Direct Research Journal of Public Health and Environmental Technology

Vol. 9(3), Pp. 106 -131, October 2024,

https://journals.directresearchpublisher.org/index.php/drjphet

Research Article
ISSN: 2734-2182

The Utilization of Information Communication Technology and Its Perceived Effects on Quality Health Care Delivery Services among Nurses in Edo North

Lucky Wesley Ifiabor[1]* and Immaculata Etim Bassey[2]

[1]College of Health Sciences Department of Nursing Science, Igbinedion University Okada, Edo State, Nigeria.
[2]College of Health sciences Department of Nursing Science, Igbinedion University Okada, Edo State, Nigeria.
Corresponding author email: ifiabor.wesley@iuokada.edu.ng

ABTRACT

Information and Communication Technology (ICT) significantly impacts nursing services by enhancing efficiency, improving patient care quality, and facilitating better communication and data management. This study investigates the utilization of information communication technology and its perceived effects on quality health care delivery services among nurses in Edo North. Employing a descriptive cross-sectional design, the study involved 250 nurses from six general hospitals. Data ICT tools, with a mean confidence score of 3.0, indicating readiness to integrate technology for improved patient care. EHRs are the most utilized ICT tool, with a mean agreement score of 2.6, highlighting their critical role in maintaining comprehensive patient records and enhancing healthcare delivery were gathered using questionnaires based on the Technology Acceptance Model (TAM) and the Relevance of TAM Model (RTM). Findings revealed that nurses exhibit positive attitudes towards. The lack of ICT use, especially in personalized care, has a mean negative impact score of 2.8, showing significant detriments to care quality without technology adoption. The primary barrier to ICT adoption is the lack of training (mean score of 3.0), emphasizing the need for comprehensive training programs to enhance technology utilization in healthcare. The study's findings underscore the critical importance of Electronic Health Records (EHRs) in maintaining comprehensive patient information and enhancing overall care quality. However, significant barriers to ICT adoption, particularly the lack of adequate training, hinder its full integration into personalized patient care. The study highlights that younger nurses demonstrate greater readiness to adopt ICT tools compared to their older counterparts, suggesting a generational divide in technology acceptance.

Keywords: Utilization, Information Communication Technology, Effect and Nurses

Article information
Received 2 August 2024;
Accepted 12 September 2024;
Published 23 October 2024
DOI: https://doi.org/10.26765/DRJPHET31770563

Citation: Ifiabor, L. W., and Bassey, I. E. (2024). The Utilization of Information Communication Technology and Its Perceived Effects on Quality Health Care Delivery Services among Nurses in Edo North. Direct Research Journal of Public Health and Environmental Technology. Vol. 9(3), Pp. 106-131. This article is published under the terms of the Creative Commons Attribution License 4.0.

INTRODUCTION

Nigeria is placed at 142 out of 195 countries according to a Lancet report´s ranking of health systems performance using healthcare access and quality as its criteria. Nigeria also ranks poorly based on the World Bank's Universal Health Coverage Service Coverage Index (Fullman *et al.*, 2018). Effective health-care delivery is usually a function of the quality, accessibility, and affordability of the service. Quality healthcare is not a fundamental human right in Nigeria; however, it forms part of the Fundamental Objectives and Directive Principles of State policy (Abdulraheem *et al.,* 2022). The implication of this is that quality health is not a right that can be enforced in a court of law, but every government has an obligation to provide quality healthcare services to its citizens. There is

not yet a consensus on the definition of quality of care, but there is a convergence of views that the definition of quality of care should include care attributes such as treatment effectiveness, acceptability, efficiency, the appropriateness of health interventions as well as equity (Car, 2018). Health is a multi-dimensional construct with diverse aspects as well as multiple determinants. Among factors that could influence the health outcome is the adequacy of health services, which in many settings are designed to be available, affordable, accessible, appropriate, as well as being equitably distributed. These services could be delivered from a multi-tier system and from privately or publicly owned health facilities. For either public or private health facilities, there continues to be the concern of whether health services are delivered in a way that guarantees optimal clients' and other stakeholders' satisfaction with services provided (Ibrahim, bin Mohtar, Dutse, 2022).

