Assessment of Attitude, Usability, and Sustainability of e-health technologies in selected health facilities in Imo State, Nigeria

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Abstract- The integration of e-health technologies in healthcare systems offers transformative opportunities to enhance service delivery, accessibility, and efficiency. This study assessed the awareness, availability, usability, and sustainability of e-health technologies among healthcare workers in Imo State, Nigeria. A mixed-methods, cross-sectional study was conducted involving 579 health workers and 16 policymakers from six hospitals. Quantitative data were analyzed using descriptive statistics and chi-square tests, while qualitative data underwent thematic analysis. The majority of respondents (55.4%) were very familiar with e-health technologies, with Electronic Health Records (31.1%) and Health Information Systems (26.3%) being the most common. However, the usability of e-health technologies was sporadic and inconsistent, with 81.7% of respondents not using them regularly. Despite challenges, 92.7% of respondents supported the ongoing use and integration of e-health technologies, and 90.8% believed in their sustainability. Increased training (91.7%) was identified as the most crucial factor in enhancing support. A strong association was found between the current state of electronic devices and personal use of e-health technologies (p=0.001). Key barriers included a lack of formal training, maintenance issues, internet connectivity, and limited awareness of government policies supporting e-health sustainability. The study highlights the need for comprehensive policies, financial support, and advocacy to ensure the long-term sustainability of e-health technologies in Imo State, Nigeria.

Indexed Terms- E-health technologies, healthcare workers, Electronic Health Records, Health Information Systems, sustainability

I. INTRODUCTION

The integration of e-health technologies into healthcare systems presents a transformative opportunity to enhance the delivery, accessibility, and efficiency of medical services, particularly in resource-constrained settings such as Imo State, Nigeria. E-health, encompassing a wide array of digital tools and applications, holds the potential to bridge geographical barriers, improve data management, facilitate remote monitoring, and empower both healthcare providers and patients (1). The advent of e-Health, which involves using ICT across various health-related activities, holds significant potential for enhancing healthcare delivery in Nigeria(2). However, the adoption of e-Health solutions has been sluggish, mainly because of a dependence on paper-based systems and insufficient infrastructure for digital record-keeping[5]. A major obstacle to effectively using e-Health technologies in Nigeria's healthcare sector is the socio-demographic differences among healthcare professionals in terms of their understanding and perceptions of these technologies.

Implementing e-Health Systems has shown significant potential in addressing systemic healthcare issues, such as geographic barriers that hinder patients from accessing necessary services. Innovative e-Health applications, including digital health platforms and electronic health records, can streamline processes and improve the efficiency of health services, thereby contributing to the achievement of Universal Health Coverage (UHC) goals in Nigeria (3).

However, the successful implementation and sustained adoption of e-health solutions hinge on a complex interplay of factors, including the attitudes of healthcare professionals, the usability of the technologies, and the long-term sustainability of the implemented systems(4). Despite the globally recognized potential of e-health applications, a significant gap persists between theoretical benefits and empirically demonstrated outcomes, indicating that the mere technical capability of these applications does not guarantee their effective integration into healthcare practices(4). A crucial aspect often overlooked is the socio-technical dimension of e-health implementation, where inadequate attention can lead to unforeseen risks to patients and hinder the overall success of the technology(5).

Therefore, a holistic assessment of these critical dimensions is essential to inform strategic decision-making and ensure the effective and equitable integration of e-health technologies within the secondary and tertiary healthcare landscape for effective service delivery.

II. MATERIALS AND METHODS

A descriptive cross-sectional study was conducted between January to December 2024 among 579 health workers and 16 policymakers for the mixed study on the makerson the awareness, availability, usability, and sustainability of e-health technologies among health workers in Imo State. A mixed method was adopted for this research for the health facilities-based study.

The areas of study are six hospitals which include: Federal University Teaching Hospital Owerri, Imo State Specialist Hospital Owerri, Imo State University Teaching Hospital Orlu, Awo mama General Hospital, Oru East, Okigwe General Hospital, and Ihitte Uboma General Hospital. They are both tertiary and secondary health facilities with over 1005 beds. The tertiaries are also a training institution for medical students, nursing students, and medical laboratory science students among others. Generally, the hospital renders primary as well as specialist services to those in need within and outside Imo State. Being top six public health facilities in the state, the tertiary receives clients directly and referrals from the general hospital and nooks and crannies of the 27 local Government areas of Imo State and beyond.

A simple random sampling method was employed to select the public hospitals for this study considering the high volume of patient flow, both tertiary and secondary health facilities were included in the study for the six health facilities (two tertiary and four secondary) making two health facilities per-geopolitical zone for the three zones in the state.

