Assessment of Awareness and Availability of E-Health Technologies in Selected Health Facilities in Imo State

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Abstract- ***E-health technologies have the potential to revolutionize healthcare delivery, but their adoption and effectiveness in resource-limited settings like Nigeria remain understudied. This cross-sectional study assessed the awareness and availability of e-health technologies among 579 healthcare workers in selected health facilities in Imo State, Nigeria. While 70% of respondents were aware of e-health, only 46% understood the concept, and 24% admitted to knowing little about it. Awareness was significantly associated with facility level, years of experience, and educational attainment ($p<0.05$). Electronic health records (31.1%) and health information systems (26.3%) were the most common e-health technologies available, but overall availability was limited. Inadequate infrastructure, inconsistent internet connectivity, and insufficient maintenance posed significant barriers to e-health adoption. Although 57.3% of electronic devices were functional, 22.3% were slightly damaged, and 20.4% were completely damaged. Service disruptions due to poor network connectivity were frequent, ranging from rarely (28.8%) to many times a day (18.0%). E-health availability was not uniform across departments, with some units like consulting clinics (25.5%) and HIV/AIDS treatment clinics (33.9%) having more access. The study highlights the need for targeted training, improved infrastructure, and consistent technical support to realize the full potential of e-health in enhancing healthcare delivery and patient outcomes in Nigeria.***

Indexed Terms- ***E-health technologies, Healthcare workers, Resource-limited settings, Electronic health records, Health information systems***

I. INTRODUCTION

E-health encompasses a diverse set of informatics tools that have been designed to improve public health and health care(1). E-health tools are designed to improve health surveillance, health-system management, health education, and clinical decision-making, and to support behavioral changes related to public-health priorities and disease management(2).

E-health is the use of information and communication technology (ICT) to link healthcare professionals, patients, and governments; to educate and inform healthcare managers, professionals, and consumers; and to promote innovation in the provision of healthcare and the management of the healthcare system (3).

E-Health, which functions as a medical record used to gather, store, and distribute data among healthcare professionals, also helps patients receive medical care (4).

E-Health encompasses a wide range of services, including consumer health informatics to assist people in making healthy decisions, telemedicine, mobile health (m-Health) services, electronic health records to provide continuity of patient treatment throughout time, and e-learning for healthcare professionals(5). electronic prescribing, clinical decision support, telemedicine, health knowledge management, virtual healthcare teams, grid-based medical research, and health informatics/healthcare information systems are some examples of computerized physician order input (6).

A variety of new opportunities for people to access and exchange health information, manage their health through electronic platforms, and take part in peer-to-

peer health care have emerged as a result of the development of these new technologies. These online options have been recognized as a way to improve patient and healthcare provider empowerment and self-management of treatment in the absence of face-to-face interaction (7).

To address health issues like diabetes management, heart health, cancer prevention, smoking cessation, and health promotion activities, among others, public health and medical practitioners can now communicate with patients in both conventional and cutting-edge ways thanks to the broad applications of e-health(8).

Technology has advanced to the pinnacle of human civilization over time and is now present everywhere, not only in wealthy nations. The notion of e-health, or electronic health, was created because healthcare providers in developing nations cannot ignore the use of information technology to offer healthcare(9).

These online strategies, which incorporate modifications of more conventional communication techniques like the dissemination of personalized information and the development of support networks, have produced numerous positive effects on the provision of healthcare (10).

According to studies, the usage of e-healthcare delivery is expanding and is having a significant impact on healthcare systems in industrialized nations (11). However, it has been stated that its implementation has had little success with poor utilization in developing nations, including Nigeria (12).

In the event of a health risk alert and subsequent notification related to a specific patient, direct care functions of e-Health Technology reporting can monitor whether expected actions have been taken, and execute follow-up notification if they have not(13). Between healthcare encounters, e-health technology reporting systems can fulfill direct care functions by alerting patients and/or the relevant providers about preventive services, tests, or behavioral actions that are due or overdue. These alerts may include, but are not restricted to, timely notifications for follow-up appointments, laboratory tests, immunizations, or examinations. Furthermore, these notifications can be tailored to individual preferences regarding timing, frequency, and the generation of administrative reports.

