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THE ROLE OF INFORMATION AND COMMUNICATION TECHNOLOGY IN DISEASE SURVEILLANCE AND NOTIFICATION: EVIDENCE FROM IBADAN NORTH LOCAL GOVERNMENT AREA, OYO STATE, NIGERIA

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ABSTRACT

Timely and accurate disease surveillance and notification are essential to early outbreak detection and effective public health response, yet the extent to which Information and Communication Technology (ICT) enhances these processes at the Local Government Area (LGA) level in Nigeria remains under-documented. This study assessed the availability, accessibility, and utilization of ICT, and their effects on the effectiveness of disease surveillance and notification, among healthcare professionals in Ibadan North LGA, Oyo State.

Anchored in the Socio-Technical Systems (STS) and Health Information Systems (HIS) theories, a descriptive cross-sectional design was adopted. A multistage sampling technique (stratification by facility category, proportional allocation, and simple random selection of respondents) was used to draw a Cochran-derived sample of 370 healthcare workers from tertiary, secondary, primary, and private health facilities (total eligible population = 2,424). A structured, expert-validated questionnaire (overall Cronbach's alpha = 0.82) covering ICT availability, accessibility, utilization, effectiveness, challenges, and improvement strategies was administered; 340 questionnaires were validly returned (92% response rate).

Descriptive analysis showed that ICT tools and infrastructure were generally available (grand mean above the 3.00 benchmark for all items, e.g., mobile devices = 3.88, computers = 3.79) and accessible (range 3.32-3.78), and were actively utilized for reporting, communication, and monitoring (range 3.44-3.89), with ICT utilization perceived to substantially improve the

timeliness, accuracy, completeness, and overall effectiveness of surveillance and notification (range 3.68-3.83). Pearson correlation analysis (n = 170) confirmed statistically significant, positive relationships between ICT availability and effectiveness ($r = 0.611$, $p < 0.001$), ICT accessibility and effectiveness ($r = 0.645$, $p < 0.001$), and ICT utilization and effectiveness ($r = 0.682$, $p < 0.001$), with utilization exerting the strongest influence. Insufficient funding, poor internet connectivity, unstable electricity supply, and inadequate training were identified as the principal barriers to optimal ICT performance.

The study concludes that ICT availability, accessibility, and utilization are each significant, interrelated determinants of disease surveillance and notification effectiveness at the LGA level, but that realising their full benefit requires concurrent investment in infrastructure, funding, technical training, and institutional support. The findings provide localised, empirically grounded evidence to guide policymakers, local health authorities, and development partners seeking to strengthen ICT-enabled disease surveillance systems in comparable sub-Saharan African settings.

KEYWORDS: Information and Communication Technology; disease surveillance; disease notification; Local Government Area; health information systems; Nigeria.

1. INTRODUCTION

Disease surveillance and disease notification are foundational components of an effective public health system, providing the evidentiary basis for early outbreak detection, monitoring, and response (World Health Organization [WHO], 2023; Federal Ministry of Health [FMoH], 2022). Disease surveillance is the continuous, systematic collection, analysis, interpretation, and dissemination of health-related data, while disease notification is the timely reporting of specified diseases and public health events by health facilities to designated public health authorities for prompt action. Recurrent outbreaks such as COVID-19 and Lassa fever, alongside a rising burden of non-communicable disease, have intensified the need for surveillance systems capable of generating timely and accurate public health information; traditional paper-based systems, by contrast, are characterised by delayed reporting, incomplete data, and poor coordination (Adepoju et al., 2020).

Information and Communication Technology (ICT) has become central to modern disease surveillance through Health Information Systems, Electronic Health Records, mobile health (mHealth) applications, and web-based reporting platforms that enable real-time data capture and transmission (Karuri et al., 2021). Globally and in Nigeria specifically, platforms such as

the District Health Information Software 2 (DHIS2) and the Integrated Disease Surveillance and Response (IDSR) strategy have improved the electronic aggregation, analysis, and dissemination of surveillance data (FMoH, 2022). Nevertheless, inadequate ICT infrastructure, erratic electricity, poor internet connectivity, insufficient funding, and limited technical capacity continue to constrain effective implementation (Oluwole et al., 2023).