The collected data was analyzed using SPSS Statistics version 21 and Microsoft Excel. Descriptive statistical methods, including frequency distribution and percentages, was used to summarize the data characteristics. Frequency distribution tables was constructed for all categorical variables and expressed as percentages.

Advanced statistical analyses like chi-square tests were employed to explore relationships between variables. Significance levels was interpreted using a p-value threshold of <0.05. For qualitative data, thematic analysis was applied after transcription to identify recurring themes and patterns. Coding techniques categorized and interpreted findings to enable a nuanced understanding of the study's qualitative aspects.

The qualitative data were analyzed using thematic analysis, where responses were transcribed and grouped into categories. Codes were generated to capture key concepts, which were further organized into overarching themes. Supporting quotes from respondents were included to illustrate and validate these themes, providing a deeper understanding of the findings.

Ethical Considerations and Informed Consent

The parameters of the Declaration of Helsinki were adhered to in carrying out this study. The Declaration of Helsinki is a set of ethical guidelines developed by the World Medical Association (WMA) to guide research involving human participants. Firstly, an introduction letter was obtained from the department of Public Health, Federal University of Technology, Owerri (FUTO), and a request letter for ethical approval for this study was developed and submitted to the Department of Planning, Research, and Statistics, Imo State Ministry of Health along with the project proposal. Having shown through my proposal that all procedures involving human subjects would be rigorously followed during the study and confidentiality ensured, ethical approval was granted by the ethical committee of the Imo State Ministry of Health, Owerri.

In line with the parameters of the Helsinki declaration which includes respect for human subjects and voluntary participation, participants were requested to give consent to take part in this study and participants who did not give consent were excluded from this study and their reason for not consenting wasn't requested. To get respondents informed consent, a consent page was presented before the researcher administered the questionnaire.

III. RESULTS

Table 1: Demographic status of the responents

Variables	Frequency (N=579)	Percentage
Sex		
Male	256	44.2
Female	323	55.8
Years of existence in the facility		
1-5 years	72	12
11-15 years	139	24
16-20 years	129	22
21 years and above	79	14
6-10 years	160	28
Highest Level of Education		
BSc	137	23.7
Diploma	71	12
MSc	201	34.7
MD	179	30.9
PhD	5	3
WAEC	9	2

The table presents demographic information from 579 participants, with a higher proportion of females (55.8%) compared to males (44.2%). The majority of respondents had 6-10 years of experience (28%), followed by those with 11-15 years (24%). Education levels were notably high, with MSc (34.7%) and MD (30.9%) being the most prevalent. However, there are some concerns: the experience categories are not in sequential order (ideally 1-5, 6-10, etc.), and the education percentages add up to 105.3%, likely due to rounding errors. The inclusion of WAEC (secondary certificate) is unusual for healthcare professionals. Overall, the data indicates a well-educated and experienced workforce, but it requires verification for accuracy.

Table 2: Attitude of Participants Toward E-Health Technologies

Variable	Frequency (N=579)	Percent (%)
In your opinion, can E-health technologies improve healthcare delivery?		
Neutral	531	92.0
Not sure	45	8.0
Strongly disagree	3	1.0
Do you think e-health technologies can improve healthcare delivery?		
No	11	2.0
Yes	568	98.0
On a scale of 1-5, how open are you to adopting e-health technologies in your practice?		
I don't care about health	12	2.0
Not interested	7	1.0
Very much interested	560	97.0
How do you perceive your colleagues' willingness to embrace and utilize e-health technologies?		
I'm not sure	62	11.0
Not willing	8	1.0
Somewhat willing	123	21.0
Very willing	386	67.0

The table 2 results showed that a majority of respondents 55.4% are very familiar with e-health technologies in their facilities, though some 16.9% are not familiar with it.

Electronic Health Records 31.1% and Health Information Systems 26.3% are the most common e-health technologies. E-health implementation relies on desktops 29.4%, laptops 16.9%, tablets 26.8%, and mobile apps 26.9%. While most electronic devices are functional 57.3%, a significant portion is damaged 22.3% slightly, and 20.4% completely. E-health technologies mainly function both online and offline 61.8%. Internet availability varies, with 61.0% having enough data, but 14.6% having no connection. Internet provision is shared between facility management 56.8%, healthcare workers, and partners. Service disruptions due to poor networks occur, ranging from rarely 28.8% to many times a day 18.0%. E-health availability is not uniform across all departments 54.9%, with certain units like Consulting Clinics 25.5% and HIV/AIDS Treatment Clinics 33.9% having more access. In many facilities, 57.0% have recently introduced new e-health technologies. Overall, there's strong support for e-health implementation 92.7% and perceived sustainability 90.8%. Increased training 91.7% is the top factor in enhancing support, but there's low awareness of government initiatives 82.0%.

