

INFORMATION TECHNOLOGY FACTORS AFFECTING OSUN STATE'S ROUTINE HEALTH INFORMATION SYSTEM' DATA QUALITY

Sunday Akingbola, Omokanye*¹, Kevin Clement, Edet², Ada Daisy, Oguizu³,
Babatunde Kayode, Ayilegbe⁴

¹Department of Public Health, Rivers State University, Port Harcourt, Nigeria.

²Department of Community Medicine, Rivers State University, Port Harcourt, Nigeria.

³Department of Public Health, Rivers State University, Port Harcourt, Nigeria.

⁴Federal Neuropsychiatry Hospital, Aro, Ogun State, Nigeria.

Article Received: 25 May 2026, Article Revised: 13 June 2026, Published on: 03 July 2026

*Corresponding Author: Sunday Akingbola, Omokanye

Department of Public Health, Rivers State University, Port Harcourt, Nigeria.

Doi: <https://doi-doi.org/101555/ijarp.4371>

ABSTRACT

Background: Information technology (IT) plays a critical role in improving Routine Health Information Systems (RHIS) by improving the quality, timeliness and reliability of data. But in low- and middle-income countries, including Nigeria, inadequate infrastructure, lack of system integration and low digital capacity still impact negatively on RHIS. We examined the role of information technology in RHIS data quality within Osun State, Nigeria, with a focus on public health facilities that cater to urban and rural communities.

Methods: We used a cross-sectional study design with a multistage sampling approach among 317 health workers in 22 public health facilities (primary, secondary and tertiary) in Osun State, Nigeria. A questionnaire and observation checklist based on the Performance of Routine Information System Management (PRISM) framework were used to collect data. The questionnaire had a good level of reliability (Cronbach's alpha = 0.790). SPSS version 30.0 was used to analyse the data using descriptive statistics and linear regression to investigate the impact of IT-related factors on RHIS data quality.

Results: The study revealed a moderate level of IT infrastructure and use (mean = 35.34 ± 10.99). Although 53.2% of survey respondents indicated computer use and 58.9% claimed that computers improved data quality, observations revealed significant infrastructural deficiencies: 73.9% of facilities did not have functional computers and 78.3% lacked internet

connectivity. While 82.6% indicated using Health Management Information Systems, only 13.0% had Electronic Health Records.

In terms of RHIS data quality, completeness (8.78 ± 2.0), timeliness (9.11 ± 1.7) and reliability (13.04 ± 3.2) were satisfactory. But reporting accuracy was low, with only 21.7% of facilities reporting accurately. The regression analysis revealed that the influence of IT factors on the data quality of the RHIS was positive and significant ($\beta = 0.251$, $t = 4.428$, $p < 0.05$), but the coefficient of determination (R^2) was low ($R^2 = 0.063$) - meaning that the use of IT factors explained 6.3% of the variance in data quality.

Conclusion: Our analysis shows that while the use of information technology for RHIS-related activities in Osun State has improved, there are still significant gaps in infrastructure, connectivity and use of digital systems. The ongoing use of paper-based systems, especially in rural and resource-limited health facilities, is hindering the effective use of RHIS and is a factor in poor data quality, particularly accuracy.

RECOMMENDATIONS: To improve RHIS data quality, it is important to strengthen ICT infrastructure through provision of functional computers, internet connectivity and power supply. Furthermore, specific capacity building for health workers, decentralisation of electronic data entry systems, as well as full adoption of integrated electronic health records and investment in rural digital health infrastructure are needed to enhance the quality of RHIS data, and contribute to evidence-based health planning in Osun State.

1. BACKGROUND TO THE STUDY

The lack of access to reliable health data at the Federal, State and Local Government levels is a huge barrier to efficient health service management, with imprecise and poor data affecting service delivery, planning and policy (1). While digital health systems and platforms are meant to enhance the accuracy and use of health data, data quality problems persist in practice (2).

Health Information Systems (HIS) are a collection of interrelated entities, resources and processes that produce, aggregate, store, analyse and disseminate data, and are critical for health policy, planning and implementation (3). But poor performing HIS can result in inappropriate resource allocation, poor health outcomes and low health system credibility (4). In Nigeria, NHMIS with DHIS2 is a critical platform for data reporting and analysis (5), but RHIS in sub-Saharan Africa still struggle to generate high-quality data.

RHIS combines digital and paper-based data tools like DHIS2 and data warehouses to inform decision-making (6), but are constrained by infrastructural and technical challenges. In the PRISM model, technical determinants, including system design, data tools and management, affect data quality (7), and poor system design and integration lead to inconsistencies (8). The use of digital health technologies is also limited by poor training, infrastructure and resources (9,10), particularly in rural regions where paper-based systems are still widely used, resulting in errors and delays (11).

Other issues like cyber security pose a threat to data security (12). In the semi-urban and rural communities of Osun State, poor infrastructure, limited internet connectivity, poor electricity supply and limited ICT training affect the performance of RHIS (13,9,10). Therefore, despite digitisation efforts, the ability of information technology to enhance the quality of RHIS data in rural health facilities is limited by system and infrastructure challenges.

2. STATEMENT OF PROBLEM

Information technology plays a key role in the effectiveness of Routine Health Information Systems (RHIS) for generating quality data. In Nigeria, lack of reliable technological infrastructure, limited access to digital tools and systems, and system integration remain major bottlenecks to data quality (14,6). While the District Health Information System 2 (DHIS2) and other electronic platforms have been deployed, poor power supply, internet connectivity and hardware limit their efficiency, resulting in delays, inconsistencies and errors in data processing. In Osun State, especially in rural and semi-urban centres, the parallel paper and electronic data management systems have led to data management gaps and inconsistencies leading to data integrity issues.

