



The influence and usage of technologies by practicing nurses in Nigeria

Adishi, Monday,
Ayedu,
Chukwuemeke¹⁺
Agbedia, Clara,
Oniovo²

^{1,2}Delta State University, Abraka, C/O No. 6, Otoba Lane, Off Abraka Road,
Eku, Delta State, Nigeria.

¹Email: mondadayadishi@hotmail.com

²Email: oniovo4life@gmail.com



(+ Corresponding author)

ABSTRACT

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Recent medical scientific advancement in e-health is influencing the art and science of nursing globally. While the use of modern technology is visible and appreciated in developed countries, such assertion is still in infancy in Nigeria. There is a dearth of research on the impact of the usage and perceived benefits of existing technologies in the practice of nursing in Nigeria. This is the premise for this study. The main objective of this study is to assess the usage and perceived benefits of existing technologies in the practice of nursing with the view to improving quality of care through adequate usage, and maintenance, more importantly informing other stakeholders on the importance of ensuring adequate supply of existing and emerging technologies. The research design is descriptive and cross-sectional. Respondents were drawn from five (5) selected hospitals each from the Northern and Southern parts of Nigeria through stratified random sampling techniques. A total of 300 nurses were selected from both regions. The quantitative data were analyzed, using Analysis of Variance (ANOVA) with a 95% confidence of 0.05 level of significance. The result of this study emphasized the importance of improving nursing care through efficient and effective usage of technologies, as well as the need for adequate availability and functionality of existing tools used by practicing nurses in Nigeria.

Contribution/Originality: Non-Familiarity of the nurses with the required equipment/technologies in patient care, Inaccuracy and Inconsistency in patient care quality, Absence of Emergency Equipment, Lack of maintenance culture, Non-availability/non-functionality of equipment noted. Suggested remedies include Regular competency trainings, Adequate maintenance culture, Availability and Functionality of equipment, and Quality Control System.

1. INTRODUCTION

The complexity in healthcare delivery systems and advancement in medical technology have not only brought great improvement to the healthcare system but have also provided ample opportunities for healthcare professionals to improve their practice in terms of skills and competence. The usage of technology demands new ways of thinking of technology within the context of nursing. The premise is that applying technology to nursing has positive and negative effects, in that not only will these technologies perform some mundane duties of the nurse, the individualized nursing care is often compromised as the patients are treated like one of the machines [1]. The major concern is that the time that nurses spend in meaningful exchanges with clients is reduced [1]. The major threat is that technology could potentially be replacing humans in the workplace [2]. As new technologies emerge, there is a potential threat to nurses and their job positions. Although it won't happen soon, new technologies will continue cutting nursing duties. There will continue to be more technology incorporated into their daily routines. More

technology introduced will allow nurses to see more patients daily, administer medications better, and more competently monitor their patients [3].

The gap between the developed and the developing world that exists in information and communication services is also present in the health sector, especially in nursing. The health sector is about fifteen years behind other sectors in application of information and communication technologies. Numerous websites have made health information more available to patients, thereby strengthening their Information and communication technologies (IT). Information Technology diffusion is greatest in administrative and financial departments where applications such as patient registration, billing, and payroll are widely used. Clinical applications, such as computerized provider order entry for drugs and laboratory investigations, are used by pharmacists and physicians in their clinical practice. Other types of clinical IT, such as picture archiving and communications systems (PACS), that allow digital storage and retrieval of x-rays, Magnetic Resonance Imaging MRIs, and other images are also widely used.

Unfortunately, the usage of these technologies in Nigeria has been greatly influenced by administrative, clinical, psychosocial and environmental factors. Administrative factors include lack of funds, unfriendly protocols, logistic challenges, organizational disorderliness, lack of or inappropriate staff training opportunities, poor maintenance culture, poor infrastructure, epileptic power supply, etc. Clinical factors such as inappropriate calibrations, lack of validity and reliability, inexperience of staff, not-user-friendly procedures, etc. are not left out. Psychosocial factors that also influence the usage of these technologies include user's mind set/preparedness, organizational capabilities of users, fear of the unknown outcomes, and inadequate staff/patient rapport, politicians hijacking the health care needs to boost their ego, etc. Environmental factors include lack of space for installation, unconducive atmosphere and network challenges, amongst others.

While modern technologies are already advanced in developed countries, many health facilities in Nigeria still use analogue procedural settings that are obsolete. Within the framework of diffusion of innovation, application of emerging technology can only be of great value to health care delivery system if done within the perimeters of its efficacy, cost, safety, and societal impact. This applies to both the introduction of the new methods and the retirement of older methods that may have outlived their usefulness. Examples of some obsolete health practices are: The use of early morning sun to treat babies with neonatal jaundice because there is no modern phototherapy equipment. The use of axillary or rectal thermometers to measure body temperature due to non-availability of thermoscan or other forms of non-touch thermometers, especially in the management of infection/contagious diseases that require restriction in direct contact with patients. These practices jeopardize patient safety. Similarly, it exposes healthcare providers to the dangers of negligence and malpractice in a dynamic and well-enlightened society where there is a great demand for accountability.

The use of emerging technologies in Nigeria is riddled with: epileptic electrical power supply, lack of adequate funds for the successful implementation of technological equipment and appropriate clinical application, inadequate plan for implementing new technologies into practice and inadequate maintenance culture [1]. The lack of awareness and usage of medical equipment, inadequate or non-availability of the basic medical equipment in most facilities, and the need to improve the quality of care of the clients through emerging technologies are the premise for the study. Within the context of nursing, emerging technology should not only lead to improvement in nursing/treatment outcome, but it should also be user-friendly to the extent that it enables the nurse practitioners to advance their skills.