Several research studies on the quality of health delivery have been undertaken over the years. Stakeholders have shown interest in ascertaining if the care provided to patients is appropriate and safe for the patient. This is based on the consideration that quality care should meet internationally best practices for the beneficiaries of the health care services. A critical goal of health care delivery in both developing and developed countries is the achievement of sustainable high quality of care at reasonable cost. This is premised on the assumption that quality can be measured, monitored, and improved.

The demand for high quality and affordable health care is spurred by the ever-evolving demographic, epidemiology, and political systems in the world as well as greater complexities in the pattern of diseases and the preferences of health consumers.

The satisfaction of the patient after a health care delivery encounter is now accepted as an indicator of quality health care delivery and this can act as a guide to the level of patient-centered health care that is provided by the health care facilities. Besides the burgeoning influence of consumerism in health care, other drivers of quality in health care include the knowledge and competence of health care providers; attitude toward the use of health care equipment; abilities to overcome the challenges and barriers of using health care facilities; patient cooperation; health insurance; leadership and management styles in health facilities; collaboration; available referral system; job satisfaction of the health care providers, etc. (Mosadeghrad, 2020).

Over the past two decades, there have been significant developments in information and communication technology and the extent of its use in nursing worldwide (While & Dewsbury, 2019). In many countries, including Nigeria, health care systems are changing at a rapid rate. Many of today's nurses were born in the industrial age and are now living in an intensifying technological age. As information technology becomes critical to the workplace, nurses are required to come to terms with the increasing reliance on information technology in the work environment (McCannon & O'Neal, 2023). The adoption of Information Communication Technology (ICT) among general practitioners is to provide access to the health services for the citizens.

Hence, the role of health information technology (HIT) has become an absolute necessity rather than an option in nursing practice in Nigeria. Nursing informatics (NI), a specialty within HIT, has transformed healthcare and nursing practice by increasing patient safety, improving healthcare quality, and reducing healthcare costs by integrating the best practices into patient care. According to Canadian Nursing Informatics Association (2019), nursing informatics refers to the practice and science of integrating nursing information and knowledge with technology to manage and integrate health information.

The American Nurses Association in (2019) defined Nursing Informatics as a specialty that integrates nursing science, computer science, and information science to manage and communicate data, information, and knowledge in nursing practice.

Nursing informatics facilitates the integration of data, information, and knowledge to support patients, nurses, and other providers in their decision making in all roles and settings. This support is accomplished using information structures, information processes, and information technology. The goal of nursing informatics which is to improve the health of the people and communities while reducing cost cannot be achieved without the full inclusion of Information Communication Technology (ICT).

While the art of nursing may lay in the interactions among individuals, one aspect of the science of nursing lies in the gathering of data and its collation into information, and ultimately knowledge. This processing of information is central to nursing practice and a novel change in direction for nursing (Staggers & Thompson, 2019).

Computers can automatically acquire much data. A nurse is required for the interpretation of content. Informatics is a tool, one concerned with the actual process and the impact that information has upon practice.

Nurses use a wide range of health information technology (HIT), including electronic health records (EHRs), computerized provider order entry (CPOE), and barcode medication administration (BCMA) as part of their daily activities (KOPPEL, 2018). These systems have the potential to increase nurses' productivity, for example, by reducing the amount of time that they spend carrying out documentation. New technologies, including health information technologies, play an important role in effectiveness of management and nursing care services. Nursing informatics strives to facilitate the unique job

responsibilities of nurses through optimized health IT methods and software tools. Assessing bedside nurses' self-confidence and competency in computer literacy, informatics literacy, and informatics management skills is necessary to provide an education that is tailored to nurses with different levels of educational preparation and various demographics. Informatics competencies are essential for nursing practice and are critical to providing safe and effective patient care.