Similarly, limited ICT training and investment in infrastructure and cybersecurity, and ineffective data validation processes restrict optimal use of digital tools, and integrity of data (12). These issues are more significant in rural areas as a result of infrastructure gaps and lack of technical support. Hence, the need to explore information technology factors affecting RHIS data quality in Osun State, including infrastructure, system design and utilisation of digital tools and cybersecurity, to enhance RHIS performance and promote evidence-based decision-making.

3. OBJECTIVE

To explore information technology factors affecting Osun State's Routine Health Information System's data quality.

4. THEORETICAL FRAMEWORK

The technology acceptance model (TAM) underpins the influence of information technology factors on the quality of RHIS data in Osun State. TAM assumes that technology adoption and use is driven by perceived usefulness and perceived ease of use (15,16), which is influenced by external elements including training, infrastructure and system design, crucial for the effective adoption of RHIS.

In health information systems, the efficiency of digital tools and electronic health platforms influence data quality attributes such as accuracy, completeness, timeliness and reliability (9). But poor ease of use, lack of adequate training and other infrastructural factors including limited internet connection limit the acceptance and effective use of systems, contributing to reporting inconsistencies and delays (10). Therefore, TAM demonstrates how user attitudes and external technological factors combine to determine RHIS use and affect the quality of health data produced and reported.

5. METHODS

We conducted a cross-sectional study to assess information technology (IT) factors affecting data quality of RHIS in Osun State. A multistage sampling approach was adopted to draw 22 health facilities with 14 primary, 6 secondary and 2 tertiary health facilities across the three senatorial districts of the state to ensure representation of all levels of health services. A sample of 317 health workers was drawn from 1,139 in the entire state.

A questionnaire and an observation checklist were developed based on the PRISM framework to gather information regarding IT infrastructure (computers, internet, software and technical support) through a questionnaire and visual observation. Expert review and construct validity, including significant Bartlett's test and high factor loadings, confirmed the validity of IT constructs. Reliability tests demonstrated acceptable internal consistency (Cronbach's $\alpha = 0.790$).

Data were collected for three months by trained assistants using a data collection guide. Descriptive statistics in SPSS version 30.0 were used to describe IT factors and regression to confirm their impact on the quality of RHIS data. The study ensured ethical considerations, such as obtaining informed consent and maintaining confidentiality.

6. RESULTS

6.1: Socio-demographic characteristics of the structured questionnaire respondents

Three hundred and seventeen (317) copies of the questionnaire were distributed and 297 copies were returned, giving a response rate of 93.69%. Thus, the 297 responses were used for data analysis.

The distribution of respondents in table 1, reveals that the sample had a greater proportion of females (74.7%) than males (25.3%). The study revealed that the majority of the respondents belonged to the age group of 30-39 years (33.7%) and 40-49 years (27.9%). When it came to educational background, the majority had a Bachelor's degree (47.5%) with PD/ND and HND each making up 21.2%.

When it came to marital status, the majority were married (68.0%), while others were single (30.6%). With respect to years of work experience, most respondents had 1-5 years (30.0%) and 6-11 years (19.2%) of experience, respectively. In terms of occupation, Health Information Management officers and nurses were the most commonly represented (28.3% each).

In terms of health care facility, most respondents came from primary level (42.7%) followed by secondary (36.4%).

Table 1: Socio-Demographical Characteristics of the Respondents from the selected Facilities across the tiers of Healthcare Deliveries in Osun State.

Variable	Frequency (n=297)	Percentage (%)
Sex		
Male	75	25.3
Female	222	74.7
Age Group		
18-29	82	27.6
30-39	100	33.7
40-49	83	27.9
50 and above	32	10.7
Level of Education		
PD/ND	63	21.2
HND	63	21.2
Bachelor's degree	141	47.5
Post Graduate degree (Master/PhD)	30	10.1
Marital Status		
Single	91	30.6
Married	202	68.0
Divorced/Separated/Widowed	4	1.3
Duration of Employment		
<1 year	24	8.1
	89	30.0

1-5 years	57	19.2
6-11 years	54	18.2
12-17 years	29	9.8
18-24 years	44	14.8
25 & above		
Profession	84	28.3
HIM	84	28.3
Nurse	36	12.1
CHO	22	7.4
CHEW	32	10.8
MLS	10	3.4
Medical Officer	14	4.7
Pharmacist	15	5.0
No Response		
Facility Category	127	42.7
Primary	108	36.4
Secondary	62	20.9
Tertiary		

6.2 The Current State of Data Quality in Osun State's RHIS (Accuracy, Completeness, Timeliness and Reliability)

6.2.1 Data Accuracy in Osun State's RHIS

Data from table 2 on data accuracy of Osun State RHIS are generally satisfactory but with mixed results across facilities. When comparing data from registers to reports, 31.0% of respondents always undertook these checks, 23.2% often undertook these, and 24.6% rarely or never undertook these checks. In the last three months, 31.0% always and 23.6% often compared data, but 27.3% still never or rarely compared data.

The performance in terms of data monitoring over time was better, with 46.8% always and 21.5% often comparing data trends, but 16.5% still rarely or never performed this check.

Overall, the data quality mean score for accuracy was 10.68 (SD = 4.3), suggesting generally good data accuracy, but with inconsistencies in routine data checks between facilities.

