allocation. Domain summaries were organised as follows: data collection and quality—accuracy, completeness and reduction of manual errors; data analysis/information access—ease of analysis and availability of information for planning/resource allocation; reporting/timeliness—timeliness of reporting and timely dashboard/report information; decision-making/programme monitoring—M&E efficiency, programme-performance feedback and evidence-based decision-making. These results represent respondents' perceived contribution and should not be interpreted as objectively verified or causal improvement in M&E performance.

Respondents reported highly favourable perceptions across all four contribution domains. Average positive endorsement ranged from 98.9% for data collection and quality to 99.3% for data analysis/information access and decision-making/programme monitoring. Across all ten indicators, average positive endorsement was 99.2%. These findings represent respondents' perceived contribution of digital technologies and should not be interpreted as independently measured causal programme effectiveness

Discussion

Types, breadth of adoption, and extent of routine Utilization of digital health technologies for monitoring and evaluation of Primary Health Care programme in Rivers State.

The first objective demonstrated broad but functionally differentiated digitalisation of primary health care monitoring and evaluation. Quantitatively, DHIS2 was the most commonly reported platform (84.7%), followed by NHLMIS (73.1%), electronic data-capture tools (65.8%), ODK (62.1%) and NDARS (59.5%). Respondents used a mean of 4.34 ± 1.25 of seven assessed technology categories and frequently or very frequently used digital technologies for a mean of 8.95 ± 1.10 of ten routine M&E activities. Qualitatively, however, participants made clear that these technologies were not interchangeable: DHIS2 was principally associated with routine health-information reporting, ODK with electronic data collection, and NHLMIS with vaccine, commodity and cold-chain functions. The integrated finding is therefore not simply that multiple platforms were adopted, but that primary health care personnel operated within a multi-platform

ecosystem structured by programme responsibilities and reporting functions.

The predominance of DHIS2 is consistent with its institutionalisation within Nigeria's routine health-information architecture. Shuaib *et al*. (2020) documented national scale-up of the DHIS2 routine-immunisation module across all 36 states and the Federal Capital Territory, including large-scale workforce training and the use of dashboards for monitoring and feedback. Byrne and Sæbø (2022) similarly showed that DHIS2 is widely used across low- and middle-income countries for routine reporting, analysis, planning and programme management. The present mixed-methods findings extend this evidence by showing how a nationally embedded platform is experienced within primary health care practice in Rivers State alongside programme-specific systems. The simultaneous use of several platforms should not automatically be interpreted as greater digital maturity. Karamagi et al. (2022) described the proliferation of digital interventions in sub-Saharan Africa and warned that fragmented implementation can produce an 'eHealth or e-Chaos' environment. Mamuye et al. (2022) likewise identified interoperability and health-information exchange standards as central requirements for moving from siloed applications to integrated digital-health systems in Africa. This interpretation is reinforced by the qualitative accounts in the present study, where multiple platforms were linked to concerns about duplicate entry and the need for systems to communicate with one another.

An especially important integrated result was the absence of a statistically significant relationship between adoption breadth and routine utilisation extent (Spearman's $\rho = 0.061$, $p = 0.137$). The qualitative strand helps explain this apparently counter-intuitive finding. A worker may use several platforms because different programmes mandate different systems, yet the number of platforms does not necessarily indicate how deeply digital processes are embedded across routine M&E activities. Conversely, a worker may rely heavily on a smaller number of platforms across many routine tasks. Thus, adoption breadth and utilisation extent represent distinct dimensions of implementation. This distinction is compatible with evidence that availability or adoption does not guarantee meaningful routine data use. Byrne and Sæbø (2022) noted that access to District Health information Sistem 2 data does not automatically translate into its routine use for action, while Wang et al. (2025) found that digital-health adoption among health workers in LMICs reflects interacting individual, technological and organisational conditions. For Rivers State, the implication is that digital-health performance should not be assessed by platform deployment alone. Monitoring should distinguish the number of systems available, active use, frequency and breadth of use, reporting completeness and timeliness, interoperability, data quality, and evidence that digital information informs programme decisions.

Perceived contribution of digital health technologies to data collection and quality, data analysis and information access, reporting and timeliness, and decision-making and programme monitoring in Primary Health Care programmes.