Despite some societal influencers sounding the alarm on the malevolence of big data, evidence shows that nursing informatics is one of the best hopes for healthcare in terms of keeping patients safe and minimizing harm (Webb, 2021). For decades, nursing informatics specialists have integrated nursing science with information and analytical sciences to identify, define, manage and communicate data, informatics, knowledge and wisdom (Schoenbaum & Anna., 2020). Several ways in which nursing informatics can have a positive impact on patient care exist. Technology brings nurses closer to the patient and helps them to perceive the patient holistically.

Nursing informatics have been fully integrated into the healthcare system of Edo state, but it is an emerging specialty and the level of Information Technology literacy among health professional is far below average (Lambooji *et al.,* 2019). This is due to lack of knowledge, lack of skills, lack of technical knowhow about the skills of nurses working in hospitals in using databases and the internet for information retrieval and acquisition of treatment modalities for better patient care (Oladeji & Okunlade, 2018).

Despite the benefits they stand to gain adopting ICT in their work, nurses expressed frustrations such as restrictions of access to the technology, software that do not always fit job specifications and lack of training opportunities. Several countries in Africa are implementing eHealth projects including Algeria, Benin, Burkina Faso, Burundi, Cameroon, Chad, Republic of Congo, Cote d'Ivoire, Ethiopia, Ghana, Kenya, Madagascar, Mali, Mauritania, Niger, Rwanda, Senegal, and South Africa. These technologies can improve efficiency in time and resource utilization and facilitate complex decision making. Diagnosis and treatment of patients can also be enhanced using these systems. However, these projects in the region continue to be on small scale and fragmented (World Health Organization, 2018).

It has been reported that despite having a good number of nursing informatics innovations in the health care industry which are evidence-based, the problem of adequate dissemination of such innovations remains a problem in Edo state. Beginning in late 2014 and in the first half of 2015, the Nigerian Federal Ministry of Health (FMOH) and Federal Ministry of Communication Technology (FMCT) led the multi-sectorial and stakeholder development of the National Health Information and Communication Technology (Health ICT) Strategic Framework (Government of Nigeria, 2018). This framework, which incorporates the effort and inputs of over 150 public and private health and technology sector stakeholders, is a three-part document that articulates the collective vision and necessary actions of stakeholders involved in the health system in Nigeria.

Borne out of the recognition for the opportunities that ICT present to support health systems strengthening and the achievement of health system goals, the National Health ICT Strategic Framework positions Health ICT within the current context of the health system. This means addressing Universal Health Coverage (UHC), one of the main priorities of the Federal Government of Nigeria.

It is important to state that in spite of all these government's efforts, nurses still lack the knowledge, the competence and have poor attitude toward use of ICT for nursing practice. It is based on this background that this study intends to assess the role of nursing informatics on quality health care delivery in Edo North Senatorial District, Edo State, Nigeria.

The Federal Ministry of Health's ability to effectively superintend the health sector is weakened due to the lack of adequate information on health outcomes, health resources, costs and the utilization of services across the various tiers including the federal, state and local levels. Quality health care delivery and providing equitable access to health care for every Nigerian is central in the country's National Health Act. But the Nigerian Health System ranks poorly in terms of access and quality just as the country also ranks poorly on Transparency International's Corruption Perception Index. The problem of lack of access to quality health care is linked with wasteful use of primary care services at referral centres. In the rural communities where the burden of disease morbidity and mortality is high, efficient health expenditure and service utilization is plagued by the absence of adequately functioning Primary Health Centers (PHCs), poor or inadequate cost sharing schemes and due to corrupt practices in the health sector.

Quality healthcare enhances the physical, mental, psychological and, economic well-being of individuals (Runnacles, 2019). Adequate quality of healthcare delivery is essential to curtail the number of people who suffer annually from poorly treated diseases that result in increased morbidity and mortality rates. Quality care delivery in healthcare facilities largely depends on organizational treatment factors and procedures, such as level of care providers' training, nature of the physician-patient relationship, treatment procedures, diagnostic procedures, and facility needs, such as laboratory equipment, number of beds, and types of diagnostic machines (Olapojoye, 2021).