Table 2: Data Accuracy in Osun State's RHIS.

Data Accuracy Check (F= 297)	Frequency	Percent
How often do you compare the information from the register with the computer-generated reports?		
Never	55	18.5
Rarely	18	6.1
Sometimes	63	21.2
Often	69	23.2
Always	92	31.0

How frequently have you compared the information from the register with the computer-generated reports over the last three months?		
Never	62	20.9
Rarely	19	6.4
Sometimes	54	18.2
Often	70	23.6
Always	92	31.0
How often does this facility compare data over time (monitoring over time)?		
Never	31	10.4
Rarely	18	6.1
Sometimes	45	15.2
Often	64	21.5
Always	139	46.8

Data Quality status (mean score + SD) = 10.68+4.3

Max obtainable score (is 3 items x 5max score) = 15. Average score is 7.5. Therefore, <7.5 = Poor status; >7.5 = Good status

6.2.2 Data Completeness in Osun State's RHIS

Table 3 on data completeness in Osun State RHIS demonstrates generally satisfactory reporting. Most respondents (60.3%) always fully completed monthly report forms, 25.6% often completed them, but 6.7% never or rarely completed monthly reports. During the past three months, 67.3% reported always fully completing monthly reports, 19.9% often did so, and 6.7% continued to report never or rarely fully completing monthly reports.

Overall, the mean score for data completeness was 8.78 (SD = 2.0), suggesting that, while generally good, there is still a small proportion of facilities with reporting gaps in full compliance.

Table 3: Data Completeness in Osun State's RHIS.

Data Completeness (F=297)	Frequency	Percentage
How often do you fill the monthly report form completely?		
Never	12	4.0
Rarely	8	2.7
Sometimes	22	7.4
Often	76	25.6
Always	179	60.3

How frequently have you filled in the monthly report form completely in the last three months?		
Never	14	4.7
Rarely	6	2.0
Sometimes	18	6.1
Often	59	19.9
Always	200	67.3

Data Quality status (mean score + SD) = 8.78+2.0

Max obtainable score (is 2 items x 5max score) = 10. Average score is 5. Therefore, <5 = Poor status; >5 = Good status

6.2.3: Data Timeliness in Osun State's RHIS

Data on data timeliness in Osun State RHIS, presented in table 4, show good overall compliance. The majority of facilities (73.7%) reported they always submitted reports on time and 18.5% often did so; only 3.4% never or rarely submitted reports on time. Over the past three months, 68.4% always and 22.9% often submitted reports on time, and 5.1% never or rarely submitted on time.

The mean timeliness score was 9.11 (SD = 1.7) suggesting overall, the timeliness of RHIS reporting was good, but there were still a few facilities that reported not meeting deadlines.

Table 4: Data Timeliness in Osun State's RHIS.

Data Timeliness (F=297)	Frequency	Percentage
How often does this facility submit its report by the specified deadline?		
Never	7	2.4
Rarely	3	1.0
Sometimes	13	4.4
Often	55	18.5
Always	219	73.7
How frequently have you submitted the monthly report by the specified deadline in the last three months?		
Never	10	3.4
Rarely	5	1.7
Sometimes	11	3.7
Often	68	22.9
Always	203	68.4

Data Quality status (mean score + SD) = 9.11+1.7

Max obtainable score (is 2 items x 5max score) = 10. Average score is 5. Therefore, <5 = Poor status; >5 = Good status

6.2.4: Data Reliability in Osun State's RHIS

Table 5, which presents data on the reliability of Osun State RHIS data, shows that the performance of facilities is generally satisfactory. A majority (62.3%) of respondents indicated that facilities always have copies of monthly RHIS reports sent to the district office, 23.9% often have them, but 7.1% never or rarely have them. Likewise, 63.6% reported data processing procedures or tally sheets always available in their facilities, 21.5% often available and 6.1% never or rarely have these available. Also, 61.6% indicated manuals for collecting data always exist, 21.2% often exist and 9.1% never or rarely have manuals.

Overall, the mean data reliability score was 13.04 (SD = 3.2), suggesting that RHIS data reliability is generally good, but some facilities need to improve their documentation and standard procedures.

Table 5: Data Reliability in Osun State's RHIS.

Data Consistency/Reliability (F=297)	Frequency	Percentage
How often does this facility keep copies of the RHIS monthly reports sent to the district office?		
Never	13	4.4
Rarely	8	2.7
Sometimes	20	6.7
Often	71	23.9
Always	185	62.3
How often do data processing procedures or a tally sheet exist in this facility?		
Never	13	4.4
Rarely	5	1.7
Sometimes	26	8.8
Often	64	21.5
Always	189	63.6
How often does a procedure manual for data collection (with definitions) exist in this facility?		
Never	20	6.7
Rarely	7	2.4
Sometimes	24	8.1
Often	63	21.2
Always	183	61.6

Data Quality status (mean score + SD) = 13.04+3.2

Max obtainable score (is 3 items x 5max score) = 15. Average score is 7.5. Therefore, <7.5 = Poor status; >7.5 = Good status

6.3: Observational Checklist Reports on the Current State of Data Quality in Osun State's RHIS (Accuracy, Completeness, Timeliness and Reliability)

As shown in table 6, Data accuracy is poor, with only 21.7% of facilities reporting accurate monthly data. There is high level of mismatch between source register and summary reports for malaria (52.2% mismatch) and ANC (39.1% mismatch). In particular, the indicators for immunisation, measles, nutrition, diarrhoea, TB, hypertension (HTN), upper respiratory tract infections (URTI) and diabetes mellitus (DM) have missing data of greater than 65%. Only 39.1% of facilities report data verification of registers from computer reports.