The impact of technology on nursing practice is replete in nursing literature. Huston [4] discussed the usage of new technologies that have contributed immensely to improve quality nursing care and general healthcare management. Some of the technologies discussed in this article include Genetics and Genomics, Less Invasive and More Accurate tools for Diagnosis and Treatment, 3-D Printing, Robotics, Biometrics, Electronic Health Records (EHR), as well as Computerized Providers Order Entry (CPOE) and Clinical Decision Support (CDS).

Pompilio [5] discussed the pros and cons of nursing technologies which have positive impact on Nursing shortage, decreased accessibility, decreased human error, etc. as well as some potential drawbacks of this development which are capable of posing threat to the human element, generational divide and Data and Security threats. Piscotty Jr, et al. [6] and Pepito and Locsin [2] in their different papers assessed the impact of emerging Technology in Global Nursing Care. In a related issue Czech, et al. [7] evaluated the use of Virtual Reality (VR) in wound care. The research shows the use of VR by nurses in burn units has helped to decrease traumatizing instances in patient wound dressing. Similarly in India, Internet of Things (IoT)-based system is being used to transmit critical warning signs to nurses for expectant mothers at high risks for fetal and maternal distress symptoms. This was very helpful in rural areas. These technological advances have also given room for more education and research [8].

2. BRIEF EXPLANATIONS OF SOME TECHNOLOGIES USED IN NURSING

2.1. These Include the Following

Robotics: Robots are those devices that usually perform healthcare services like the humans do.

Biometrics: Biometrics is the science of identifying people through physical characteristics, such as Finger prints, Hand prints, Retinal scans, Palm vein prints, Voice recognition, Facial structure and Dynamic signatures.

Computerized Provider Order entry (CPOE) is a clinical software application designed significantly for providers to write patient orders electronically rather than on paper. **Clinical Decision Support (CDS)** is defined broadly as a process of enhancing health-related decisions and actions with pertinent organized clinical knowledge and patient information to improve health and healthcare delivery.

Electronic Health Record (EHR): is a digital record of a patient's health history that may be made up of records from many locations and/or sources, such as hospitals, providers, clinics, and public health agencies.

3. RECENT TECHNOLOGIES THAT ARE PATIENTCARE-CENTERED

Virtual Reality (VR): This can immerse patients in a relaxing environment to help reduce stress, hence its use in Post-Traumatic Stress Disorder (PTSD). . VR can help lower a patient's pre and post-surgery anxiety.

Artificial Intelligence (AI): Technology has made it possible for software algorithms to be used to complete tasks requiring human intelligence. Therefore, AI can be used in Research and Development. Billing, and Digitized Supply Chain.

Internet of Things (IoT): Internet of Things (IoT) uses a connected network of object that collects and exchanges data. It was also estimated that by 2020, 40% of all IoT connected technology will have healthcare applications. IoT can affect a). Care coordination b). Digitized operations c). Inventory control d). Remote patient monitoring e). Digital supply chain.

Drones: Drones include driverless vehicles and aircraft, Drones can be used for Emergency and Disaster response. Delivery of goods and. Digitized supply chain.

Blockchain: Blockchain is a distributed electrical ledger, which helps to increase the security of records and confirm successful transactions. Blockchain also helps in the prevention of fraud and personal health protection.

3.1. Challenges in Integrating New Technologies in Nursing Practice

- Balancing the human element with technology. Technology should only enhance, not eliminate human element in nursing.
- Balancing costs and benefits. However, no matter how efficient and effective an emerging technology may be, its benefits must outweigh the potential cost to ensure its continued relevance in the health sector.

- Training a Technology-enabled Nursing Workforce and Assuring ongoing Competency. The ability of the leadership to ensure that nurses are adequately trained to work with the new healthcare technologies seamlessly determines the success recorded by the nurses at the end of the day.

In nursing profession, patient care is facilitated through the use of certain tools and equipment which usually aid in the diagnosis, treatment and prevention of any health condition. As these tools are utilized in the care of clients, certain benefits are derived from them by the clients and also by the nurses who use them on their clients. Having understood the existence of both advantages and disadvantages of such tools and equipment, more innovations are explored to help reduce their disadvantages and increase their advantages, to improve the quality of client care. Recently, many tools/technologies have emerged to improve nursing practice.

No wonder why Oleksii Tsybal, in an article: 'Healthcare Technology Trends and Digital Innovation in 2023', published on October 8, 2022, saw the implementation of modern technology in health care as a global trend, leading to the increasing development of technology and information systems. The introduction of modern technology in nursing increases the nurses' efficiency, but it is also changing the way of care for patients.

3.2. Research Questions

1. What are the various forms of equipment currently available in use in care of patients in the health facility?
2. Do these modern equipment's influence quality nursing care?
3. Are these forms of equipment available and functional?
4. What capacity building measures are put in place to increase the competency level of the nurses in using and maintaining the equipment?
5. What are the factors hindering the usage of the equipment?
6. What useful strategies can be put in place to enhance better usage?

3.3. Research Design

The research design for this project is a Descriptive and Cross-Sectional Research Design. This design enabled the researcher to understand the usage of modern technologies by nurses working in hospitals in the Northern and the Southern parts of the country.

3.4. The Variables Selected for this Study Were as Follows:

- Equipment familiarity.
- Equipment usage.
- Needs assessment of medical equipment.
- Equipment maintenance culture.
- Equipment availability and functionality.
- Equipment validity and reliability.