Local Government Areas (LGAs) occupy a strategic position in Nigeria's surveillance architecture, as Disease Surveillance and Notification Officers (DSNOs) at this level coordinate the collection, verification, compilation, analysis, and transmission of data from health facilities within their jurisdiction (FMoH, 2022). Ibadan North LGA of Oyo State, a densely populated urban area with numerous public and private health facilities participating in the IDSR framework, remains vulnerable to the occurrence and spread of infectious disease and therefore requires an efficient ICT-enabled surveillance and notification system. However, most existing Nigerian studies have examined ICT and EMR implementation at national or state level, or in relation to specific outbreaks, leaving the extent and effect of ICT utilization in routine surveillance and notification at the LGA level, and specifically in Ibadan North LGA, empirically under-examined (Isere et al., 2015; Nnebue et al., 2022; Oluwole et al., 2023). This study addresses that gap.

1.1 Objectives of the study

The specific objectives were to: (i) assess the availability of ICT tools and infrastructure for disease surveillance and notification in Ibadan North LGA; (ii) assess the accessibility of ICT tools and infrastructure; (iii) examine the level of ICT utilization; (iv) evaluate the effect of ICT utilization on disease surveillance and notification reporting; (v) identify challenges associated with ICT use; and (vi) propose strategies for improving ICT-driven disease surveillance and notification in the LGA.

2. Theoretical Framework and Literature Review

2.1 Socio-Technical Systems (STS) Theory and Health Information Systems (HIS) Theory

This study is anchored on Socio-Technical Systems (STS) Theory (Trist & Bamforth, 1951), which holds that system performance depends on the joint optimisation of technical and social subsystems, and is complemented by Health Information Systems (HIS) Theory, which conceptualises health systems as information-processing structures whose effectiveness depends on the quality, flow, accessibility, and use of health information (AbouZahr, Boerma, & Health Metrics Network, 2019; Lippeveld, 2017). Within surveillance systems, the technical subsystem comprises ICT infrastructure (electronic reporting platforms, mHealth

applications, databases, networks), while the social subsystem comprises healthcare workers, reporting protocols, and institutional practice; system outcomes such as timeliness, accuracy, and effectiveness emerge from the interaction, rather than either subsystem alone (Sittig & Singh, 2020; Carayon et al., 2021). Persistent challenges such as delayed reporting and incomplete notification are therefore better understood as a misalignment between technology and human/organisational factors than as purely technical failure. Together, STS and HIS theories directly inform this study's conceptualisation of ICT availability, accessibility, and utilization as determinants of surveillance timeliness, accuracy, and effectiveness.

2.2 Disease Surveillance, Disease Notification, and ICT

Disease surveillance may be passive (routine facility reporting), active (proactive case-finding), sentinel (selected representative sites), syndromic (symptom-based, near-real-time), or event-based (informal/media-sourced signals), and these approaches are integrated within Nigeria's IDSR framework (WHO, 2019, 2021; Henning, 2018). Disease notification, the formal and timely reporting of notifiable disease cases, is conducted through immediate/emergency, routine/periodic, laboratory-based, electronic, and community-based channels (WHO, 2021; Centers for Disease Control and Prevention [CDC], 2020). ICT integration, particularly through mobile applications, SMS, web-based platforms, and systems such as DHIS2, has been shown to improve the completeness and timeliness of both surveillance and notification and to strengthen inter-agency coordination (Tom-Aba et al., 2018; Ameh, Owoaje, & Oyo-Ita, 2022; Eze, Adeleke, & Nwankwo, 2023).

2.3 Empirical Evidence on ICT Availability, Accessibility, and Utilization

Empirical studies consistently link ICT availability to improved compliance with notification timelines, but also report persistent rural-urban disparities, poor maintenance, and system downtime that limit its benefit (Adedeji, Adebayo, & Olatunji, 2022; Ouma, Were, & Muturi, 2021; Mensah & Boateng, 2022; Chukwu & Oladipo, 2023). ICT accessibility, shaped by internet connectivity, electricity, and system access rights, has similarly been shown to determine whether available technology translates into effective reporting (Kariuki, Muthoni, & Njoroge, 2023; Adebayo, Salami, & Oladipo, 2021; Mboera, Rumisha, & Lyimo, 2021). ICT utilization, in turn, is strongly associated with improved data quality, completeness, and timeliness, but is frequently constrained by inadequate training, resistance to change, and weak organisational support (Mwangi, Mutua, & Ochieng, 2022; Okon, Johnson, & Effiong, 2021; Mashauri, Mmbuji, & Kweka, 2023; Abubakar, Suleiman, & Ahmed, 2022).