Data completeness is relatively better, with 78.3% of facilities having 100% reporting and acceptable completeness for most data items. For timeliness, 73.9% of facilities send reports in the first week of the subsequent month, while 95.7% of district offices report receipt dates; but only approximately 45% of reports were reported on time in the months selected (January and July 2024), with some cases of missing reports.

Data consistency and reliability is relatively strong, with 69.6% of facilities calculating indicators, 78.3% comparing data with targets, and 95.7% monitoring data over time. Although formal procedures in data processing are rare (34.8%), procedure manuals are accessible (95.7%) and practices in monitoring indicate generally good coordination and reliability in data management.

Table 6: Current State of RHIS Data Quality across Healthcare Facilities in Osun State (Observational Checklist Report)

Data Quality Dimension (n = 23)	Response Summary	Key Findings (%)
A. Accuracy		
Copies of RHIS monthly reports sent to district office	Majority of facilities send copies to district office	Yes (91.3)
Availability of last 12 months' reports	Reports largely inaccurate or incomplete	Accurate (21.7), Inaccurate (60.9)
Malaria data match (register vs summary)	Moderate accuracy	Matched (34.8), Mismatched (52.2)
ANC data match	Relatively better performance	Matched (43.5), Mismatched (39.1)
Immunization, Measles, Nutrition, Diarrhoea, TB, HTN, URTI, DM	Very poor accuracy; high missing data	Missing data >65 for all
Comparison of register with computer-generated report	Most do not perform data comparison	Yes (39.1), No (60.9)
Overall Accuracy Impression	Accuracy performance is weak, with substantial mismatches and	<50 accurate reporting

	missing data across service areas	
B. Completeness		
Facility completeness level (FCL)	High overall completeness levels	(78.3)
Completeness of data items	Most data items were fully reported	Complete (78.3), Incomplete (21.7)
Overall Completeness Impression	Data completeness is satisfactory in most facilities	>75 completeness
C. Timeliness		
Deadline for submitting RHIS monthly report	Majority submit within the first week of following month	Timely (73.9)
District office records receipt date	Nearly all district offices record receipt dates	Yes (95.7)
Timeliness (January 2024)	Around half submitted on time	Timely (43.5), Untimely (8.7), Missing (47.8)
Timeliness (July 2024)	Similar pattern to January	Timely (39.1), Untimely (8.7), Missing (52.2)
Overall Timeliness Impression	Reasonably timely submission pattern, but significantly missing reporting data	≈45 timely reporting
D. Data Consistency/reliability		
Availability of data-processing procedure/tally sheet	Limited use of formal tally sheets	Yes (34.8), No (65.2)
Facility calculates catchment indicators	Majority perform indicator calculations	Yes (69.6)
Facility compares data with district/national targets	Widespread use of comparative analysis	Yes (78.3)
Facility compares service coverage types	Common practice across facilities	Yes (73.9)
Facility monitors data over time	Almost all facilities track data trends	Yes (95.7)
Availability of procedure manual for data collection	Nearly universal presence of manuals	Yes (95.7)
Overall Data Consistency/reliability Impression	Data analysis and monitoring practices are strong, though procedural documentation is inconsistent	>70 performance level

6.4: Information Technology Factors Affecting Osun State's RHIS Data Quality

The results in table 7 show that there is an average level of information technology infrastructure and use in Osun State. A majority (53.2%) of respondents indicated use of computers for report preparation and submission, and 58.9% agreed that computers help improve data quality. But utilisation is not consistent due to lack of computer systems in many facilities.

For internet use, 45.8% reported internet is available for reporting, 43.5% reported stable internet, and 40.4% reported unstable internet, with varying access to internet. Nearly half (52.2%) of respondents agreed that internet improves data quality and 53.8% indicated no internet affects reporting negatively.

Concerning HMIS and Electronic Health Records (EHR), 46.5% reported that they have functional systems, while 42.7% reported that systems are not functional (limited or no use), indicating limited uptake of electronic health records. Moreover, 51.2% agreed that HMIS/EHR functionality enhances data quality.

Data interfaces were reported as good by 64.0% but 22.5% did not agree. The IT mean score was 35.34 ± 10.99 suggesting a moderate level of technological capacity. The results show improvement in digitalisation, but also indicate limited computer availability, internet access, and functionality of HMIS/EHR in RHIS facilities in Osun State.

Table 7: Information Technology Factors Influencing Osun State's RHIS Data Quality.

Computer Facilities (F = 297)	Frequency	Percent
In our facility, we use computer system in generating and transmission of reports		
Strongly disagree	62	20.9
Disagree	65	21.9
Neither disagree nor agree	12	4.0
Agree	90	30.3
Strongly agree	68	22.9
In our facility, use of computer systems contribute to data quality output		
Strongly disagree	47	15.8
Disagree	60	20.2
Neither disagree nor agree	15	5.1
Agree	93	31.3
Strongly agree	82	27.6
In our facility, lack of computer systems adversely affected data quality		
Strongly disagree	55	18.5
Disagree	53	17.8
Neither disagree nor agree	16	5.4
Agree	80	26.9
Strongly agree	93	31.3
Internet Facilities		