Table 3: Useability of E-Health Technologies

Variables	Frequency (579)	Percent
How often are e-health technologies used in your facility?		
Monthly	14	2.4
On a need basis	214	4.7
Daily	334	5.9
Two to three times a week	11	1.9
Weekly	12	2.1
Are there specific units or departments where e-health technologies are more readily used?		
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No	128	39.4
Yes	451	60.6
If yes, please specify the units/departments		
Emergency & Intensive care unit	81	18.0
In-Patient Wards	51	11.3
Pharmacy	29	6.4
X-ray department	34	7.5
Accounting unit	75	16.6
Outpatient Department	45	10.0
Laboratory	25	5.5
Health & Medical Records	111	24.6
How do you rate the user-friendliness of e-health technologies used in your facility?		
Not user friendly	113	19.5
Partially user friendly	203	35.0

Very user friendly	263	45.4
Do you personally use e-health technologies in your daily work in your facility?		
No	106	18.3
Yes	473	81.7
If yes, how often do you encounter challenges while using e-health technologies in your daily practice?		
Hardly	8	1.7
Never	34	7.2
Occasionally	85	17.9
Often	110	23.3
Very often	224	47.4
If yes, Do you experience difficulty in logging in to e-health technologies used in your health facility?		
No	125	26.4
Yes	348	73.6
In your opinion, have e-health technologies made healthcare delivery in your facility more efficient		
I'm not sure	146	25.2
No	55	9.5
Yes	378	65.3
Have you observed any positive changes in patient care resulting from e-health technologies?		
No change	79	13.6
Yes, significant improvement	349	60.3
Yes, some improvement	151	26.1

Table 3, the usability of e-health technologies is explored. Most respondents (81.7%) use e-health technologies in their daily work, with only 18.3% indicating non-regular use. For those who do use these technologies, many encounter occasional challenges (10.7%), and a notable portion (9.8%) experience difficulties logging in. Despite these challenges, 13.5% of respondents report that e-health technologies have made healthcare delivery more efficient, and 8.5% observe significant improvements in patient care.

Table 4: Sustainability of E-Health Technologies

Variables	Frequency (579)	Percent
Are you in support of the continued implementation and integration of e-health technologies in your facility?		
I don't care if e-health is used or not	7	1.2
No	35	6.0

Yes	537	92.7
Do you think e-health technologies can be sustained and maintained in your healthcare facility?		
No	53	9.2
Yes	526	90.8
What changes or improvements could enhance your support for e-health technologies in your workplace?		
Increased training	531	91.7
Improved user-friendliness	141	24.4
More resources	153	26.4
No change needed	11	1.9
Are you aware of any government policies or initiatives aimed at ensuring the long-term sustainability of e-health technologies in your health facility?		
No	475	82.0
Yes	104	18.0

Table 4, a large majority, 92.7%, showed support for the ongoing use and integration of e-health technologies in their facilities, reflecting a strong positive response. This is in contrast to a small minority who were either indifferent (1.2%) or opposed (6.0%). Additionally, the perception of sustainability is highly favorable, with 90.8% believing that e-health technologies can be maintained in their healthcare facilities, while only 9.2% expressed skepticism. When it comes to boosting support for e-health technologies, increased training was identified as the most crucial factor, mentioned by 91.7% of respondents. Other significant factors included enhanced user-friendliness (24.4%) and the allocation of more resources (26.4%). A mere 1.9% felt that no changes or improvements were needed. Interestingly, there seems to be a lack of awareness about government support for e-health, as 82.0% of respondents reported not knowing of any government policies or initiatives aimed at ensuring the long-term sustainability of e-health technologies in their health facilities, compared to only 18.0% who were aware.

Table 5: Bivariate Analysis of participant's current state of electronic devices used to implement e-health in their facilities and their personal use e-health technologies

Variables		Do you personally use e-health technologies in your facility		Chi-Square Value (X^2)	P-Value
	Categories	No	Yes		
What's the current State of electronic devices used to implement e-	Completely damaged and not in-use	12 (66.67%)	6 (33.33%)		
	Functional and In Use	17 (33.33%)	34 (66.67%)	128.42	0.0001

health in the facility?	Slightly damaged and in-use	14 (53.85%)	12 (46.15%)		

Table 5 analyzes the association between the current state of electronic devices in healthcare facilities and participants' personal use of e-health technologies. The chi-square value of 128.42 and p-value of 0.001 indicate a very strong association. Participants whose facilities have functional, and in-use electronic devices report higher personal use of e-health technologies (66.67%), whereas those in facilities with damaged devices have significantly lower usage rates. This finding emphasizes the importance of having functional electronic infrastructure in place to enable the effective use of e-health technologies.