3.5. Sample and Sampling Technique

Multi-stage stratified random sampling technique was used to select the samples for this study. At the first stage, five health care facilities (mainly tertiary hospitals) were selected from the Northern and the Southern parts of the country giving a total of ten healthcare facilities for the study. Three hundred (300) nurses were then randomly selected from these selected hospitals. This resulted to 150 participants selected from North and 150 participants from the South.

3.6. Exclusion Criteria

- Other members of the health team, such as the Doctors, Pharmacists, Lab Scientists, Radiologists/Radiographers, etc. were excluded from this study.
- It was not possible to use all the hospitals in the country. Hence samples were randomly selected from northern and southern regions to represent all the hospitals in the country.

3.7. Tools for Data Collection

Questionnaire was the major instrument used for data collection for this study. This was distributed to the target population. The questionnaires were divided into six sections. These include:

- Equipment Familiarity.
- Equipment Usage.
- Needs Assessment of Medical Equipment.
- Equipment Maintenance Culture.
- Equipment Availability and Functionality.
- Equipment Validity and Reliability.

The above sections were utilized to sufficiently explore any similarities and/or disparities in the approaches to the use of technologies by the nurses in the various healthcare facilities under review. Five health care facilities (mainly tertiary hospitals) each were selected from the Northern and the Southern parts of the country. All the hospitals used in this study were coded for privacy and anonymity. Hospitals in the north are coded HA-HE, while those from the south are coded H1-H5.

3.8. Ethical Considerations

All the healthcare facilities that participated in this research were coded for privacy and anonymity. While carrying out the research, the following were considered:

- Participants' rights were protected.
- Privacy and confidentiality were maintained throughout the study.
- Respondents were clearly informed about the study in order to gain their consent.
- The research involved no risk to the respondents.

3.9. Data Analysis

A total of 300 Questionnaires were distributed and all were retrieved, giving a 100 percent retrieval rate. The questionnaires were randomly distributed to the clients in each of the selected facilities. Every document collected was treated with utmost confidentiality. The data were collected and analyzed, using IBM /SPSS statistical package, while the association between the variables was analyzed, using Analysis of Variance (ANOVA) with a 95% confidence of 0.05 level of significance. The data were summarized on frequencies and percentages, using the formula below due to its simplicity: $F/T \times 100/1$ Where F represents frequency of variables and T represents the total number of variables. Analysis of variance (ANOVA) tests were carried out using SPSS version 20.

Table 1. Demographic data of participants.

Age range	Male	Female	Post-qualification experience in YRS
20 – 25 YRS	12	20	1 – 5
26 – 30 YRS	16	32	6 – 10
31 – 40 YRS	33	52	11 – 15
41 – 50 YRS	40	27	16 – 20
51 YRS and above	42	26	Above 20
Total	143	157	300

3.10. Demographic Data of Participants

Table 1 shows the participants in the study, including their age ranges, sex, and post-qualification experiences. A total of 300 participants (143 males and 157 females) took part in the study. It is worthy of note that the highest number of females who participated in the research were within 31 – 40 years age group, recording 52 respondents, representing 33% of females and the male respondents recorded their highest within the 51-years-and-above age group with a score of 42 participants, representing 29% of males. However, participants within the 31 – 40 years age group participated most in this research, representing 28% of total respondents, as recorded.

Within the facilities under review, out of the 300 participants, 84 (28%) were from Surgical Ward, 43 (14%) from Children's Ward, 105 (35%) from medical ward, 5 (2%) from ICU, 53 (18%) from Accident & Emergency Ward and 10 (3%) from Maternity Ward.

3.11. Research Question 1

3.11.1. Forms of Equipment Currently Available, and Are in Use for Care of Patients in the Health Facility

This research question will be answered by the results from the 'Equipment Usage' Section of the Questionnaire used for this study.

Table 2. Equipment usage.

Variables	North	South
HOSP A/HOSP 1	88.3	100
HOSP B/HOSP 2	97.0	57.3
HOSP C/HOSP 3	53.7	68.4
HOSP D/HOSP 4	68.7	65.6
HOSP E/HOSP 5	76.9	47.1
Mean score North/South	77.0	68.0

Table 2 presents the following data.

Using 90% as a set target, among health care facilities in the North, Hospital B had the highest number of nurses (97.0%) who were privileged to utilize the medical equipment/technologies in patient care, followed by Hospital A with 88.3% of nurses on equipment usage.

Analysis in the southern healthcare facilities reveal that 100% of their nurses in Hospital (1) were privileged to utilize the medical equipment/technologies in patient care, followed by Hospital (3) with 68.4% of nurses on equipment usage. Hospital (5) had the lowest number of nurses who were privileged to utilize the equipment/technologies in patient care with a score of 47.1%. On the average, 77% of their nurses from Northern Healthcare facilities were able to utilize modern equipment/technologies in patient care, while 68% of nurses from Southern Healthcare Facilities utilize modern equipment/technologies in patient care.

3.12. Research Question 2

3.12.1. Do Modern Equipment's Influence the Quality of Nursing Care?

This question was answered with the results from the 'Needs Assessment' and 'Validity & Reliability' sections of the questionnaire used for this study. It is pertinent here to explain the concept of validity of the instruments/equipment used in patient care. The validity of the instruments/equipment in the context of this study, is different from the validity of the instruments of data collection, which is the questionnaire. Here, external service providers are expected to regularly come to the hospital to test and maintain the accuracy of the instruments/equipment used in clinical practice. Thus, in this study, the validity and reliability of all the equipment/technologies used in the various healthcare facilities were explored to ascertain their functionality & readiness for use.