Regarding outcomes, ICT has been repeatedly shown to reduce reporting delays and support real-time notification (Kiberu, Matovu, & Makumbi, 2021; Adewale, Adeyemi, & Lawal,

2022), to improve data accuracy through validation and reduced manual error (Boateng, Mensah, & Asante, 2021; Okeke, Eze, & Okafor, 2022), and to strengthen overall surveillance effectiveness through improved coordination and decision-making (Nsubuga, White, & Thacker, 2021; Akinyemi, Afolabi, & Awolude, 2022; Gebremariam, Alemu, & Desta, 2023). Nonetheless, several studies note that infrastructural limitations, weak institutional support, and limited technical capacity continue to constrain the full realisation of these benefits, particularly in rural and low-resource settings (Njuguna, Wangai, & Karanja, 2020; Ojo, Adeyemi, & Salawu, 2020).

2.4 Research Gap

While the reviewed literature establishes strong evidence for the individual roles of ICT availability, accessibility, and utilization, most studies examine these components in isolation, focus on disease surveillance to the relative neglect of disease notification, and are situated at national or state level rather than the LGA level where routine data collection and reporting actually occur. There is, in particular, limited empirical evidence that simultaneously tests the combined and comparative influence of ICT availability, accessibility, and utilization on surveillance and notification effectiveness within a single, localised analytical framework grounded in socio-technical theory. This study addresses that gap using Ibadan North LGA, Oyo State, as its empirical setting.

3. MATERIALS AND METHODS

3.1 Research Design and Setting

A descriptive cross-sectional survey design was adopted, permitting the systematic collection of quantitative data from a defined population at a single point in time. The study was conducted in Ibadan North Local Government Area of Oyo State, Nigeria, across health facilities spanning four categories: tertiary (e.g., University College Hospital, Institute of Child Health, Kola Daisi Clinic, Jaja Clinic), secondary (e.g., Adeoyo Maternity Teaching Hospital, Polytechnic Clinic), 20 primary healthcare centres, and 8 private hospitals.

3.2 Population, Sample Size, and Sampling Technique

The target population comprised 2,424 healthcare professionals directly involved in disease surveillance and notification activities across the selected facilities, including medical doctors, nurses/midwives, Community Health Officers, Community Health Extension Workers, medical laboratory personnel, Health Information Managers, ICT personnel, Disease Surveillance and Notification Officers (DSNOs), and physiotherapists (Table 1).

Table 1. Population distribution by health facility category.

Health Facility Category	Population
Tertiary Hospitals	1,684
Secondary Hospitals	449
Primary Health Centres	235
Private Hospitals	56
Total	2,424

Source: Field data (2026).

The sample size was determined using the Cochran (1977) formula for large populations, $n_0 = Z^2pq/d^2$, with Z = 1.96, p = q = 0.5, and d = 0.05, giving $n_0 \approx 384$. This was adjusted for the known finite population (N = 2,424) using $n = n_0/[1 + (n_0-1)/N]$, giving $n \approx 332$, and further adjusted for an anticipated 10% non-response rate (n/0.9), yielding a final sample size of 370. A multistage sampling technique was applied: Stage 1 stratified health facilities into tertiary, secondary, primary, and private categories; Stage 2 allocated the sample proportionally to each stratum using $n_h = (N_h/N) \times n$; and Stage 3 selected individual respondents within each facility by simple random sampling among eligible staff (Table 2). Detailed facility-level allocations are available from the corresponding author on request.

Table 2. Proportional sample allocation by facility category.

Facility Category	Population	Sample
Tertiary Hospitals	1,684	257
Secondary Hospitals	449	69
Primary Health Centres	235	36
Private Hospitals	56	8
Total	2,424	370

Source: Field data (2026).

3.3 Research Instrument, Validity, and Reliability

Data were collected using a structured, self-administered questionnaire comprising seven sections: (A) socio-demographic characteristics; (B) availability of ICT tools; (C) accessibility of ICT; (D) utilization of ICT; (E) effect of ICT on surveillance and notification reporting; (F) challenges associated with ICT utilization; and (G) strategies for improving ICT-driven surveillance. Sections B-G were measured on a 5-point Likert scale (Strongly Agree/Highly Available = 5 to Strongly Disagree/Not Available = 1). Content and face validity were established through expert review by specialists in Health Information Management and Public Health, leading to rephrasing of ambiguous items and improved structure. A pilot study among 20 healthcare workers in the neighbouring, non-study Akinyele

LGA yielded an overall Cronbach's alpha of 0.82, exceeding the 0.70 acceptability threshold (Table 3).