In our facility, we have access to the internet for transmission of computer/manual generated reports	70	23.6
Strongly disagree	61	20.5
Disagree	30	10.1
Neither disagree nor agree	73	24.6
Agree	63	21.2
Strongly agree		
In our facility, Internet access is constant and reliable	65	21.9
Strongly disagree	55	18.5
Disagree	48	16.2
Neither disagree nor agree	79	26.6
Agree	50	16.9
Strongly agree		
In our facility, reliability of data transmission over the internet contribute to data quality output	50	16.8
Strongly disagree	57	19.2
Disagree	35	11.8
Neither disagree nor agree	96	32.3
Agree	59	19.9
Strongly agree		
In our facility, lack of Internet adversely affected data quality	54	18.2
Strongly disagree	46	15.5
Disagree	37	12.5
Neither disagree nor agree	88	29.6
Agree	72	24.2
Strongly agree		
Health Management Information System (HMIS) and Electronic Health Records (EHR)		
In our facility, we have functional Electronic Health Management Information System (HMIS) and Electronic Health Records (EHR)	64	21.5
Strongly disagree	63	21.2
Disagree	32	10.8
Neither disagree nor agree	75	25.3
Agree	63	21.2
Strongly agree		
In our facility, we use functional Health Management Information System (HMIS) and Electronic Health Records (EHR)	63	21.2
Strongly disagree	53	17.8
Disagree	36	12.1
Neither disagree nor agree	91	30.6
Agree	54	18.2
Strongly agree		

In our facility, functionality of the Health Management Information System (HMIS) and Electronic Health Records (EHR) contribute to data quality output	48	16.2
Strongly disagree	48	16.2
Disagree	49	16.5
Neither disagree nor agree	85	28.6
Agree	67	22.6
Strongly agree		
Data Entry/Transmission Interfaces		
In our facility, there are adequacy of data entry interfaces	33	11.1
Strongly disagree	34	11.4
Disagree	40	13.5
Neither disagree nor agree	130	43.8
Agree	60	20.2
Strongly agree		
In our facility, adequacy of data entry interfaces contribute to data quality output	32	10.8
Strongly disagree	42	14.1
Disagree	25	8.4
Neither disagree nor agree	125	42.1
Agree	73	24.6
Strongly agree		

Behavior mean score + SD = 35.34 + 10.99; Max obtainable score (is 12 items x 5 max score) = 60. Average score is 30. Therefore, <30 = Poor status; >30 = Good status etc.

6.5: Observational Checklist Reports on Information Technology Factors Affecting Osun State's RHIS Data Quality

Table 8 highlights that most facilities did not have access to computer systems (73.9%) and the internet (78.3%). However, a large proportion (82.6%) reported the use of Health Management Information Systems (HMIS) to assist with the collection of health data, instead of individual data access. However, the use of Electronic Health Records (EHR) was low (13.0%). Similarly, the majority didn't have many data processing software (26.1) or data entry/transmission interfaces (43.5). Overall, the trend shows that there is a need to invest in better digital infrastructure and training to enhance the health information management process.

Table 8: Information Technology Factors affecting RHIS Data Quality (Observational Checklist Report.)

Equipment (f = 23)	No F (%)	Yes F (%)
Use Computer Systems	17 (73.9)	6 (26.1)
Have Access to the Internet	18 (78.3)	5 (21.7)
Use Health Management Information System (HMIS)	4 (17.4)	19 (82.6)
Use Electronic Health Records (EHR)	20 (87.0)	3 (13.0)
Use Data Processing/Analysis Software	17 (73.9)	6 (26.1)
Have Data Entry/Transmission Interfaces	13 (56.5)	10 (43.5)

6.6: Comparison of Data Quality and Associated IT Factors Across Facility Levels

Table 9 here, reveals that Primary facilities had the highest mean data quality (43.59 ± 5.78), followed by tertiary (40.31 ± 7.73) and secondary facilities (40.03 ± 7.48). Primary facilities also achieved higher mean scores across data quality dimensions including accuracy (11.31 ± 3.72), timeliness (9.25 ± 1.53), consistency (13.91 ± 1.67) and completeness (9.13 ± 1.44) compared to secondary and tertiary facilities.

However, tertiary facilities had higher scores for IT-related dimension including availability of computers (11.76 ± 2.67), internet connectivity (14.03 ± 3.60), Health Management Information System (HMIS) facilities (11.89 ± 3.32) and data entry facilities (7.77 ± 1.89) than primary and secondary facilities.

In summary, the results reveal that, while tertiary facilities are better equipped with IT infrastructure, primary facilities had a higher data quality, suggesting a disconnection between IT infrastructure and data quality.

Table 9: Comparison of Data Quality and Associated IT Factors Across Facility Levels.

Assessed Parameters	Primary (mean + SD)	Secondary (mean + SD)	Tertiary (mean + SD)
Data accuracy	11.31 + 3.72	9.778 + 3.78	10.95 + 3.64142
Data completeness	9.13 + 1.44	8.68 + 1.85	8.27 + 2.04994
Data timeliness	9.25 + 1.53	9.10 + 1.48	8.85 + 1.74475
Data consistency	13.91 + 1.67	12.49 + 3.31	12.23 + 2.98312
Computer facilities	9.21 + 3.56	9.42 + 3.73	11.76 + 2.66542
Internet facilities	12.63 + 4.70	11.27 + 4.50	14.03 + 3.59858
HMIS facilities	9.28 + 3.89	7.98 + 3.76	11.89 + 3.32455
Data entry facilities	6.88 + 2.37	6.861 + 2.56	7.77 + 1.89407
Data Quality	43.59 + 5.78	40.03 + 7.48	40.31 + 7.73451
Technology factors	34.94 + 10.93	32.41 + 11.05	41.26 + 8.60411

6.7: Test of Hypothesis

The regression analysis examined whether there is no relationship between Information Technology (IT) factors and data quality in Osun State's RHIS. The findings (Table 10) indicate that IT factors have a significant positive impact on data quality in RHIS ($B = 0.171$, $\beta = 0.251$, $t = 4.428$, $p < 0.001$). The model shows a small association between IT factors and data quality ($R = 0.251$), accounting for 6.3% of the variance in the RHIS data quality ($R^2 = 0.063$, Adjusted $R^2 = 0.060$), and the model was statistically significant ($F = 19.604$, $p < 0.05$). This indicates that IT infrastructure and systems development has a positive but limited impact on data quality within the RHIS.