The second objective showed strong convergence between the two strands. Quantitatively, positive endorsement across the ten perceived-contribution indicators averaged 99.2%, with similarly high endorsement for data collection and quality, data analysis and information access, reporting and timeliness, and decision-making and programme monitoring. Qualitatively, participants described faster reporting, easier retrieval of historical information, identification of omissions or inconsistencies, and improved visibility of programme performance. The qualitative evidence therefore supplied plausible operational mechanisms for the highly favourable quantitative perceptions. These findings are consistent with Nigerian evidence. Shuaib *et al.* (2020) reported that the DHIS2 routine-immunisation module supported more timely access to

information, feedback and data use. Ojo *et al*. (2022) also reported favourable perceptions of electronic-health-record integration among primary health care workers in Nigeria. In Lagos, Shekoni *et al*. (2024) found that healthcare workers perceived mobile-health technologies as useful for improving access to information, communication and time efficiency. At the broader health-system level, Lemma *et al.* (2020) concluded that technology enhancement combined with capacity building, data-quality assessment and feedback could improve routine health-information quality and use. The integrated interpretation nevertheless requires an important qualification. The present study measured perceived contribution, not objective causal effectiveness. Participants' descriptions of faster reporting and easier access strengthen the credibility of the survey perceptions, but neither strand establishes that digital technologies caused measurable improvements in data quality, programme performance or health outcomes. Such claims would require independent indicators such as reporting completeness and timeliness, source-document concordance, error rates, system logs, turnaround time, documented data-use decisions, or longitudinal and experimental comparisons. The finding is also relevant to the Unified Theory of Acceptance and Use of Technology (UTAUT), particularly performance expectancy. The overwhelmingly favourable perceptions indicate that respondents generally saw digital technologies as useful to their work. This is consistent with Edo *et al*. (2023), who found perceived usefulness to be positively associated with behavioural intention among Nigerian healthcare professionals, and with Wang *et al.* (2025), whose systematic review identified performance-related expectations among recurrent facilitators of digital-health adoption in low- and middle-income countries. However, the present study also shows that high perceived usefulness can coexist with difficult implementation conditions. Perceived value should therefore be understood as necessary but not sufficient for a well-functioning digital-health environment.

Strengths and Limitations

A major strength of this study was its mixed-methods approach, which provided complementary quantitative and qualitative evidence on the adoption and utilisation of digital health technologies among 602 PHC personnel. The study also distinguished adoption breadth from routine utilisation and assessed perceived contributions across key M&E functions, providing a comprehensive understanding of digital health integration in PHC programmes. However, the cross-sectional design limits causal interpretation, while reliance on self-reported practices and perceptions may have introduced recall and social desirability biases. Furthermore, perceived contributions do not necessarily represent objectively measured improvements in data quality, reporting performance or programme monitoring. The findings are also limited to PHC personnel in Rivers State and may not be generalisable to other settings.

Conclusion

This study concludes that digital health technologies are widely adopted and extensively utilised for primary health care monitoring and evaluation among the surveyed personnel in Rivers State, with DHIS2 being the most commonly used platform. The technologies support different data collection, reporting, records and logistics functions and are generally perceived to contribute positively to data management, information access, reporting timeliness and programme monitoring. The findings demonstrate that adoption breadth and routine utilisation are distinct, as the number of technologies adopted was not significantly associated with the extent of their use across routine M&E activities. Overall, digital health technologies are perceived as valuable tools for strengthening PHC monitoring and evaluation in Rivers State, although their

contribution depends on effective integration into routine health information processes.

Recommendations

1. Primary Health Care authorities in Rivers State should strengthen the adoption and coordinated use of relevant digital health technologies across PHC facilities, building on the existing widespread use of platforms such as DHIS2, NHLMIS, ODK and other electronic reporting systems.
2. PHC programme managers should promote the consistent integration of digital health technologies into routine monitoring and evaluation activities to strengthen data collection and quality, facilitate data analysis and information access, improve reporting timeliness, and support evidence-informed decision-making and programme monitoring.

Ethics statement

Ethical approval was obtained from the Faculty of Basic Medical Sciences Ethics Committee, Rivers State University, according to the source manuscript. Informed consent was obtained from participants, and confidentiality and privacy procedures were implemented.

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Conflict of interest

No conflict of interest

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