Epidemic Infectious diseases disproportionately affect populations in Africa and sub-Saharan Africa in particular and are the leading cause of death in most low-and middle-income countries (14). In recent years, the world has faced several diseases of epidemic potential, such as Ebola, the Coronavirus (COVID-19), Mpox), and arboviruses (15,16). Alongside morbidity and mortality, outbreaks strain already limited health system resources, accelerate violence against women and minority groups, and cause economic and political instabilities, as well as the collapse of societies (17,18).

To accelerate outbreak detection and response in the healthcare system, the WHO recommends the integration of information and communication technologies, specifically mobile phones and computers, in the implementation of integrated Disease Surveillance and Response (IDSR) activities (19). Globally, the integration of mobile phone-based and computer-based systems as e-health in infectious disease surveillance has shown significant gains (20). The expansion of network and internet infrastructures in emerging nations such as Nigeria promises even more benefits (21).

Therefore, there's a need to assess the awareness and availability of e-health technologies in selected health facilities in Imo State, Southeastern Nigeria.

II. MATERIALS AND METHODS

Study Design

A descriptive cross-sectional study was conducted among 579 respondents between January to December 2024 on the awareness and availability of e-health technologies in selected Health Facilities in Imo State, Southeastern Nigeria.

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.

Study Area

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 collected data was analyzed using SPSS Statistics version 21 and Microsoft Excel. Descriptive statistical methods, including frequency distribution and percentages, were 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 were interpreted using a p-value threshold of <0.05. For qualitative data,

Ethical Approval

Ethical approval was obtained from Federal University of Technology, Owerri (FUTO), Imo State University Teaching Hospital, Owerri (IMSUTH), Imo State Ministry of Health, and the Hospitals Management Board.

III. RESULT

Table 1: Socio-demographic Characteristics of the Respondents

Variables	Frequency (N=579)	Percentage
Age Bracket		
20-30 years	14	2
31-40 years	150	26
41-50 years	232	40
51-60 years	178	31
61-70 years	5	1
Designation		
Doctor	179	31
Nurse	161	28
Laboratorian	79	14
Pharmacist	59	10
Medical Record Officer	41	7
Radiographer	27	5
Other positions	12	2
Type of Facility		
Hospital	197	34
Clinic	113	20
Laboratory	75	13
State Ministry of Health	68	12
Others	57	10
Geo-political zone		
Okigwe Zone	93	16
Orlu Zone	188	32
Owerri Zone	298	51
Level of Health Care		
Tertiary	381	65.8
Secondary	198	34.2

The age range of participants is primarily centered on middle-aged individuals. The majority are between 41 and 50 years old (40%), followed by those aged 51 to 60 (31%) and 31 to 40 (26%). There are fewer younger participants (20-30 years) and older participants (61-70 years), making up 2% and 1%, respectively. In terms of professional roles, doctors represent the largest segment (31%), with nurses following closely (28%). Other notable professions include laboratorians (14%), pharmacists (10%), medical record officers (7%), and radiographers (5%). Those in other roles constitute a minor portion (2%). Concerning facility types, hospitals are the most prevalent (34%), followed by clinics (20%), laboratories (13%), and the State Ministry of Health (12%). Other facility types make up 10%. Geographically, the Owerri Zone has the largest representation (51%), with the Orlu Zone (32%) and the Okigwe Zone (16%) following. Regarding healthcare levels, most respondents are from Tertiary healthcare facilities (54%), with secondary facilities comprising 28% and primary facilities 18%. The respondents' experience levels vary. The 6-10 years and 11-15 years categories are the most common (28% and 24%, respectively), followed by those with 16-20 years of experience (22%). Smaller proportions are seen in other qualifications, a PhD, or a WAEC certificate 3%, 3%, and 2%, respectively.