In many countries including Nigeria, health care systems are changing at a rapid rate. Many of today's nurses were born in the industrial age and are now living in an intensifying technological age. As information technology becomes critical to the workplace, nurses are required to come to terms with the increasing reliance on information technology in the work environment (Carter and Barlow, 2020).

The problems related to the delivery of poor-quality care in most healthcare hospitals in Nigeria include increased rates of chronic diseases, medical errors due to lack of knowledge on use of informatics, attitude toward use of ICT, in competencies on the use of ICT, the continual increase in monies spent on healthcare services without commensurate health outcomes and, high morbidity and mortality rates. Nursing informatics, (NI) is a core competency for bedside nurses and preparing a workforce with essential knowledge and skills is crucial to providing safe patient care and quality health care delivery.

However, integration of NI into a nursing workforce with different educational backgrounds, diverse informatics skill sets, various years of experience, and different generations has posed many challenges which have led to poor service and health care delivery. The federal government of Nigeria spends at least 50% of the federal ministry of health's budget on health facilities alone, without concomitant health outcomes (Oyebade, 2019). Despite this unfortunate situation, information on constraints relating to low-quality care delivery in hospitals, which ought to be useful for improving the quality of care in healthcare hospitals, is not available. It is based on this problem that this study intends to assess the role of nursing informatics on quality health care delivery in Edo North Senatorial District, Edo State, Nigeria.

Objectives of the study

The aim of this study is to assess the utilization of information communication technology on quality healthcare delivery in Edo North Senatorial District, Edo State, Nigeria.

The specific objectives of this study will be to:

1. Assess the extent of utilization of information communication technology among nurses.
2. Identify the various Information Communication Technology (ICT) in nursing practice.
3. The effects of non-utilization of information communication technology in nursing practices.
4. Examine the barriers to information communication technology usage among nurses.

Research Questions

1. To what extent do nurses utilize information communication technology (ICT) in their daily practice?
2. What are the different types of Information Communication Technology (ICT) tools and systems used in nursing practice?
3. What are the effects or consequences of not using information communication technology (ICT) in nursing practices?
4. What are the main barriers or challenges that hinder the adoption and effective use of information communication technology (ICT) among nurses?

LITERATURE REVIEW

The Concept of Information Communication Technology

Information and Communication Technology (ICT) refers to the use of technology to manage, process, and communicate information. It encompasses a wide range of technologies, including computers, the internet, mobile phones, and other digital devices. ICT involves the integration of hardware, software, and services that enable the creation, storage, retrieval, and exchange of information (Bwalya, & Sebina, 2021). The component of ICT includes physical devices such as computers, servers, mobile devices, and networking equipment. Hardware forms the foundation of ICT systems, providing the necessary infrastructure for data processing and communication. The advancements in hardware technology have significantly increased the capacity and speed of ICT systems, making them more efficient and reliable (Gurung & Prater, (2020). Software is another key aspect of ICT that consists of applications, programs, and operating systems that run on hardware. Examples include word processors, databases, and mobile apps that facilitate various functions such as data management, analysis, and communication. Software is essential for translating user commands into machine-readable instructions, thereby enabling the hardware to perform specific tasks (Laudon & Laudon, 2020). The key components of ICT encompasses networking,

Networks, including local area networks (LANs) and wide area networks (WANs), enable the connection and communication between different hardware devices. The internet, a global network, is a key component of ICT, facilitating instant communication and access to information across the world. Networking technologies have evolved to provide faster and more secure connections, supporting the growing demand for data transfer and connectivity (Tan & Goh, 2018). ICT services include internet services, cloud computing, and technical support services that enhance the functionality and

accessibility of ICT systems. These services ensure that hardware and software work together seamlessly to meet user needs. Cloud computing; in particular, has revolutionized the way data is stored and accessed, providing scalable and flexible solutions for businesses and individuals (Rittinghouse & Ransome, 2017). ICT has revolutionized various aspects of modern life, including communication, education, business, and healthcare:

Communication

ICT enables instant communication through email, social media, and video conferencing. These technologies allow individuals and organizations to connect and collaborate from different parts of the world, breaking down geographical barriers (Castells, 2019).