Table 3. Needs assessment & validity and reliability.

Respondents	Needs assessment		Validity & reliability	
	North	South	North	South
HOSP A/HOSP 1	83.3	80	74.0	98
HOSP B/HOSP 2	95.0	90	86.0	66.7
HOSP C/HOSP 3	63.7	76.7	40.0	58
HOSP D/HOSP 4	53.3	47	48.0	72.7
HOSP E/HOSP 5	62.0	45	61.3	70
Mean score: North/South	72	68	62	73

Table 3 displays the following facts:

Needs Assessment analysis of health facilities in the North shows that Hospital B has the highest number of modern equipment/technologies needed in an emergency with a score of 95%. The same hospital is also most consistent with Validity and Reliability of their equipment by 86%. However, the overall assessment of the entire healthcare facilities in the south reveals the average Needs Assessment rate to be 68%, while that of validity and reliability has a total average score of 73%.

3.13. Research Question 2

3.13.1. Are These Forms of Equipment Available and Functional?

The “Availability and Functionality” Section of the Questionnaire will be used to answer the Research Question 3.

Table 4. Equipment availability and functionality.

Respondents	North	South
Hosp A/Hosp 1	84.7	97.0
Hosp B/Hosp 2	96.7	66.0
Hosp C/Hosp 3	49.3	63.3
Hosp D/Hosp 4	46.7	34.0
Hosp E/Hosp 5	56.0	32.0
Mean score North/South	67.0	59

Table 4 is explained as follows:

While it is important to have modern equipment/technologies in various healthcare facilities, it must be stressed that it is not enough to have them, but it is very essential to ensure they are functional.

Of all the healthcare facilities that participated in this study from the North, Hospital B was found to have had the greatest number of medical equipment/technologies available and functioning, with a score of 96.7%. Hospital (1) was found to have had the greatest number of medical equipment/technologies available and functioning, with a score of 97% from the south healthcare facilities. In some of the facilities, (Hospital A and B) some personnel were responsible for regularly checking the functionality of those equipment, detecting any faulty equipment and reporting to the management as appropriate for necessary actions.

It was observed in the study that some of those technologies or forms of equipment were either not available or are available but not functional. This problem is common to all the facilities both in the North and South, though with varying degrees of availability and functionality. The overall mean score of Availability and Functionality of Medical Equipment/technologies in the southern healthcare facilities is 59%. In other words, the Equipment availability and functionality in the south is down by 41%. This percentage negative is obviously on the high side in the face of challenging healthcare delivery systems across the globe.

Just like it is in the north, some of the healthcare facilities in the south admitted having external service providers who regularly visit their facilities, reassess their equipment, service them and update those that need to be updated. This research also revealed that the frequency of their visit to service the facilities’

equipment/technologies were based on the agreements reached between them and the hospital management, ranging from monthly to quarterly, biannually or annually. For instance, in some of the facilities, some assigned personnel were responsible for checking regularly the functionality of those equipment, detecting any faulty equipment and reporting to the management as appropriate for necessary action.

Table 5. Familiarity and maintenance culture.

Respondents	Familiarity		Maintenance culture	
	North	South	North	South
Hosp A/Hosp 1	77.6	100	84.3	97.6
Hosp B/Hosp 2	96.7	62.4	78.6	71.9
Hosp C/Hosp 3	44.7	46.3	46.7	86.7
Hosp D/Hosp 4	41.0	50.9	79.0	46.7
Hosp E/Hosp 5	58.3	58.7	75.0	48.0
Mean score – North/South	64	64	73	70

3.14. Research Question 4

3.14.1. What Capacity Building Measures are Put in Place to Increase the Competency Level of The Nurses in Using and Maintaining the Equipment?

In order to ascertain the capacity building measures to increase the competency level of the nurses in clinical practice, “Equipment Maintenance Culture” and “Equipment Familiarity” Sections of the Questionnaire are used.

The capacity building measures put in place by most facilities under review were mainly competency training programs and use of Standard Operating Procedures (SOPs). However, it is sad to note that some nurses use ‘Trial and Error’ Methods, Personal Experiences and Suggestions from Colleagues to carry out their procedures. This, no doubt, may lead to a lot of procedural errors that could cause harm to the patients, compromise to patient care quality, as well as damage to the equipment.

In terms of Equipment Familiarity, Hospital B had the highest number of nurses who were familiar with the modern equipment/technologies in their facilities with a score of 96.7%. However, from the general assessment of “Maintenance Culture” among the healthcare facilities under review, Hospital A took the lead with a score of 84.3%. Therefore, from the overall assessment of the capacity building measures put in place to increase their competency level, the northern healthcare facilities were familiar with their equipment/technologies by 64%, while their maintenance culture was 73%. In other words, the northern healthcare facilities were scored down on Equipment Familiarity by 36%, while their maintenance culture was rated low by 27%.

The southern healthcare facilities were familiar with their equipment/technologies by 64%, while their maintenance culture was 70%. In other words, the southern healthcare facilities were scored down on Equipment Familiarity by 36%, while their maintenance culture was rated low by 30%.