Table 2: Awareness of Participants toward E-Health Technologies

Variable	Frequency (N=579)	Percent (%)
Are you aware of e-health technologies and their uses?		
No	175	30
Yes	404	70
How would you rate your knowledge of e-health?		
I don't know very much about E-health	141	24
I don't know a lot about E-Health and its usage	172	30
I only know about the concept of E-Health	266	46
Which of these statements closely defines E-health technologies?		
All of the Above	133	23
E-health technologies are information and communication technologies that support health and healthcare	434	75
They are digital health technologies that take the place of the doctor	12	2
In your opinion, which of these is not true about e-health technologies?		
They make healthcare delivery easy and fast	262	45
They reduce the burden of work from health workers	317	55
Have you received any training on e-health technologies in the last 3 years?		
No	483	83
Yes	96	17
If YES, how many?		
1-3 years	80	14
4-6 years	14	2
6-10 years	2	0

Although a strong majority (70%) of participants are familiar with e-health technologies and their applications, a notable minority (30%) are not, highlighting a considerable gap in basic awareness. Upon closer examination, the depth of knowledge seems limited. A significant portion indicates a limited understanding: 24% admit they "don't know very much about E-health," and 30% claim they "don't know a lot about E-Health and its usage." The largest group (46%) is only aware of the concept of E-Health. This suggests that being aware does not necessarily equate to having a comprehensive working knowledge of e-health technologies. Most participants (75%) accurately describe e-health technologies as "information and communication technologies that support health and healthcare," indicating a general grasp of the field's scope. However, some (23%) selected "All of the Above," which might suggest a less precise understanding or an acknowledgment of e-health's multifaceted nature. A small minority (2%) incorrectly defined e-health as "digital health technologies that take the place of the doctor." There is a significant perception that e-health technologies do not inherently simplify healthcare processes or lessen workload. A substantial portion (45%) disagrees with the idea that e-health technologies "make healthcare delivery easy and fast." Even more (55%) disagree that they "reduce the burden of work from health workers." These responses indicate that participants recognize the complexities involved in implementing and using e-health and do not necessarily view it as a quick solution to existing challenges. A major concern is the lack of training. The overwhelming majority (83%) of participants have not received any training on e-health technologies in the past three years. Only a small minority (17%) have undergone training. Among those who did receive training, most (14%) had it within the last 1-3 years, with very few having received training 4-6 years ago (2%) or 6-10 years ago (0%). This identifies a critical need for more training opportunities to ensure effective adoption and utilization of e-health technologies.

Table 3: Availability of E-Health Technologies

Variables	Frequency (579)	Percent
How familiar are you with E-health technologies currently in use at your facility		
Not familiar at all	98	16.9
Quite familiar	160	27.6
Very familiar	321	55.4
Type of E-health currently available in the facility		
Telehealth	41	17.2
Tele-medicine	4	7.1
Remote patient monitoring	8	1.4
E-laboratory	18	3.1
Mobile Health Telephone Reminder	98	17.0
Health Information System	152	26.3
Health Chatbox	5	0.9
Electronic Health Records	180	31.1
Wearable Health Devices	5	0.9

Online support group	4	0.7
Tele-pharmacy	9	1.6
Electronic prescription	5	0.9
Online mobile social media consultation	11	1.9
Surveillance Outbreak Response Management and Analysis System	27	4.7
E-logistics management system	12	2.1
Type(s) of Electronic Device Used to Implement E-Health in Your Facility		
Desktop	170	29.4
Laptops	98	16.9
Tablets	155	26.8
Mobile Apps	156	26.9
Current state of electronic devices used to implement e-health in your facility		
Functional and In-use	332	57.3
Slightly damaged and in-use	129	22.3
Completely damaged and not in use	118	20.4
What is the functionality of the e-Health technologies in use?		
Both (online and offline)	358	61.8
Online	145	25.0
Offline	141	24.4
How available is the e-health in your facility?		
No internet connection is available	86	14.6
There's always enough data to access the internet	353	61.0
There's hardly enough data	140	24.2
Who provides the internet for the e-health in your facility?		
Healthcare workers	27	4.6
Partners	116	20.0
Sometimes the healthcare workers, sometimes the facility management	172	29.7
The facility management	329	56.8
How often is service to patients disrupted due to poor network?		
Network is hardly stable, so service is disrupted many times a day	104	18.0
A few times per day	67	11.6
Occasionally (few times a week)	241	41.6
Network issues rarely cause disruptions in service	167	28.8
Are e-health technologies uniformly available across all departments and units within your healthcare facility?		
No	318	54.9
Yes	261	45.1
Are there specific units or departments where e-health technologies are available more than others?		
No	136	30.7
Yes	443	76.5
If yes, what are those units/departments?		