Education

ICT has transformed education by providing access to vast amounts of information and learning resources online. E-learning platforms and educational software enable interactive and personalized learning experiences, improving educational outcomes (Voogt & Knezek, 2018).

Business

ICT streamlines business operations through automation, data management, and online transactions. E-commerce platforms enable businesses to reach a global market, while enterprise software enhances productivity and efficiency (Bharadwaj et al., 2018).

Healthcare

In healthcare, ICT improves patient care through electronic health records (EHRs), telemedicine, and health information systems. These technologies enhance the accuracy of diagnoses, facilitate remote consultations, and improve the management of patient data (Agarwal et al., 2016).

Despite its numerous benefits, ICT also presents challenges that need to be addressed, including issues related to cybersecurity, data privacy, and the digital divide. Ensuring the security of information systems and protecting user data from breaches and unauthorized access is paramount (Smith & Watson, 2018). Additionally, efforts must be made to bridge the digital divide, ensuring that all individuals have access to ICT resources and the benefits they offer (Ragnedda & Muschert, 2018). In summary, ICT is a critical component of modern society, enabling individuals, businesses, and organizations to operate effectively and efficiently. Its broad range of technologies and applications has transformed various sectors, enhancing communication, education, business operations, and healthcare. As ICT continues to evolve, addressing challenges such as cyber security and the digital divide will be essential to fully realize its potential.

There have been amazing advancements in healthcare technology over the past few decades, giving medical professionals access to more data with greater reliability than ever before. And with the evolution of informatics, nurses can leverage the information resulting from these scientific marvels to provide better care and treatment to patients.

Informatics has contributed to many innovations in healthcare delivery, including the adoption of digital health records, standardization of diagnostic information, simplified health insurance administration and improved patient privacy (Hart, 2020). Within the larger field of health informatics, nursing informatics uses data management and information technology approaches to improve patient care practices and prevent adverse health outcomes. Because nurses make up the majority of direct care practitioners, they are in an ideal position to make an impact as specialized experts at the intersection of healthcare and technology. Registered nurses go beyond providing clinical care to take on roles in operations, education, leadership, and technology in today's healthcare system. Nursing informatics allows nurses to deliver evidence-based and patient-centered care, improve human health and advance medical research. It also enhances clinical workflows so that nurses and other personnel can care for patients more efficiently and effectively (Hart, 2020).

While nursing informatics is an essential component of care delivery today, there is a long tradition of innovative nurses using data to improve clinical practice and patient health. The history of nursing informatics dates back to the 1850s, when healthcare pioneer Florence Nightingale originated the practice by collecting, organizing and processing data to enhance sanitation via nursing and medical protocols. Nursing-specific engagement with information technology started a little over a century later, in the 1960s. The following decade saw the first conference on nursing and computers, along with the international publication of nursing-specific informatics papers by American and British healthcare professionals. Then, in the 1980s and early 1990s, we saw such advancements as the creation of the International Medical Informatics Association (IMIA) Nursing Informatics working group and the practice-related activity of the International Council of Nurses (ICN). A U.S. newsletter called Computers in Nursing, which was the forerunner to the journal CIN: Computers, Informatics, and Nursing were founded in 1983.

The formal establishment and definition of nursing informatics as a specialty practice by the American Nurses Association occurred in 1992, which was the

same year that an official certification program for the field was created. Since then, there have been updates to the core content and requirements for certification to keep up with continually evolving theory, practice and technology. There have also been organized endeavors to advance informatics education and workforce training, one of the most notable of which was the TIGER (Technology Informatics Guiding Education Reform) Initiative in 2006 (Sam, 2019). As nursing informatics plays an increasingly central role in hospitals and other healthcare organizations, experts are needed at every level to collect health information, process findings and communicate conclusions to clinicians and other stakeholders. From frontline practice to executive-level leadership, nurse informatics significantly impact patient care and organizational efficiency. Nursing informatics strives to facilitate the unique job responsibilities of nurses through optimized health IT methods and software tools. Specialists known as nurse informatics may apply their skills to:

- Develop data structures and software tools for nurses to use
- Keep electronic health records aligned with best practices for data management, processing and organization
- Implement analytics to monitor and facilitate nursing processes
- Enable healthcare and IT professionals to communicate with each other more effectively
- Develop and enforce privacy policies in accordance with ethics and regulations
- Educate providers in how to make the best use of electronic health records and clinical decision support systems.