IV. DISCUSSION

Despite gaps in knowledge, the overall attitude toward e-health technologies was overwhelmingly positive. Ninety-eight percent of respondents believed e-health could improve healthcare delivery, reinforcing a broad recognition of its potential. Qualitative findings echoed this sentiment, with participants emphasizing the role of e-health in enhancing healthcare efficiency and providing statewide benefits such as better data management for healthcare programs. These perceptions align with findings from(6), which suggest that Nigerian health workers recognize the transformative role of digital health solutions in improving patient care and reducing administrative burdens.

However, initial resistance to e-health adoption was noted, with some participants expressing hesitation about using new technologies. One respondent highlighted a U-curve pattern of adoption, where the initial reaction to e-health tools was rejection, followed by reluctant learning, and ultimately increased acceptance. This pattern is well-documented in healthcare settings, where professionals often exhibit cautiousness toward new technologies until they see their practical benefits(7).

A key barrier to adoption was the lack of formal training, with 83% of respondents reporting no training in e-health technologies in the past three years. This aligns with findings from(8), which noted that professional development opportunities for digital health remain limited in Nigerian healthcare settings(9). Additionally, concerns regarding technology maintenance were raised, with respondents highlighting delays in replacing faulty e-health equipment due to bureaucratic procurement processes.

The study also explored perceptions of peer adoption, finding that 67% of participants believed their colleagues were very willing to embrace e-health, while 21% reported that they were somewhat willing. This suggests that while there is broad acceptance, a segment of health workers remains hesitant, likely due to concerns about usability, infrastructure, and training gaps.

The usability of e-health technologies was reported as sporadic and inconsistent. A majority of respondents (81.7%) indicated they do not use e-health technologies regularly in their daily tasks, with only 5.9% using them daily and a further 4.7% on an as-needed basis. This reflects findings from (10), who noted that even when e-health tools are available, usability issues and insufficient training can limit their adoption. In the qualitative feedback, health workers noted challenges such as complex navigation and insufficient technical support, with one participant remarking, "If we encounter issues, it takes too long to get any technical support." This finding aligns with(11), who identified a lack of immediate help desks and insufficient user support as common challenges in low-resource settings.

Despite these challenges, some health workers appreciated the efficiency that e-health technologies could provide. For example, 14% of participants observed improvements in healthcare delivery, while 9% noted significant enhancements in patient care due to e-health. Key informants reported that "if it takes an hour to run a sample or do something analog, e-health does it in minutes." This positive perception is echoed in (12), who found that when functional and user-friendly, e-health solutions significantly reduce administrative burdens and improve patient care. This suggests that e-health technologies have the potential to enhance healthcare efficiency but require increased usability, training, and support for widespread adoption.

Internet connectivity and device maintenance were major barriers to e-health usability. Only 9% of respondents indicated consistent data availability, while 5% reported frequent service disruptions due to unstable networks. Furthermore, limited facility-provided internet access was a concern, with only 1.6% of respondents indicating that facility management reliably provides internet support. This is in line with(13) work, which identified poor internet connectivity and inadequate digital infrastructure as ongoing challenges in Nigerian healthcare facilities, particularly in rural areas.

The current state of electronic devices in healthcare facilities is strongly associated with personal use of e-health technologies (p=0.001). Participants in facilities with functional devices reported significantly higher personal usage rates (66.67%) compared to those with damaged or non-functional devices. This finding suggests that the functionality of electronic infrastructure is critical to enabling effective use of e-health technologies. In facilities where devices are "completely damaged and not in use," personal e-health engagement is notably lower, reflecting a barrier that could hinder both individual and facility-wide adoption of digital health tools. The importance of functional infrastructure aligns with research by(14), who found that even the most well-designed e-health systems face substantial challenges in settings where the technological infrastructure is unreliable or unavailable. Regular maintenance and upgrading of devices are essential to ensure healthcare workers can access and effectively use e-health resources in their daily routines.

A recurrent concern across both quantitative and qualitative data was the sustainability of e-health technologies. While enthusiasm for these technologies was high, issues of maintenance and availability were evident, with key informants expressing concerns over "technology maintenance" and the bureaucratic challenges involved in replacing broken equipment. This aligns with findings from (15), who observed that the lack of timely maintenance and the bureaucratic hurdles for procuring replacement equipment posed significant challenges to sustaining e-health initiatives in Nigerian hospitals.