Table 3. Reliability (Cronbach's alpha) of the research instrument. (pilot study)

Section	Variable Measured	No. of Items	Cronbach's Alpha
B	Availability of ICT Tools	8	0.82
C	Accessibility of ICT Tools	8	0.79
D	Utilization of ICT Tools	8	0.85
E	Effectiveness (Timeliness & Accuracy)	8	0.81
	Overall Instrument		0.82

3.4 Data Collection Procedure

Following institutional and facility-level ethical approval and informed consent, the researcher administered questionnaires directly to eligible healthcare workers at the selected facilities, retrieving completed copies immediately to minimise data loss and clarifying item meaning where necessary.

3.5 Data Analysis

Data were coded and analysed in SPSS version 29. Descriptive statistics (frequencies, percentages, means, and standard deviations) summarised demographic characteristics and Likert-scale responses, with a criterion mean of 3.00 (the scale midpoint) used as the decision benchmark: mean scores ≥ 3.00 indicated agreement/availability and scores < 3.00 indicated disagreement. Pearson Product-Moment Correlation (PPMC) was used to test the three research hypotheses linking ICT availability, accessibility, and utilization to surveillance and notification effectiveness, at a 0.05 significance level.

3.6 Ethical Considerations

Approval was obtained from the appropriate authorities in the selected health facilities before data collection. Participation was voluntary, informed consent was obtained from all participants, and no personal identifiers were collected; confidentiality and anonymity were strictly maintained throughout.

4. RESULTS

4.1 Response Rate

Of 370 questionnaires administered, 340 were correctly completed and returned, a response rate of 92% (Table 4).

Table 4. Response rate.

Response Description	Frequency	Percentage (%)
Returned Questionnaires	340	92
Not Returned	30	8
Total	370	100

Source: Fieldwork (2026).

4.2 Demographic Characteristics of Respondents

Females constituted the majority of respondents (80.0%), reflecting the gendered structure of the frontline healthcare workforce. Most respondents were aged 30-39 years (41.2%), Nurses/Midwives (33.8%), held OND/Technician qualifications (44.1%), had fewer than 10 years of experience (67.7% combined), and were drawn from tertiary hospitals (55.9%) (Table 5).

Table 5. Demographic characteristics of respondents. (N = 340)

Variable	Category	Frequency (n)	Percentage (%)
Sex	Male	68	20.0
	Female	272	80.0
Age (years)	20–29	100	29.4
	30–39	140	41.2
	40–49	70	20.6
	50 and above	30	8.8
Profession	Medical Doctors	35	10.3
	Nurses/Midwives	115	33.8
	Community Health Officers	28	8.2
	Community Health Extension Workers	40	11.8
	Medical Laboratory Personnel	22	6.5
	Health Information Managers	30	8.8
	ICT Personnel	25	7.4
	DSNOs	30	8.8
	Physiotherapists	15	4.4
Years of Experience	< 5 years	120	35.3
	5–10 years	110	32.4
	11–15 years	60	17.6
	> 15 years	50	14.7
Educational Qualification	OND/Technician	150	44.1
	HND	110	32.4
	BSc	70	20.6
	Postgraduate	10	2.9
Facility Category	Tertiary Hospitals	190	55.9
	Secondary Hospitals	80	23.5
	Primary Health Centres	50	14.7
	Private Hospitals	20	5.9

Source: Fieldwork (2026).

4.3 Availability of ICT Tools and Infrastructure

All eight items measuring ICT availability recorded mean scores above the 3.00 benchmark, indicating general availability. Smartphones/mobile devices recorded the highest mean (3.88), followed by computers (3.79) and reliable electricity supply the lowest (3.46), though still within the 'available' range (Table 6).

Table 6. Availability of ICT tools and infrastructure. (N = 340)

Item	HA	A	MA	SA	NA	Mean	SD	Decision
Desktop/laptop computers available	110	120	60	30	20	3.79	1.03	Available
Internet services available	95	110	70	40	25	3.62	1.09	Available
Smartphones/mobile devices available	130	110	50	30	20	3.88	1.01	Available
e-IDSR platform available	90	115	65	40	30	3.57	1.12	Available
DHIS2 platform available	100	110	60	40	30	3.62	1.11	Available
Reliable electricity supply available	85	100	75	45	35	3.46	1.15	Available
Data storage facilities available	95	105	70	40	30	3.57	1.12	Available
Communication devices available	70	95	80	55	40	3.29	1.18	Available

Source: Fieldwork (2026). Decision rule: mean ≥ 3.00 = Available.