3.15. Research Question 5

3.15.1. What are the Factors Hindering the Usage of the Equipment?

As seen in the literature review in this study, the usage of these technologies can be greatly influenced by administrative, clinical, psychosocial and environmental factors. Respondents in this study identified the under listed factors as hindering the usage of the equipment. These include:

- Unfamiliarity with most medical equipment/technologies due to lack of or insufficient competency training. This often leads to frequent equipment damages and breakdown.
- Insufficient supply of modern equipment/technologies especially those needed in emergency situations.
- Lack of provision to assess the validity and reliability of the equipment/technologies used in patient care. This often leads to non -functionality of available equipment. The respondents’ stress could be ascribed to delay in institutional policy on maintenance.

- Insufficient availability of functional emergency equipment/technologies needed.
- Poor Inventory Management and Documentation resulting in delay in the repair or replacement of damaged equipment.
- Inability of the management to procure needed equipment.
- Epileptic power supply, causing damage to expensive equipment due to power surge.
- Unplanned Education and training, resulting in lack of competency and proficiency.
- Poor equipment maintenance culture.
- Bad management and non-proactive attitudes of high-ranking organizational staff with emphasis on misappropriation of scarce resources and funds. This is common when politicians use health issues to win election. Political tussles often result in misplacement of priorities. Nigeria health care sectors especially in the rural areas are dotted with White Elephant Health Facilities with poor conditions of service and often funds starved. Some politicians sited these health facilities within their communities without proper visibility studies in terms of manpower and the necessary infrastructure.

The above factors, it can be argued may pose a great challenge to the nurses working in such facilities, as they are capable of promoting maleficence and reducing beneficence. Therefore, quality of patient care would be obviously compromised.

3.16. Research Question 6

3.16.1. What Useful Strategies Can Be Put in Place to Enhance Better Equipment Usage?

Having highlighted the above factors, as hindering equipment usage, respondents were of the opinion that the useful strategies to be employed in order to enhance better usage include the following:

- Regular competency training programs for the nurses.
- Use of Standard Operating Procedures, especially for the kinds of equipment that are manufacturer specific. This involves always following written procedures for high risk or unusual situations.
- Addressing abnormal conditions promptly.
- Procurement of the needed equipment by the stakeholders in clinical practice.
- Ensuring easy accessibility of the nurses to the equipment for regular practice. A situation where equipment is kept in storage for a long time without usage should be avoided.
- Sustainability of adequate maintenance culture of the equipment.
- Quality Control Systems to be constantly put in place to ensure validity and reliability of the equipment.

The capacity building measures put in place by most facilities under review to increase the competency level of the nurses in using and maintaining the equipment were mainly competency training programs and use of Standard Operating Procedures (SOPs). However, some nurses are still using 'Trial and Error' Methods, Personal Experiences and Suggestions from Colleagues. etc. to carry out their procedures. These capacity building pitfalls might also lead to procedural errors that could cause harm to the patients, compromise to patient care quality, and damage to the equipment.

3.17. Comparison of the Northern and Southern Healthcare Facilities

Having reviewed the activities of the various healthcare facilities in the north and south, using the six distinct sections of the questionnaire, it is pertinent to ascertain the similarities and disparities displayed by the two regions of the country in terms of Equipment familiarity, Equipment usage, Equipment maintenance culture, Needs Assessment of medical equipment in emergencies, Equipment availability and functionality, as well as Equipment validity and reliability. [Table 5](#) shows, at a glance, the comparison between the two regions as follows:

Table 6. Comparison of Northern and southern healthcare facilities.

Variables in percentages	North	South
Equipment familiarity	65.6	65.6
Equipment usage	76.9	67.6
Needs assessment	71.5	67.7
Equipment maintenance culture	72.7	70.2
Equipment availability and functionality	66.6	58.5
Equipment validity and reliability	61.8	73.1

From [Table 6](#):

Using 90% as a set target, majority of the healthcare facilities have fallen short of best practice in the following areas:

- **Equipment Familiarity:** Of the research participants, the North and the South equally fall short of Equipment Familiarity by 34.4% each. In other words, the nurses were not used to some of the equipment/technologies utilized in those healthcare facilities, even though they had long been in existence and in use all over the world for some decades. It is therefore clear that enough training programs are not being drawn to update the nurses' skills, competency, and proficiency. This would definitely affect the quality of patient care in the country's health facilities.
- **Equipment Usage:** Of the equipment/Technologies being used in the various healthcare facilities, 23.1% of nurses in the north and 32.4% of nurses in the south do not utilize them. This also goes to explain the fact that nurses need to avail themselves of every opportunity to access and utilize such equipment/technologies through constant and regular practice under the tutelage of those nurses who are already familiar with and are capable of utilizing them in the care of their patients.
- **Equipment Needs Assessment:** The healthcare facilities in the north fall short of the Equipment Needs Assessment by 28.5% while those in the south are down by 32.3%. In other words, certain basic equipment needed in times of emergencies were not readily available when needed. This goes a long way in adversely affecting the outcomes of medical/surgical emergencies and their management as they occur in the hospitals.
- **Equipment Maintenance Culture:** It is one thing to utilize equipment, and it is another thing to maintain their integrity, so as to prolong their life span, efficiency and effectiveness. However, the northern nurses are down on equipment maintenance culture by 22.3%, while the southern nurses are down by 29.8%. This also explains that the maintenance culture of the nurses across the country is generally less than adequate. Therefore, Equipment maintenance culture should be included as part of the nurses' competency training programs regularly.
- **Equipment Availability and Functionality:** Making the equipment available for use by the stakeholders in patient care has been a very big challenge in clinical practice. The nurses face this challenge because those equipment/technologies are not procured by the hospital management. This leads many nurses to resort to using alternative means which might not yield very good results. Even the few equipment available might not be functioning properly due to lack of maintenance, resulting in compromising patient care. The northern healthcare facilities have fallen short of this by 33.4%, while the southern healthcare facilities are down by 41.5%. This finding is therefore challenging all stakeholders responsible for hospital management and procurement of hospital equipment to ensure adequate supply of the relevant equipment/technologies as well as maintenance of their integrity.
- **Equipment Validity and Reliability:** Research shows that the northern healthcare facilities have fallen short of validity and reliability of their equipment/technologies by 38.2%, while the southern healthcare facilities are also down by 26.9%. This means that at one time or the other, their equipment/technologies could not measure what they were supposed to measure at all times (Validity), and at some other times, their