Consulting clinic	113	25.5
Laboratory	87	19.6
Pharmacy	46	10.4
HIV/AIDS treatment clinic	150	33.9
Obstetrics & Gynaecology Unit	35	7.7
Others	12	2.7
Has your facility recently introduced any new e-health technologies or initiatives?		
No	249	43.0
Yes	330	57.0

The table 3 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 4: Bivariate Analysis of Participants' Awareness of E-health Technologies and Level of Health Care Facility

Variables		Level of Health Care Facility		Chi-Square Value (X^2)	P-Value
	Categories	Secondary	Tertiary		
Are you aware of what e-health technologies are and what they're used for	No	40 (24.7%)	55 (13.2%)	39.812	0.0001
	Yes	122 (75.3%)	362 (86.8%)		

In Table 4, the analysis examines the relationship between awareness of e-health technologies and the level of healthcare facilities. The findings indicate a clear trend, with awareness increasing at higher levels of healthcare. Among primary healthcare workers, more than half (56.1%) reported not being aware of e-health technologies, highlighting a significant knowledge gap at this level. In contrast, awareness was much higher among tertiary than their secondary healthcare workers counterparts, with 86.8% and 75.3% respectively indicating familiarity with e-health technologies.

The chi-square test result ($X^2 = 39.812$, $P = 0.001$) shows a statistically significant association between awareness and the level of the healthcare facility. This suggests that exposure to e-health technologies is more prevalent in secondary and tertiary healthcare settings, where digital health solutions are more likely to be implemented and utilized.

Table 5: Bivariate Analysis of Participants' Awareness of E-Health Technologies and Number of Years Spent in their Facilities

Variables		Are you aware of what e-health technologies are and what they're used for		Chi-Square Value (X^2)	P-Value
	Categories	No	Yes		
How many years have you been in this facility	1-5 yrs	21 (11.8%)	51 (12.7%)		
	11-15 yrs	36 (20.2%)	103 (25.7%)		
	16-20 yrs	50 (28.1%)	79 (19.7%)	27.052	0.0001
	21 yrs and above	39 (21.9%)	40 (10.0%)		
	6-10 yrs	32 (18.0%)	128 (31.9%)		

Table 5 examines the association between participants' awareness of e-health technologies and the number of years spent working at their facilities. The chi-square value of 27.052 and a p-value of 0.000 indicate a significant relationship between these variables. Participants with 6-10 years in their facility show the highest awareness (31.9%), whereas those with 21 years or more show lower awareness (10.0%). This suggests that mid-career professionals are more likely to be familiar with e-health technologies, possibly due to recent training or technological changes introduced during their tenure.

Variables		Are you aware of what e-health technologies are and what they're used for		Chi-Square Value (X^2)	P-Value
	Categories	No	Yes		
What's your highest level of education	Bachelor's Degree	35 (20.0%)	102 (23.9%)		
	Diploma	34 (19.4%)	37 (8.7%)		
	MSc	82 (46.9%)	119 (27.9%)		
	MD	19 (10.9%)	160 (37.5%)	22.014	0.001
	PhD	1 (0.6%)	4 (0.9%)		
	WAEC	4 (2.3%)	5 (1.2%)		

Table 6: Bivariate Analysis of Participants' Awareness of E-health Technologies and Level of Education

Table 6 presents the relationship between participants' awareness of e-health technologies and their level of education. The chi-square value of 22.014 and p-value of 0.001 indicate a significant association between these variables. Participants with higher educational qualifications, such as MD (37.5%) demonstrated greater awareness and were higher followed by those with and MSc 23.9%, while those with PhD 0.6% and WAEC 2.3% showed lower awareness. This highlights the important of advanced education, though any educated person trained can use it.