4.4 Accessibility of ICT Tools and Infrastructure

Accessibility indicators ranged from 3.32 to 3.78, all above the agreement threshold. Technical support (3.78) and ease of access to ICT tools (3.75) were rated most favourably, while the statement that current access enables effective performance recorded the lowest, though still positive, mean (3.32) (Table 7).

Table 7. Accessibility of ICT tools and infrastructure. (N = 340)

Item	SA	A	U	D	SD	Mean	SD	Decision
ICT tools easily accessible for surveillance activities	110	120	50	35	25	3.75	1.07	Agree
Authorised access to e-IDSR/DHIS2 platforms	100	115	60	40	25	3.66	1.09	Agree
Internet connectivity sufficiently accessible	95	110	65	45	25	3.60	1.10	Agree
ICT facilities accessible without administrative delay	90	110	70	45	25	3.57	1.11	Agree
Shared ICT resources accessible when required	85	105	75	45	30	3.50	1.13	Agree
Technical support readily accessible	120	110	50	35	25	3.78	1.05	Agree
Adequate access opportunities during working hours	80	100	80	50	30	3.44	1.15	Agree
Current access level enables effective performance	70	95	85	55	35	3.32	1.18	Agree

Source: Fieldwork (2026). Decision rule: mean ≥ 3.00 = Agree (Accessible).

4.5 Utilization of ICT in Disease Surveillance and Notification

Utilization scores ranged from 3.44 to 3.89, with the routine use of ICT for data collection (3.89) and disease notification (3.79) rated most highly, while receipt of surveillance feedback through ICT platforms recorded the lowest mean (3.44) (Table 8).

Table 8. Utilization of ICT in disease surveillance and notification. (N = 340)

Item	SA	A	U	D	SD	Mean	SD	Decision
Regularly use ICT to collect surveillance data	120	115	55	30	20	3.89	1.02	Agree
Use electronic platforms to notify reportable diseases	110	120	60	30	20	3.79	1.03	Agree
Use ICT to transmit reports to higher authorities	95	110	75	35	25	3.63	1.09	Agree
Use ICT to retrieve surveillance information	90	115	80	35	20	3.65	1.07	Agree
ICT is primary means of reporting surveillance data	105	120	60	30	25	3.74	1.05	Agree
Use ICT to monitor disease trends/outbreaks	125	110	50	30	25	3.82	1.04	Agree
Receive surveillance feedback through ICT platforms	80	95	90	45	30	3.44	1.15	Agree
Competent in using ICT applications for surveillance	115	120	55	30	20	3.82	1.03	Agree

Source: Fieldwork (2026). Decision rule: mean ≥ 3.00 = Agree (High Utilization).

4.6 Effect of ICT Utilization on Disease Surveillance and Notification Reporting

All eight effect items exceeded the 3.00 benchmark. ICT was perceived to most strongly improve data accuracy (3.83) and overall effectiveness (3.82), while its effect on decision-making during surveillance activities was comparatively, though still positively, rated (3.68) (Table 9).

Table 9. Effect of ICT utilization on disease surveillance and notification reporting. (N = 340)

Item	SA	A	U	D	SD	Mean	SD	Decision
ICT has improved timeliness of disease reporting	118	112	60	28	22	3.81	1.04	Agree
ICT has improved accuracy of surveillance data	122	115	50	30	23	3.83	1.03	Agree
ICT has reduced delays in disease notification	105	120	65	30	20	3.76	1.02	Agree
ICT has improved completeness of surveillance reports	110	118	60	30	22	3.78	1.04	Agree
ICT has enhanced early detection of outbreaks	100	115	70	35	20	3.71	1.06	Agree
ICT has improved inter-facility/authority communication	120	110	55	30	25	3.79	1.05	Agree
ICT has improved decision-making during surveillance	98	112	75	35	20	3.68	1.07	Agree
Overall, ICT has improved surveillance/notification effectiveness	115	120	55	30	20	3.82	1.03	Agree

Source: Fieldwork (2026). Decision rule: mean ≥ 3.00 = Agree (High Effect).

4.7 Challenges Associated with ICT Utilization

Insufficient funding (3.86) and poor internet connectivity (3.84) were the most strongly endorsed barriers, followed by unstable electricity (3.82) and frequent software/hardware failure (3.80); resistance to adopting new ICT systems recorded the lowest, though still significant, mean (3.50) (Table 10).