measurement might not roughly remain within the same range, all things being equal (Reliability). Maintaining the validity and reliability of medical equipment/technologies is very essential in the healthcare industry, so as to ensure accuracy of healthcare parameters and eliminate errors, which can be misleading to the healthcare providers and dangerous to the patients.

Table 7. Analysis of variance test results.

Hospital	Location	Familiarity	Usage	Needs assessment	MTCE culture	Avail/Funct.	Val/Relia
Hospital A	North	77.6	88.3	83.3	84.3	84.7	74
Hospital B	North	96.7	97	95	78.6	96.7	86
Hospital C	North	44.7	53.7	63.7	46.7	49.3	40
Hospital D	North	41	68.7	53.3	79	46.7	48
Hospital E	North	58.3	76.9	62	75	56	61.3
Hospital 1	South	100	100	80	97.6	97	98
Hospital 2	South	62.4	57.3	90	71.9	66	66.7
Hospital 3	South	46.3	68.4	76.7	86.7	63.3	58
Hospital 4	South	50.9	65.6	47	46.7	34	72.7
Hospital 5	South	58.7	47.1	45	48	32	70

Table 7.1. Univariate test of significance for equipment familiarity.

Univariate tests of significance for equipment familiarity (Sheet1 in Variable in percent)					
Sigma-restricted parameterization					
Effective hypothesis decomposition; std. error of estimate: 22.3568					
Effect	SS	Degr. of	MS	F	P
Intercept	40525.96	1	40525.96	81.07980	0.000018
Location	0.00	1	0.00	0.00000	1.000000
Error	3998.62	8	499.83	0.00000	1.000000
Means					
Location	Familiarity mean	Familiarity std. err	Familiarity -95.00%	Familiarity +95.00%	1.0000000
North	63.66000	9.998280	40.60393	86.71607	1.0000000
South	63.66000	9.998280	40.60393	86.71607	1.0000000

Table 7.1 presents the analysis of EQUIPMENT FAMILIARITY as follows:

- Done at 5% level of significance; the nurses are not used to most of the equipment/technologies utilized in those healthcare facilities which reemphasizes the point that there are inadequate training programs to update the nurses' skills, competency, and proficiency both in the north and south.
- Data from north and south hospitals for each of the variables are compared.
- Standard error of estimate is 22.3568.
- Result shows that none of the variables is statistically, significantly different at 5% level of significance. In other words, what affect the healthcare facilities in the North equally affect those in the South. The Northern Healthcare facilities are significantly equal in familiarity of the nurses with the medical equipment/technologies utilized in clinical practice.

Table 7.2 presents the analysis of EQUIPMENT USAGE at 5% level of significance as follows:

Data from north and south hospitals for each of the variables are compared.

Std error of estimate;18.4396

Result shows that none of the variables is statistically, significantly different at 5% level of significance. This also means that both Northern and Southern regions experience almost equal similarities in their levels of usage of the equipment/technologies. In other words, there is no significant difference between the North and the South in terms of equipment usage.

Table 7.2. Univariate tests of significance for equipment usage.

Effect	Univariate Tests of Significance for Usage (Sheet 2 in Variable in percent) Sigma-restricted parameterization Effective hypothesis decomposition; Std. Error of Estimate: 18.4396				
	SS	Degr. of	MS	F	P
Intercept	52272.90	1	52272.90	153.7350	0.000002
Location	213.44	1	213.44	0.6277	0.451038
Error	2720.16	8	340.02	0.0000	0.000000
Means					
	Location	Usage mean	Usage std.err.	Usage -95.00%	Usage +95.00%
	North	76.92000	8.246448	57.90366	95.93634
	South	67.68000	8.246448	48.66366	86.69634

Table 7.3. Univariate tests of significance for needs assessment.

Effect	Univariate Tests of Significance for Needs Assessment (Sheet 3 in Variable in percent) Sigma-restricted parameterization Effective hypothesis decomposition; Std. error of estimate: 18.8652				
	SS	Degr. of	MS	F	P
Intercept	48441.60	1	48441.60	136.1119	0.000003
Location	34.60	1	34.60	0.0972	0.763177
Error	2847.16	8	355.90	0.0000	0.000000
Means					
	Location	Needs assess mean	Need assess std.err.	Needs assess - 95.00%	Needs assess +95.00
	North	71.46000	8.436771	52.00477	90.91523
	South	67.74000	8.436771	48.28477	87.19523

Table 7.3 presents the analysis of The analysis for NEEDS ASSESSMENT, done at 5% level of significance as follows:

- Data from north and south hospitals for each of the variables are compared.
- Standard error of estimate;18.8652
- Result shows that none of the variables is statistically, significantly different at 5% level of significance.
- This also goes to explain the fact that both the Northern and the Southern Healthcare facilities are equally affected in terms of needs assessment of emergency equipment.
- Even though the Needs Assessment level of the North is approximately 72% while that of the South is approximately 68%, the difference between the two regions is not statistically significant.