Nurses who build the skills to solve problems through technology and quantitative analysis can succeed in nursing informatics careers. These professionals commonly hold job titles such as:

- Chief Medical Information Officer
- Chief Nursing Information Officer
- Chief Technology Information Officer
- Clinical Informatics Analyst
- Clinical Informatics Nurse
- Clinical Informatics Specialist
- Clinical Informatics Systems Analyst
- Digital Diabetes Research Officer
- Nursing Informatics Officer
- Nursing Informatics Specialist
- Nursing Information Systems Coordinator
- Registered Nurse Clinical Information Systems Educator.

Nurses' utilization of Information Communication Technology (ICT)

The environment in healthcare encompassed more than just a physical location. There is an increase in the use of ICT such as mobile computers, wireless solution and automated exchanges between health providers and patients. Adapting to these new environments requires a paradigm shift on communication and delivery of care, which requires knowledge of the evolution of new technologies. Nurses are at the centre of this advancement as the professionals with the greatest amount of direct patient care. Health environments now incorporated virtual office visit, online appointments scheduling and payment mobile laboratories and electronic medication prescription. Nurses are also essential in helping patients set up their own personal health records (PHRs) or explaining to patients how to use a patient how to use a patient portal.

The challenge for these technologies with healthcare is ensuring that the automated solutions completely interact with one another, as well as with the healthcare professionals using Health Information Management System (HIMS) (David, 2019) Although, the knowledge of Information Technology projects management exist, its utilization has not been very significant (Toivanen et al 2019). There are numerous studies on the acceptance and use IT in healthcare. Many organizations in the process of implementing IT for nursing practice has experienced resistance from the staff (Palm et al., 2021; cited in the works of Marital, 2019). The inherent potential of the various components of Information communication technology (ICT) to prevent health medical complications cannot be over emphasized. According to Gibbs (2019), preventing medical errors, improving care and patient safety are among the most important advantages of adopting information communication technology (ICT) in healthcare. More than ever, healthcare is being driven by need to access and use ICT, regardless of where services are delivered.

David (2019) stated that modern information communication technology innovations increasingly influence standards of care by allowing patients and providers to be better informed. This enables more efficient diagnosis and treatment of illness and improves the relief of suffering. Patients are also uniquely empowered because they can access health information directly without depending on physician, clinics and hospital to select what they read and hear about health and healthcare (David, 2019). Too often, the indirect patient care activities lead to nurses frustrating and dissatisfaction with profession and healthcare environment.

ICT is radically needed to manage the tasks and activities that disrupt, interrupt, and remove the nurse from providing direct patient care.

The increasing amount of times nurses spend on indirect patient care activities must come at the cost of sacrificing some level of patient care. A short but comprehensive list includes change of list or new patient admission, reporting, verification of medication orders, incident report, dietary ordering, charging planning etc. Health care staff has a major role in selecting the most reasonable health information sources for patients and ensuring that the information sources used are reliable (Kim et al, 2020). Internet was used by 79% of the population of a particular country at the beginning of 2007 and 59% of users reported seeking health-related information (Finland Statistics 2020). Users' acceptance has been viewed as the pivotal factor in explaining the success of new IT applications (Marital, 2019). Lack of acceptance is a significant barrier to the success of new IT applications. To ensure that nurses have capacities to use new working methods with IT and to guide patients on how to use computers or to evaluate the quality of the health information available, nurses" acceptance of IT should be ensured (Repique, 2018). This will be achieved by means of on-the-job training including IT education, developing the content of work and management systems and by offering opportunities to learn at work (Andrew, 2018). Acceptance of IT has been considered from the perspectives of attitudes, that is motivation to use IT, satisfaction with IT and experience of the benefits of IT.