Table 10. Challenges associated with ICT utilization in disease surveillance and notification. (N = 340)

Item	SA	A	U	D	SD	Mean	SD	Decision
Poor internet connectivity affects ICT utilization	127	109	48	34	22	3.84	1.06	Agree
Unstable electricity supply affects ICT utilization	121	113	52	31	23	3.82	1.07	Agree
Inadequate ICT equipment limits surveillance activities	108	117	63	29	23	3.76	1.08	Agree
Lack of adequate ICT training affects utilization	102	111	71	33	23	3.69	1.10	Agree
Limited technical support affects ICT performance	97	119	66	34	24	3.68	1.09	Agree
Insufficient funding affects ICT implementation	132	107	46	33	22	3.86	1.05	Agree
Frequent software/hardware failures disrupt reporting	114	118	57	29	22	3.80	1.06	Agree
Resistance to adopting new ICT systems	88	101	79	39	33	3.50	1.14	Agree

Source: Fieldwork (2026). Decision rule: mean ≥ 3.00 = Agree (High Challenge).

4.8 Strategies for Improving ICT Utilization

All proposed strategies recorded high mean scores (3.79-3.89), with reliable internet services (3.89), regular ICT training (3.88), and increased ICT equipment provision (3.86) rated most strongly (Table 11).

Table 11. Strategies for improving ICT utilization in disease surveillance and notification. (N = 340)

Item	SA	A	U	D	SD	Mean	SD	Decision
Government should provide more ICT equipment	129	112	46	31	22	3.86	1.05	Agree
Regular ICT training should be organized	133	109	44	32	22	3.88	1.04	Agree
Reliable internet services should be provided	137	105	43	33	22	3.89	1.03	Agree
Stable electricity supply should be ensured	126	111	52	30	21	3.84	1.06	Agree
Government should allocate more funds for ICT	131	108	48	32	21	3.85	1.05	Agree
Routine maintenance of ICT equipment strengthened	122	114	51	31	22	3.80	1.06	Agree
Continuous technical support should be provided	128	110	49	31	22	3.83	1.05	Agree
Regular monitoring/evaluation of ICT systems	119	112	58	30	21	3.79	1.07	Agree

Source: Fieldwork (2026). Decision rule: mean ≥ 3.00 = Agree (High Acceptance).

4.9 Test of Hypotheses

Hypothesis One tested the relationship between ICT availability and effectiveness. Pearson correlation revealed a strong, positive, statistically significant relationship ($r = 0.611$, $n = 170$, $p < 0.001$), leading to rejection of the null hypothesis (Table 12).

Table 12. Correlation between ICT availability and effectiveness. (H_{01})

Variables	ICT Availability	Effectiveness
ICT Availability	1.000	0.611
Effectiveness	0.611	1.000
Sig. (2-tailed)	—	< 0.001
N	170	170

Note: $p < 0.05$. Decision: H_{01} rejected — significant relationship confirmed.

Hypothesis Two tested the relationship between ICT accessibility and effectiveness. A moderately strong, positive, statistically significant relationship was found ($r = 0.645$, $n = 170$, $p < 0.001$), and the null hypothesis was rejected (Table 13).

Table 13. Correlation between ICT accessibility and effectiveness. (H_{02})

Variables	ICT Accessibility	Effectiveness
ICT Accessibility	1.000	0.645
Effectiveness	0.645	1.000
Sig. (2-tailed)	—	< 0.001
N	170	170

Note: $p < 0.05$. Decision: H_{02} rejected — significant relationship confirmed.

Hypothesis Three tested the relationship between ICT utilization and effectiveness. A strong, positive, statistically significant relationship was found ($r = 0.682$, $n = 170$, $p < 0.001$), the strongest of the three tested relationships, and the null hypothesis was rejected (Table 14).

Table 14. Correlation between ICT utilization and effectiveness. (H_{03})

Variables	ICT Utilization	Effectiveness
ICT Utilization	1.000	0.682
Effectiveness	0.682	1.000
Sig. (2-tailed)	—	< 0.001
N	170	170

Note: $p < 0.05$. Decision: H_{03} rejected — significant relationship confirmed.

Collectively, these results indicate that ICT availability, accessibility, and utilization are all significant, positive predictors of disease surveillance and notification effectiveness in Ibadan

North LGA, with utilization exerting the strongest influence, followed by accessibility and then availability.