Maintenance of devices and the availability of functioning technology were also issues, with some participants mentioning the burden of maintaining "slightly damaged and in-use" devices. Such findings resonate with(16), who observed that the longevity and functionality of e-health tools in African healthcare facilities were often compromised by budgetary constraints and delayed repairs, which ultimately hinder service continuity.

Furthermore, the findings show strong support for the continued integration of e-health technologies among healthcare workers, with 93% of respondents in favor of ongoing e-health implementation. Despite this, 82% of participants were unaware of any government policies or initiatives promoting long-term e-health sustainability, suggesting a significant policy awareness gap that may impact ongoing support and implementation. This is consistent with the findings of (17), who noted that although e-health support among Nigerian healthcare workers is high, awareness of supportive policies is lacking, which can undermine the confidence and momentum needed for long-term adoption.

91% of respondents believed that e-health could be maintained within their facilities, but they identified key improvements necessary for this. Increased training was the most frequently mentioned enhancement, with 92% of respondents citing this as essential. Qualitative feedback emphasized that ongoing "training and retraining" are necessary to sustain e-health use, especially given rapid advancements in digital healthcare tools. This resonates with the work of(18), who highlighted that the sustainability of e-health systems is heavily reliant on continuous capacity-building initiatives to keep healthcare workers adept with evolving technologies.

Moreover, participants stressed a need for greater financial and policy support to uphold e-health systems. The absence of effective government policies and financial backing was cited as a challenge, with some respondents expressing concern about a lack of funding to implement existing policies. As one participant put it, "The policy is there, but the financial strength to implement and achieve that goal is not there." This aligns with findings from(19), who found that policy existence without adequate funding and infrastructural support significantly limits the impact of e-health initiatives. Similarly, (20) argue that without dedicated funds and incentives, policies can become ineffective, reducing long-term sustainability prospects.

Another theme emerging from the qualitative data was the need for financial sustainability mechanisms, such as loans and grants from the government to support e-health infrastructure and maintenance. A participant mentioned that "it's not even easy to access loans" for e-health, calling for government intervention in the form of financial support and grants. This finding parallels the work of (21), who emphasized that financial constraints are a primary barrier to the sustainable integration of e-health technologies in Nigeria, especially in public healthcare facilities that depend on governmental or organizational funding.

A substantial proportion of respondents (82%) indicated they were unaware of policies for e-health sustainability. Some participants highlighted the need for advocacy to build awareness and mobilize support for these technologies. As one respondent shared, "We keep on advocating for support... it can't get damaged like hard copies." This reflects findings from (22), who emphasized the importance of advocacy and awareness campaigns to generate institutional and public support for e-health policies, which can help bridge gaps in policy knowledge and ensure broader buy-in.

The lack of comprehensive policies and the absence of active governmental support create obstacles to sustainability, as confirmed by(23). These authors argue that policies should not only be developed but should also include detailed frameworks for funding, maintenance, and training to ensure sustainability. By promoting sustained advocacy and mobilizing governmental and non-governmental resources, Nigeria could build a foundation that ensures e-health technologies are not only adopted but are durable and effective in the long term.

CONCLUSION

This study provides valuable insights into the current state of e-health technology adoption in Imo State, Nigeria. The findings reveal a generally positive attitude towards e-health among healthcare professionals, with strong support for its implementation and perceived potential to improve healthcare delivery. However, several challenges impede the full realization of e-health benefits, including inadequate infrastructure, inconsistent internet connectivity, and lack of formal training. The strong association between functional electronic devices and personal use of e-health technologies emphasizes the critical need for reliable infrastructure. To address this, policymakers should prioritize investments in robust technological infrastructure and ensure regular maintenance of existing systems. The identified gap in awareness of government policies supporting e-health sustainability highlights the need for improved communication and dissemination of information regarding e-health initiatives. Enhancing policy awareness could foster greater confidence and momentum for long-term adoption among healthcare workers. To improve usability and sustainability, increased training opportunities, enhanced user support, and the development of user-friendly interfaces should be prioritized. Additionally, establishing sustainable funding mechanisms and creating comprehensive policies that address implementation, maintenance, and ongoing support are crucial for the long-term success of e-health initiatives in Nigeria. Future research should focus on evaluating the impact of targeted interventions to address the identified challenges and on developing strategies to enhance the integration of e-health technologies into routine healthcare practices. By addressing these key areas, Nigeria can work towards realizing the full potential of e-health technologies in improving healthcare delivery and outcomes.

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