Ho: Information Technology Factor has no significant effect of Data Quality in Osun State's RHIS

Table: 10				
Model	Sig.	Unstandardized		Standardized
		Coefficients		Coefficients
		B	Std. Error	Beta
1 (Constant)		3.909	.145	
IT Factors in RHIS Data Quality		.171	.039	.251

a. Dependent Variable: Level of RHIS Data Quality

$R=0.251$, $R^2=0.063$, Adjusted $R^2= 0.060$, $F=19.604$, $P < 0.05$

7. DISCUSSION

The findings reveal that ICT integration within the Routine Health Information System (RHIS) in Osun State is constrained by limited infrastructure, resulting in a gap between perceived and actual availability of digital resources. While many health workers report access to computers and internet-enabled tools, observational evidence shows that most facilities still depend heavily on paper-based systems. This indicates that digitalisation remains largely conceptual at the point of data generation, limiting its effectiveness in improving data quality. These findings are consistent with Chekol et al. (17), Moloko and Ramukumba (18), and Fraser et al. (19), who describe similar hybrid RHIS models in low-resource settings, as well as Mensah et al. (20) and Kuusaana (21), who highlight infrastructural barriers such as unreliable electricity and poor connectivity. In contrast, Adeyemi (13) and Nguetack-Tsague (22) report better ICT functionality in more resourced settings, underscoring the influence of systemic resource constraints.

Despite widespread awareness of the benefits of ICT, actual utilisation remains low, particularly at the facility level where manual data processes dominate and electronic reporting is largely deferred to the LGA level. This reflects superficial adoption and weak institutionalisation of ICT, contributing to risks of transcription errors, delays, and data loss. Limited staff capacity, lack of structured training, and absence of technical support further constrain effective use of available technologies, reinforcing reliance on manual systems. These findings align with Chekol et al. (17), Wude et al. (23), Hlaing and Zaw (24), and Mucee et al. (25), as well as Alharbi (26) and Yehula (27), who emphasise the persistence of mixed paper-electronic systems despite training efforts. Although Fraser et al. (19) demonstrates improved outcomes in fully functional digital environments, the Osun context highlights that awareness and training alone are insufficient without supportive infrastructure and continuous system support. Similarly, disparities in ICT availability across facility levels—favouring tertiary over primary care—mirror patterns reported by Chekol et al. (17), Sylla et al. (4), Mucee et al. (25), and Nguefack-Tsague (22), though differing from the more uniform systems described by Adeyemi (13).

The study further demonstrates that ICT availability is positively associated with key data quality dimensions, particularly timeliness and completeness, although overall system maturity remains limited. Facilities with better ICT resources show improved reporting performance, while those relying on manual systems experience persistent data quality challenges. These findings support Fraser et al. (19), Leon (28), and Syed et al. (29), as well as Mensah et al. (20) and Kuusaana (21), though they contrast with more advanced outcomes reported by Morris (9) in settings with integrated EHR systems.

8. APPLICATION OF THE THEORETICAL FRAMEWORK TO THE FINDINGS OF THIS STUDY

The findings of this study can be explained using three complementary frameworks. From the Technology Acceptance Model (15), the results show that although health workers demonstrate high perceived usefulness of ICT, evidenced by strong agreement on its role in improving accuracy, completeness, and timeliness, and the significant effect of IT factors on data quality ($\beta = 0.251$, $p < 0.001$), actual utilisation remains low due to poor perceived ease of use arising from infrastructural and capacity constraints such as limited computers, weak internet connectivity, low EHR utilisation, and inadequate ICT training, thereby sustaining reliance on paper-based and hybrid systems. From the Diffusion of Innovation Theory (30), ICT adoption appears uneven and at an early stage of diffusion, with implementation

concentrated in better-resourced tertiary facilities while primary healthcare facilities lag behind, reflecting a slow and hierarchical adoption pattern that contributes to disparities in data quality. From the PRISM Framework (31), the findings indicate an imbalance between strong behavioural factors (positive attitudes) and weak technical and organisational systems (infrastructure, system reliability, training, and support), which constrains effective ICT integration; collectively, these suggest that the RHIS in Osun State is at a transitional stage of digital development, requiring improved infrastructure, equitable ICT distribution, system integration, and sustained capacity building to enhance technology utilisation and data quality.

9. CONCLUSION

The study finds that while ICT is theoretically integrated into the RHIS in Osun State and recognised for its potential benefits, adoption is limited and inconsistent across health facilities. Infrastructure and capacity gaps, as well as manual processes, restrict the effective use of ICT, and hence its potential to address data quality in terms of accuracy, timeliness and completeness.