Table 7.4. Univariate tests of significance for maintenance culture.

Effect	Univariate Tests of Significance for MTCE CULTURE (Sheet 4 in Variable in percent) Sigma-restricted parameterization Effective hypothesis decomposition; Std. Error of Estimate: 19.2397				
	SS	Degr. of	MS	F	P
Intercept	51051.03	1	51051.03	137.9135	0.000003
Location	16.13	1	16.13	0.0436	0.839868
Error	2961.34	8	370.17	0.0000	0.000000
Means					
	Location	MTCE CULTURE mean	MTCE CULTURE std.err	MTCE CULTURE - 95.00%	MTCE CULTURE +95.00%
	North	72.72000	8.604266	52.87853	92.56147
	South	70.18000	8.604266	50.33853	90.02147

Table 7.4 presents the analysis for MAINTENANCE CULTURE, done at 5% level of significance as follows:

- Data from north and south hospitals for each of the variables were compared.
- Std error of estimate;19.2397
- Result shows that none of the variables is statistically, significantly different at 5% level of significance. In other words, the level of their maintenance culture still maintains a ratio of 1:1. Therefore, there is no significant difference between the two regions.

Table 7.5. Univariate tests of significance for availability and functionality.

Univariate Tests of Significance for Availability/Functionality. (Sheet 5 in Variable in percent) Sigma-restricted parameterization Effective hypothesis decomposition; Std. Error of Estimate: 24.7621					
Effect	SS	Degr. of	MS	F	P
Intercept	39150.05	1	39150.05	63.84965	0.000044
Location	168.92	1	168.92	0.27549	0.613901
Error	4905.28	8	613.16	0.00000	0.000000
Means					
	Location	Avail/Func . mean	Avail/Func. std.err	Avail/Func. -95.00	Avail/Func. +95.00
	North	66.68000	11.07393	41.14346	92.21654
	South	58.46000	11.07393	32.92346	83.99654

Table 7.5 presents the analysis for AVAILABILITY/ FUNCTIONALITY, done at 5% level of significance as follows:

- Data from north and south hospitals for each of the variables were compared.
- Std error of estimate;24.7621
- Result shows that none of the variables are statistically, significantly different at 5% level of significance. In other words, there was no significant difference between the north and the south in area of Availability and Functionality of Medical Equipment. That means their ratio is also approximately 1:1. What this explains to us is that the North and the South equally experience approximately the same level of significance in terms of Availability and Functionality.

Table 7.6. Univariate tests of significance for validity and reliability.

Univariate Tests of Significance for Validity/Reliability (Sheet 6 in Variable in percent) Sigma-restricted parameterization Effective hypothesis decomposition; Std. Error of Estimate: 16.9527					
Effect	SS	Degr. of	MS	F	P
Intercept	45522.01	1	45522.01	158.3966	0.000001
Location	314.72	1	314.72	1.0951	0.325931
Error	2299.14	8	287.39	0.0000	0.000000
Means					
	Location	Val/Relia mean	Val/Relia std.err	Val/Relia - 95.00%	Val/Relia +95.00%
	North	61.86000	7.581458	44.37713	79.34287
	South	73.08000	7.581458	55.59713	90.56287

Table 7.6 presents the analysis for VALIDITY/RELIABILITY, done at 5% level of significance as follows:

- Data from north and south hospitals for each of the variables were compared.
- Std error of estimate; 16.9527
- Result shows that none of the variables are statistically, significantly different at 5% level of significance. Again, there is no significant difference between the North and the South in terms of

Validity and Reliability of Medical Equipment. This means that both the north and the south face the same challenges in area of validity and reliability.

4. DISCUSSIONS

From Table 1-7 it can be seen that

- Equipment Familiarity saw Hospital 1 as the most compliant amongst all participating healthcare facilities in the country with 100% of its nurses already familiar with the medical equipment/technologies in clinical practice. This is followed by Hospital B.
- Equipment Usage also had 100% of nurses in Hospital 1, as most compliant amongst all the participating healthcare facilities in the country. This is followed by Hospital B with 97% of their nurses utilizing the equipment available in their facility.
- Needs Assessment of emergency medical equipment captured Hospital B as most compliant with a score of 95%, followed by Hospital 2 with 90%, among all the facilities under review.
- Regarding Equipment Maintenance Culture, Hospital 1 was most compliant with a score of 97%, followed by Hospital 3 with 86%, amongst all participating healthcare facilities in the country.
- Concerning Availability and Functionality, Hospital 1 was also most compliant with a score of 97%, followed by Hospital B with 96.7% compliance.
- Validity and Reliability also saw Hospital 1 as most compliant with 98%, while Hospital B appeared second in compliance with a score of 86%.

From the above analyses, it is obvious that the healthcare facilities in Nigeria are still far behind when compared with the developed countries, where technologies are already more advanced in all respects. In other words, usage of technologies in healthcare facilities in Nigeria is still in infancy stage. However, it is encouraging to note that the introduction of modern medical equipment/technologies into the healthcare facilities in Nigeria is changing the orientation of professional nurses across the country towards quality nursing care. It is also interesting to note that capacity building measures have been put in place by some few healthcare facilities to increase the competency level of nurses using these technologies, even though such measures are less than adequate. Certain factors affecting the usage of such technologies in Nigerian hospitals were pointed out in this study. These include Poor Inventory Management and Documentation resulting in delay in repair or replacement of damaged equipment. Inability of the management to procure needed equipment, Epileptic power supply, causing damage to expensive equipment due to power surge, unplanned education and training leading to lack of competency training, Poor equipment maintenance culture and environmental factors were also identified in this study. Unfortunately, however, most of the government-owned healthcare facilities have not been adequately equipped to meet the current standards of clinical practice with such modern technologies. Nigeria is the most thickly populated country in Africa, and therefore is expected to wake up to meet the demands of its citizenry Healthwise. It is rather disheartening to discover that, though staff of such facilities tries to acquire the necessary technologies, they are often frustrated by bad management staff through misappropriation of funds, political tussles, and misplacement of priorities, unfriendly policies and non-proactive attitudes of management.