5. DISCUSSION

This study assessed the availability, accessibility, and utilization of ICT and their effects on disease surveillance and notification effectiveness in Ibadan North LGA. The female-dominated, relatively young (20-39 years), and multidisciplinary composition of the sample is consistent with the structure of Nigeria's frontline healthcare workforce and supports Mwangi et al. (2022), who found younger workers more receptive to ICT-driven systems, and Kiberu, Matovu, and Makumbi (2021), who emphasised the value of clinical-technical collaboration in surveillance.

The finding that ICT tools, particularly mobile devices and computers, were generally available is consistent with Ouma, Were, and Muturi (2021) and Mensah and Boateng (2022), while the comparatively lower mean for reliable electricity supply corroborates Karuri et al. (2021), who identified unstable power as a persistent constraint on ICT-enabled health systems in developing countries. Similarly, generally favourable accessibility ratings align with Adebayo, Salami, and Oladipo (2021), though variation across items reflects the facility-level disparities documented by Kariuki, Muthoni, and Njoroge (2023).

High utilization scores, particularly for routine data collection and disease notification, corroborate Okon, Johnson, and Effiong (2021) and Mwangi et al. (2022), and the comparatively lower score for receiving structured feedback through ICT platforms suggests that current systems remain oriented toward upward reporting rather than two-way communication, a weak feedback loop that STS theory identifies as a barrier to sustained compliance and data quality. The strong positive effect of ICT utilization on timeliness, accuracy, completeness, and overall effectiveness is consistent with Akinyemi, Afolabi, and Awolude (2022) and Kiberu et al. (2021), while the comparatively lower rating for ICT's effect on decision-making support suggests that, as in the EMR-adoption literature more broadly, operational use of ICT (reporting, communication) is more mature than its analytical use (data-driven decision-making).

The hierarchy of correlation strengths, utilization ($r = 0.682$) exceeding accessibility ($r = 0.645$), which in turn exceeds availability ($r = 0.611$), offers an important theoretical and practical insight: merely providing ICT infrastructure is necessary but not sufficient. This finding lends strong empirical support to the Socio-Technical Systems perspective, which holds that technology's contribution to system performance is mediated by the extent to

which it is actually accessed and used by the social subsystem, and echoes the findings of Ouma et al. (2021) and Adebayo et al. (2021), who similarly reported that access and use, more than mere presence of infrastructure, determine surveillance outcomes. The identification of insufficient funding, poor connectivity, unstable power, and inadequate training as leading barriers is consistent with Karuri et al. (2021) and Mensah and Boateng (2022) and indicates that these systemic constraints operate as a ceiling on the benefit that availability, accessibility, and utilization can jointly deliver.

6. CONCLUSION

This study set out to assess the role of ICT in disease surveillance and notification in Ibadan North Local Government Area of Oyo State and found that ICT tools are generally available and accessible, and are actively utilised by healthcare professionals for disease reporting, communication, and monitoring, with statistically significant positive relationships confirmed between each of ICT availability, accessibility, and utilization and the effectiveness of disease surveillance and notification, with utilization exerting the strongest influence. At the same time, the study found that these benefits are not yet fully realised, being constrained by insufficient funding, unreliable internet connectivity and electricity supply, inadequate ICT training, and limited technical support, and that ICT's contribution to routine reporting functions is currently more developed than its contribution to analytical, feedback, and decision-support functions. Taken together, these findings demonstrate that ICT is a critical and empirically validated enabler of effective disease surveillance and notification at the Local Government Area level, but that its full public health value in Ibadan North LGA, and by extension in comparable Nigerian LGAs, depends on parallel and sustained investment in infrastructure, funding, human capacity, and institutional support rather than on the provision of technology alone.

7. RECOMMENDATIONS

Based on the findings, the following five recommendations are made, each specifying the responsible party and the corresponding action:

1. Oyo State Ministry of Health: should prioritise the provision and equitable distribution of ICT infrastructure, including functional computers, mobile devices, and reliable internet connectivity, across all tertiary, secondary, primary, and private health facilities in Ibadan North LGA, with particular attention to facilities currently reporting the lowest availability scores.

2. Ibadan North Local Government Health Authority and Disease Surveillance and Notification Officers (DSNOs): should streamline and simplify administrative reporting channels to reduce bureaucratic bottlenecks between health facilities and higher surveillance authorities, and should strengthen feedback mechanisms so that reporting facilities routinely receive structured feedback through ICT platforms.

3. Department of Public Health and Disease Control Units, in collaboration with Health Information Management training providers: should implement regular, structured capacity-building programmes for health personnel on digital reporting systems (e-IDSR, DHIS2), data management, and analytical use of surveillance platforms, moving ICT use beyond routine reporting toward decision support.