10. RECOMMENDATIONS

1. Paper-based facilities (primary and secondary) should consider digital infrastructure, including functional computers, internet connectivity and DHIS2 workstations.
2. Osun State Ministry of Health (SMOH) should prioritise decentralised ICT deployment to ensure data entry at the facility level and minimise reliance on LGA systems.
3. The Policy and Planning Directorate of the SMOH is advised to include a formal Data Quality Improvement (DQI) strategy in the state RHIS policy, with specific budget lines for ICT infrastructure and supervision, workforce development and sustainability to maintain the system and meet the national RHIS standards.
4. Osun State's health training colleges, including the School of Health Information Management, School of Community Health Programmes and School of Nursing, should provide competency-based refresher courses through adult learning strategies to enhance staff skills in data management, validation and utilisation of electronic devices.
5. Osun State Ministry of Health with the support of development partners should provide alternative power supply options and enhanced internet connections, especially in rural facilities, to enable digital reporting.

11. LIMITATION

The research faced time constraints in collecting data on ICT infrastructure and use due to staff availability and schedules. There was also the potential for verification bias, with health workers possibly overestimating the use and functionality of ICTs. In addition, observational verification was limited by intermittent unavailability of computers or poor internet connections, which could have impacted the ICT assessment.

Other Information

1. Funding Statement: This research was self-funded by the authors, and no external financial support was received for the conduct of this study.

2. Ethical Statement

Ethics Approval and Participant Consent

Ethical approval for this study was obtained from the appropriate institutional review authority of Obafemi Awolowo University Teaching Hospitals Complex prior to data collection. Informed consent was obtained from all participating patients, ensuring voluntary participation. Strict measures were implemented to maintain confidentiality and anonymity of all respondents, and all procedures were conducted in accordance with established ethical standards for research involving human participants.

3. Conflict of Interest Statement

Disclosure of conflict of interest: The authors declare that there are no conflicts of interest or competing interests associated with this study.

4. ACKNOWLEDGEMENT

The authors sincerely acknowledge the Research and Project Committee of the School of Health Information Management, Obafemi Awolowo University Teaching Hospitals Complex, for their constructive feedback and valuable contributions. Appreciation is also extended to the academic staff of the School, particularly Mr. Adeniregun, Mr. Lamidi, Mr. Kolawole, Mr. Jeje, and Mr. Akilo, for their guidance and support. The authors further thank the 2024/2025 final year students and all participants across the selected Local Government Areas in Osun State for their time and cooperation in this study.

5. Author Contribution Statements

SAO conceived the study, initiated the study design, participated in data analysis and coordination, and drafted the manuscript. KCE contributed to the study design and coordination and critically reviewed the manuscript for intellectual content. ADO also

contributed to the study design and coordination and reviewed the manuscript. BKA participated in the study design and coordination and was actively involved in data collection and data analysis. All authors read and approved the final manuscript and agree to be accountable for all aspects of the work in line with the recommendations of the International Committee of Medical Journal Editors.

6. Clinical Trial Registration

Not applicable (NA). This study did not involve a clinical trial and therefore was not subject to registration in accordance with the recommendations of the International Committee of Medical Journal Editors.

7. REFERENCES

1. Omole, M. S., Adebayo, T. T., Adio, R. A., UMAR, F. A., Adejo, M. B., & Wada, A. (2019). Influence of National Health Management Information System, on the planning of health care services in Nigeria. *Library Philosophy and Practice (e-journal)*, 3643.
2. Zhang, Y., Callaghan-Koru, J. A., & Koru, G. (2024). The challenges and opportunities of continuous data quality improvement for healthcare administration data. *JAMIA Open*, 7(3), Article ooae058. <https://doi.org/10.1093/jamiaopen/ooae058>
3. Adejumo, A., & Criss, J. (2017). *An assessment of data quality in routine health information systems in Oyo State, Nigeria*. University of the Western Cape.
4. Sylla, B., Savadogo, L., & Diallo, G. (2024). Improving health information systems data quality in sub-Saharan Africa. *Studies in Health Technology and Informatics*, 316, 383–387. <https://doi.org/10.3233/SHTI240428>
5. Shuaib, F., Garba, A. B., Meribole, E., & Adamu, S. (2020). Implementing the routine immunization data module and dashboard of DHIS2 in Nigeria, 2014–2019. *BMJ Global Health*, 5, Article e002203. <https://doi.org/10.1136/bmjgh-2019-002203>
6. WHO. (2023). *Strategy for optimizing national routine health information systems*. World Health Organization.
7. USAID and MEASURE Evaluation. (2008). *Using PRISM to strengthen and evaluate health information systems*, FS-07-18.
8. Hotchkiss, D. R. (2010). Evaluation of the Performance of Routine Information System Management (PRISM) framework: Evidence from Uganda. *BMC Health Services Research*, 10, Article 188.