5. SUMMARY OF FINDINGS

1. Nurses' familiarity with medical equipment/technologies is less than adequate in Nigerian healthcare facilities due to lack of or insufficient competency training, non-availability of the relevant technologies, etc.
2. Majority of the nurses who claimed familiarity with most of the equipment/technologies do not have access to them due to insufficient supply, non-availability, or non-functionality.

3. Supply of emergency equipment/technologies needed in emergency situations is critically insufficient in the Nigerian Healthcare Facilities.
4. There is generally lack of good maintenance culture displayed by the nurses and other healthcare providers when handling the equipment/technologies in patient care, leading to too frequent equipment damages and non-functionality.
5. Majority of the healthcare facilities do not have the provision to assess the validity and reliability of the equipment/technologies used in patient care.
6. Delay in repair or replacement of damaged equipment has been clearly unveiled, and institutional policy is highly implicated as a major cause, amongst other factors.

6. LIMITATIONS OF THE STUDY

6.1. *The Limitations of This Study Include but are Not Limited to the Following*

- Possible dishonesty from the respondents.
- Difficulty in retrieving the questionnaires from the respondents.
- Logistic challenges.
- Lack of funding.
- Time constraints.

7. IMPLICATIONS OF FINDINGS

The findings as stated above have implications for nursing.

7.1. *The Implications of Findings Can Be Highlighted as Follows*

- Non-familiarity of the nurses with the equipment/technologies will adversely affect the overall quality of client care, as this gives room to compromising the care given and potential damage to the equipment, amongst others.
- No matter how familiar the nurses could be with the equipment/technologies, without utilizing them in their day-to-day patient care, the accuracy and consistency of patient care quality may be negatively affected and the opportunities to make further discoveries that could lead to further research might be lost.
- The absence of emergency equipment/technologies when needed in an emergency creates tension and disorderliness, leading to unnecessary loss of lives, especially if the patients were not referred quickly and appropriately to other facilities with higher levels of care.
- Lack of proper maintenance culture shortens the lifespan of medical equipment/technologies, as this would create rooms for frequent damages and faulty results.
- In the presence of non-availability and/or non-functionality of medical equipment/technologies in any healthcare facility, there would be frequent records of negligence, and one of the tenets of Operational Excellence, which says: "Always Ensure Safety Devices are in place and functioning" would be breached.
- A healthcare facility where validity and reliability of medical equipment/technologies are not guaranteed will most likely produce erroneous clinical parameters and adversely affect the quality of patient care.

8. RECOMMENDATIONS

8.1. *The Recommendations from the Study are as Follows*

1. Competency training programs should be organized regularly and frequently for the nurses in all healthcare facilities, with much emphasis on familiarity, usage, maintenance culture, validity, and reliability of medical equipment/technologies in healthcare delivery.

2. The hospital management should, as a matter of urgency, procure the relevant equipment/technologies needed in both routine and emergency care of patients. When routine care is ignored, it will give birth to emergency situations.
3. Adequate budget should be made available for good maintenance culture in every healthcare facility, and this should be closely monitored to ensure good financial accountability.
4. All healthcare providers and users of healthcare technologies/equipment should imbibe good maintenance culture to care for, maintain and prolong the lifespan of the equipment/technologies used in clinical practice.
5. Any damaged equipment/technology used in healthcare delivery system should be repaired or replaced urgently as appropriate to prevent unhealthy gaps.
6. Provisions for Quality Control System should be made to assess the validity and reliability of the equipment/technologies used in healthcare delivery on a regular basis.
7. Efforts should be made by the nurses to utilize every available opportunity of using those technologies to pave way for further research on the usage of technologies in clinical practice. Use of Standard Operating Procedures, especially for the manufacturer-specific equipment/technologies, should be encouraged.
8. Healthcare providers should imbibe the culture of always following written procedures for high risk or unusual situations, especially as it concerns the equipment/technologies used in patient care, so as to prevent short cuts and prolong their lifespans.
9. All stakeholders in the healthcare industry should adopt, maintain, and sustain the culture of always addressing abnormal conditions promptly. In other words, all stakeholders in healthcare should promptly attend to any abnormal situation as it occurs in clinical practice. No procrastination should be entertained.

9. CONCLUSION

The study has shown that the availability, functionality, and familiarity in the usage of technologies in the healthcare industry have great influence on the way nurses carry out their duties and the outcome in patient care. From data analysis, challenges encountered by respondents were mainly because of inadequate familiarity with the technologies, ineffective usage of the available technologies, non-availability of relevant equipment for patient care, non-functionality of the appropriate medical equipment, as well as less-than-adequate validity and reliability of the available medical equipment. It is therefore important for the nurses to avail themselves of every opportunity at their disposal to practice and utilize those equipment/technologies in their day-to-day management of patient. It is essential that these nurses must acquaint themselves with the necessary technical skills needed to become proficient. However, these could certainly be possible if the hospital management and organizational stakeholders procure the appropriate equipment/technologies for use and sustain their maintenance.

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