Table 7: 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-health in the facility?	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
	Slightly damaged and in-use	14 (53.85%)	12 (46.15%)		

Table 7 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

This study found that awareness of e-health technologies among health workers in Imo State was relatively high, with 69% of respondents indicating familiarity. However, a deeper examination revealed gaps in knowledge, as only 46% understood the general concept, while 24% admitted to knowing little about e-health. These findings align with previous studies(1), which highlight that while awareness of digital health solutions is growing, practical knowledge remains low due to limited training opportunities.

The study also found significant associations between e-health awareness and facility level, years of experience, and educational attainment. Healthcare workers in primary facilities had the lowest awareness (56.1%), while those in secondary and tertiary institutions reported much higher levels (75.5%). This pattern suggests that access to technology and training opportunities is greater in higher-level facilities. Additionally, mid-career professionals (6-10 years of experience) showed the highest awareness, possibly due to greater exposure to digital health tools. Conversely, professionals with over 20 years of service had lower awareness, indicating a lack of ongoing training for senior staff. Similarly, those with advanced degrees (e.g., MSc and MD holders) demonstrated higher awareness than diploma holders (p=0.001), reinforcing the role of education in shaping familiarity with e-health technologies.

These findings suggest that structured training programs, digital literacy initiatives, and enhanced infrastructure could help bridge the knowledge gap, particularly at the primary healthcare level and among lower-educated health workers. Integrating e-health education into medical and nursing curricula may also improve knowledge retention and practical application across all levels of healthcare.

This study revealed that awareness of available e-health technologies in healthcare facilities was generally low, with only 8.3% of respondents being "very familiar" with them. Furthermore, the variety of e-health tools, including telemedicine, remote monitoring, health information systems, and electronic health records, was limited, with less than 11% of facilities offering any single e-health solution. The limited availability and low awareness align with findings from by Nigeria Health Watch, who observed that although e-health is slowly being introduced in Nigerian healthcare, its spread is uneven and more prominent in urban than rural areas. This finding is consistent with(22), who found that healthcare workers in resource-limited settings often rely on personal devices for e-health tasks due to limited facility resources. The lack of infrastructural support and basic devices is a significant barrier, suggesting that increased investment in both hardware and network infrastructure could facilitate e-health adoption and effectiveness.

CONCLUSION

These findings highlight key factors influencing awareness and use of e-health technologies among healthcare workers in Imo State, Nigeria. Facility level, tenure, educational attainment, and device functionality all play significant roles in determining the extent to which healthcare workers are familiar with and can utilize e-health technologies. Future strategies to enhance e-health adoption should focus on targeted training for both mid-career and senior professionals, ensuring equitable access to resources and consistent device functionality across all facility levels. These measures will support broader engagement with digital health technologies, enhancing healthcare delivery and patient outcomes in Nigeria.

The availability of e-health technologies in healthcare facilities in Imo State are limited by low awareness, inadequate infrastructure, inconsistent internet connectivity, and insufficient maintenance resources. This aligns with a study(23). While there is an appreciation for the potential benefits of e-health among healthcare workers, a lack of support and training poses significant barriers. The study's findings align with similar challenges identified in other studies across Nigeria, identifying the need for a strategic focus on infrastructure improvement, digital literacy, and consistent technical support to realize the full potential of e-health in enhancing healthcare delivery and patient care.

Further, the study highlights both the high potential and significant barriers to implementing e-health technologies in selected health facilities in Imo State. While awareness and willingness to adopt e-health are generally positive, gaps in training, infrastructure, and sustainability pose obstacles. Addressing these challenges through policy changes, increased funding, and targeted training could improve e-health in Nigeria's healthcare sector.

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