9. Morris, L. D., Nyongesa, M. W., & Sokiri, T. D. (2024). Factors influencing data quality in routine health information systems in Maridi county, South Sudan. *South African Journal of Information Management*, 26(1), Article a1856. <https://doi.org/10.4102/sajim.v26i1.1856>
10. WHO. (2019). *WHO guideline recommendations on digital interventions for health system strengthening*. World Health Organization.
11. Makazha, T. (2020). *Assessment of the quality of HIV data in an electronic system in a health sub-district in the Eastern Cape*. University of the Western Cape. <https://uwcscholar.uwc.ac.za/items/b5a2fd67-c523-4973-859e-613e9ac1461f/full>
12. Pool, J. (2024). A systematic analysis of failures in protecting personal health data: A scoping review. *International Journal of Information Management*, 74, Article 102719.
13. Adeyemi, N. K. (2022). Distribution patterns of primary health care centers in Osun State, Southwestern Nigeria: Implications for sustainable development goals and containment of COVID-19. *International Journal of Health Services*, 52(4).
14. McKing Izeiza Amedari, E., Nneka, N. K., & Adewale, S. T. (2021). Improving access, quality and efficiency in health care delivery in Nigeria: a perspective. *Pan-African Medical Journal - One Health*, 5(3). <https://doi.org/10.11604/pamj-oh.2021.5.3.28204>
15. Davis, F. D. (1989). Perceived usefulness, perceived ease of use, and user acceptance of information technology. *MIS Quarterly*, 13(3), 319–340. <https://doi.org/10.2307/249008>
16. Opoku, M. O., & Enu-Kwesi, F. (2019). Relevance of the technology acceptance model (TAM) in information management research: a review of selected empirical evidence. *Research Journal of Business and Management (RJBM)*, 7(1), 34–44.
17. Chekol, A., Ketemaw, A., Endale, A., Aschale, A., Endalew, B., & Asemahagn, M. A. (2023). Data quality and associated factors of routine health information system among health centers of West Gojjam Zone, northwest Ethiopia, 2021. *Frontiers in Health Services*, 3. <https://doi.org/10.3389/frhs.2023.1059611>
18. Moloko, S. M., & Ramukumba, M. M. (2022). Healthcare providers' views of factors influencing family planning data quality in Tshwane District, South Africa. *African Journal of Primary Health Care & Family Medicine*, 14(1), 1–10. <https://doi.org/10.4102/phcfm.v14i1.3545>
19. Fraser, H. S. F., Mugisha, M., Bacher, I., Ngenzi, J. L., Seebregts, C., Umubyeyi, A., & Condo, J. (2024). Factors influencing data quality in electronic health record systems in 50 health facilities in Rwanda and the role of clinical alerts: Cross-sectional

- observational study. *JMIR Public Health and Surveillance*, 10, e49127. <https://doi.org/10.2196/49127>
20. Mensah, N. K., Adzakupah, G., Kissi, J., Abdulai, K., Taylor-Abdulai, H., Johnson, S. B., Opoku, C., Hallo, C., & Boadu, R. O. (2024). Health professionals' perceptions of electronic health records system: A mixed method study in Ghana. *BMC Medical Informatics and Decision Making*, 24, 254. <https://doi.org/10.1186/s12911-024-02672-3>
21. Kuusaana, J. A. E., Monstadt, J., & Smith, S. (2023). Practicing urban resilience to electricity service disruption in Accra, Ghana. *Energy Research & Social Science*, 95, 102885.
22. Nguetack-Tsague, G., Tamfon, B. B., Ngnie-Teta, I., Ngoufack, M. N., Keugoung, B., Bataliack, S. M., & Bilounga Ndongo, C. (2020). Factors associated with the performance of routine health information system in Yaoundé-Cameroon: a cross-sectional survey. *BMC medical informatics and decision making*, 20(1), 339.
23. Wude, H., Woldie, M., Melese, D., Lolaso, T., & Balcha, B. (2020). Utilization of routine health information and associated factors among health workers in Hadiya Zone, Southern Ethiopia. *PLoS One*, 15(5), Article e0233092. <https://doi.org/10.1371/journal.pone.0233092>
24. Hlaing, T., & Zaw, M. M. (2022). Factors affecting data quality of health management information system at township level, Bago Region, Myanmar. *International Journal of Community Medicine and Public Health*, 9(3), 1298-1307. <https://doi.org/10.18203/2394-6040.ijcmph20220686>
25. Mucee, E. M., Kaburi, W., Odhiambo-Otieno, P. G., & Kinyamu, R. K. (2016). Routine health management information use in the public health sector in Tharaka Nithi County, Kenya. *Imperial Journal of Interdisciplinary Research*, 2(3), 660–672.
26. Alharbi, M. F. (2025). Does Electronic Health Record Implementation Enhance Hospital Efficiency and Patient Outcomes? A Comprehensive Systematic Review. *Sage Open*, 15(3).
27. Yehula, C. M., Walle, A. D., Tegegne, M. D., Endehabtu, B. F., Wubante, S. M., Melaku, M. S., ... & Tilahun, B. (2023). Health information utilization and its associated factors among health professionals in northwest Ethiopia: A crossectional study. *Informatics in Medicine Unlocked*, 40, 101287.
28. Leon, N., Balakrishna, Y., Hohlfeld, A., Odendaal, W. A., Schmidt, B.-M., Zweigenthal, V., Anstey Watkins, J., & Daniels, K. (2020). Routine health information system (RHIS)

- improvements for strengthened health system management. *Cochrane Database of Systematic Reviews*, 8, Article CD012012.
29. Syed, R., Eden, R., Makasi, T., Chukwudi, I., Mamudu, A., Kamalpour, M., ... & Myers, T. (2023). Digital health data quality issues: systematic review. *Journal of medical Internet research*, 25, e42615.
30. Putteeraj, M., Bhungee, N., Somanah, J., & Moty, N. (2022). Assessing E-Health adoption readiness using diffusion of innovation theory and the role mediated by each adopter's category in a Mauritian context. *International Health*, 14(3), 236-249.
31. Aqil, A., Lippeveld, T., & Hozumi, D. (2009). PRISM framework: A paradigm shift for designing, strengthening and evaluating routine health information systems. *Health Policy and Planning*, 24(3), 217–228. <https://doi.org/10.1093/heapol/czp010>