Nurses' competencies in use of Information Communication Technology (ICT) in nursing practice

Competence as generally defined in Oxford Advance Learner's Dictionary (2018) is "the ability to do [something] well" or together with its less frequent version competency "a skill that you need in a particular job or for a particular task". Those definitions stress the importance of skills in the process of gaining competence. However, competence in nursing is hardly limited to skills. Many nurse researchers and theorists, with Peplau (2018) at the frontline, underline the humanistic side to nursing and the need to find balance between science and art as a core of nursing practice. Peplau states clearly that "the most useful nursing services for people can only be achieved if both the art and the science of nursing are retained, fully developed, and used in nursing practice" (2018). The artistic aspect encompasses skills, personal ideals, values and attitudes while the science is synonymous with nursing knowledge (Peplau, 2018).

The presence of health information on the internet has equalized knowledge opportunities among the healthcare providers and the patients creating an e-patient phenomenon (Darvish et al., 2019). Nursing informatics can enhance the information sharing between the nurses and the patients building unique relationships that lead to positive patient outcomes. Electronic health records can change the quality of care and patient outcome. According to Brennan and Bakken (2022); Gephart (2020), nursing informatics allows healthcare providers to address patient needs on time while allowing the patients to access their diagnosis information quickly. Moreover, the authors underlined that nursing informatics promotes patient-centred healthcare, educates patients and health professionals, and improves healthcare quality. Nursing informatics has improved management systems, information systems, communication systems, and computerized decision-making systems. Fundamentally, improvements in the healthcare systems point back to the patient outcome, where promotion in each system improves the well-being of the patients in the hospitals, leading to positive results. However, the issue of implementing nursing informatics remains a complicated subject encompassing dynamics at various levels, including patients, healthcare providers, and healthcare organizations. Such challenges may result in reduced performance, and patients' needs may not be addressed to the recommended standards, hindering the patient-centred healthcare framework (Rouleau, Gagnon, Côté, Payne-Gagnon, Hudson, & Dubois, 2021).

Competent use of ICT requires from nurses the skill to incorporate ICT in their working routines. Nilsson, Skär, & Söderberg (2019) observe that the mobile phone application enables nurses to write messages wherever they are thus not binding them to one specific working environment. This requires adopting new working routines and might be challenging for many nurses (Meristö *et al.,* 2019).

According to Kouri, *et al* (2018), the use of ICT requires from nurses the ability to "function as a 'go-between'", meaning that the nurses should be able to consider the information available digitally to the clients/users to communicate with them. The issue of verbal versus non-verbal communication is discussed by Gund, Sjoqvist, Wigert, Hentz, Lindecrantz, and Bry (2019), as their study involved both text-based ICT application and video-based Skype. According to the clients, being able to see the nurse improves communication (Gund et al. 2019).

The category of knowledge required from nurses for competent use of ICT consists of such subcategories as training and development, nursing interventions, legal issues and IT literacy. To achieve competence nurses should undergo sufficient training in ICT applications and devices (Loh et al. 2019). This requires time and resources as well as personal, versatile training options and support (Nilsson et al. 2019). Additionally, nurses could be involved in projects developing ICT (Kouri et al. 2019 184). Nurses should be knowledgeable about legal issues concerning nursing practice and ICT utilization. These include privacy protection, confidentiality, data security and security procedures (Loh et al. 2019). Additionally, the legal limitations of responding to ICT

facilitated information and advice should be clear and known to nurses.