4. Federal Ministry of Health, in collaboration with the National Information Technology Development Agency and telecommunication service providers: should develop and enforce policy promoting standardised, interoperable digital surveillance platforms and should partner with telecommunication providers to expand network coverage and internet reliability within Ibadan North LGA and comparable LGAs.

5. Health facility administrators, supported by donor agencies and non-governmental organisations: should ensure routine maintenance of ICT equipment, provide on-site technical support to reduce system downtime, and mobilise supplementary funding and technical assistance to close the resource gaps identified as the leading barriers to ICT utilization.

8. Implications of the Study

The findings carry several practical and policy implications. First, because ICT utilization is the strongest predictor of surveillance effectiveness, initiatives that provide infrastructure without corresponding investment in training and institutional support are unlikely to achieve their intended public health benefit; policy and funding priorities should therefore be rebalanced toward accessibility and utilization, not availability alone. Second, the weaker performance of ICT in supporting feedback and decision-making relative to routine reporting suggests that Local Government-level surveillance systems currently function primarily as one-way data conduits; strengthening two-way feedback loops is likely to improve both data quality and workforce compliance, consistent with the Socio-Technical Systems perspective. Third, the identification of funding, connectivity, and power supply as the leading barriers indicates that infrastructural constraints specific to Nigeria's public-sector operating environment, rather than workforce attitude, are the primary obstacles to optimal ICT performance, implying that policy interventions should prioritise infrastructure and financing

over persuasion-based adoption campaigns. Fourth, for health informatics research and practice in similar sub-Saharan African LGA settings, the study demonstrates the value of examining ICT availability, accessibility, and utilization as distinct but interrelated constructs, since their differential strength of association with effectiveness has direct implications for how limited public health resources should be sequenced and allocated.

9. Contributions to Knowledge

1. Provision of the first empirically grounded, statistically validated assessment of ICT availability, accessibility, and utilization as distinct, comparatively ranked predictors of disease surveillance and notification effectiveness at the Local Government Area level in Nigeria, extending a literature previously concentrated at national or state level.
2. Empirical demonstration, through comparative correlation analysis, that ICT utilization exerts a stronger influence on surveillance effectiveness than either availability or accessibility, providing quantitative support for the Socio-Technical Systems proposition that technology's value is realised through use rather than mere presence.
3. Integrated application of Socio-Technical Systems Theory and Health Information Systems Theory to a routine, non-outbreak, LGA-level surveillance and notification context, offering an analytical framework transferable to other Nigerian and sub-Saharan African LGAs.
4. Generation of context-specific, multistage-sampled evidence spanning tertiary, secondary, primary, and private health facilities within a single urban LGA, together with a validated 48-item survey instrument (CSADSQ-type structure, overall alpha = 0.82) that can be adapted for surveillance-system assessment in comparable settings.

10. Limitations of the Study

This study has several limitations. First, it relies on self-reported perceptions of ICT availability, accessibility, utilization, and effectiveness rather than objective system audit data, and is therefore subject to possible response bias. Second, although the sampling frame covered tertiary, secondary, primary, and private facilities, logistical and resource constraints meant that not all private health facilities in the LGA could be included, potentially narrowing the range of perspectives captured. Third, the cross-sectional design captures a single point in time and cannot establish causality between ICT use and surveillance effectiveness, nor track change over time. Fourth, infrastructural conditions such as electricity and internet connectivity prevailing at the time of data collection may themselves have shaped both ICT utilization and respondents' perceptions, introducing a contextual

dependency. Finally, the findings are specific to Ibadan North LGA and may not be fully generalisable to LGAs with different infrastructural, administrative, or demographic profiles; comparative multi-LGA and longitudinal studies are recommended to build on these findings.

Author Contributions

Adeyinka Adebimpe Olubisi: Conceptualisation, methodology, investigation, formal analysis, data curation, writing — original draft, writing — review and editing. Adebayo T. T.: Supervision, conceptualisation, validation, writing — review and editing. Oyekanmi E. O.: Co-supervision, methodology review, validation, writing — review and editing. All authors read and approved the final manuscript.

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Conflict of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Data Availability Statement

The datasets generated and/or analysed during the current study are available from the corresponding author on reasonable request, subject to institutional ethical approval and participant confidentiality safeguards.

Ethical Approval

This study was conducted in accordance with institutional ethical guidelines. Approval and permission were obtained from the management of the selected health facilities in Ibadan North Local Government Area, and informed consent was obtained from all individual participants included in the study.

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