Nursing Informatics has developed into a mandatory focus for all registered nurses on a global scale (Kaminski, 2019). Now, in the twenty-first century, official organizations, schools, and continuing education which help prepare nurses for engaging in informatics related practice are springing up all over the world especially in technologically advanced nations. There is however a growing need for practicing registered nurses, nurse educators and researchers and nursing administration to ensure that the expected competencies in informatics are met. Nurses certified in Nursing Informatics are skilled in the analysis, design, and implementation of information systems that support nursing in a variety of healthcare settings; function as translators between nurse clinicians and information technology personnel and ensure that information systems capture critical nursing information American Library Association (2010).

The TIGER Nursing Informatics Competencies Model (2007) consists of three parts: Basic computer competencies, information literacy and information management. Grobe (2019) identified three levels of competencies as: beginner entry or user level, intermediate or modifier level and advanced or innovator level of competency. Each of the three competency levels includes both knowledge and skills required to: use information and communication technologies to enter, retrieve and manipulate data; interpret and organize data into information to affect nursing practice; and combine information to contribute to knowledge development in nursing. The expertise of these competencies is in a continuum and include;

Technical competencies

Technical competencies are related to the actual psychomotor use of computers and other technological equipment. Specific nursing informatics competencies include the ability to use selected applications in a comfortable and knowledgeable way. It is important that nurses feel confident in their use of computers and software in the practice setting, especially at the bedside, in order to be able to attend to the client at the same time (Kaminski, 2020).

Utility competencies

Utility competencies are related to the process of using computers and other technological equipment within nursing practice, education, research and administration. Specific nursing informatics competencies include the process of applying evidenced based practice, critical thinking, and accountability in the use of selected applications in a comfortable and knowledgeable way (Kaminski, 2020).

Leadership competencies

Leadership competencies are related to the ethical and management issues related to using computers and other technological equipment within nursing practice, education, research and administration. Specific nursing informatics competencies include the process of applying accountability, client privacy and confidentiality and quality assurance in documentation in the use of selected applications in a comfortable and knowledgeable way (Kaminski, 2020). A "User" level of competency indicates nurses who demonstrate core nursing informatics competencies. This level includes practicing nurses, nursing administration, nurse researchers and educators. In most taxonomy, this is the basic level that all nurses should minimally demonstrate, no matter what area of practice he or she works in. The competencies required by nurses in the workplace are categorized in a number of ways. Although different language is used to describe these competencies, the key concepts and categories are quite similar across taxonomies. All proposed frameworks include competencies that describe: the use of information and communication technology (technical competencies), the use of automated information in a professional context (utility competencies), decision-making with respect to planning for and using both the technology and information (leadership competencies).

A "Modifier" level of competency indicates nurses who demonstrate intermediate nursing informatics competencies. This level includes nurses who have mastered basic kills and use technology in inventive ways in their practice and the "Innovator" level of competency indicates nurses who demonstrate advanced and specialized nursing informatics competencies. This level includes practicing nurses, nursing administration, nurse researchers and educators who have mastered expert skills and use technology in design, plan and coordinate the use of technologies and informatics theory in nursing. As of 2009, one of the accepted assumptions in the competencies and blueprint document for the Canadian Registered Nurse Examination (Canadian Registered Nurse Examination Competencies, 2019) is that the entry-level registered nurse uses information and communication technologies to interpret, organize and utilize data to affect nursing practice, improve client outcomes and contribute to knowledge development in nursing.

Factors or barriers the use of Information Communication Technology (ICT) in nursing practice

Despite widespread efforts for facilitating IT adoption and presenting positive impacts or benefits of integrating IT into healthcare, several studies reported that nurses have not adopted such tools completely (Crampton *and* Shachak, 2020). There are still some barriers (e.g.

underutilization and reluctance to use IT, sabotage, nurses' resistance to IT implementations, and unfavorable attitudes toward IT) to the successful interaction of nurses with IT in health care and fitting IT into the workflow of nurses is challenging (Khajouei, *et al* 2018).

The lack of IT adoption can result in unintended negative consequences such as anxiety, fear, a desire to return to paper system, deterioration of work conditions and quality, dissatisfaction, cognitive overload, exhaustion and sense of ineffectiveness (Simon *et al.,* 2019). Other reported consequences are the failure of IT implementations, or suboptimal user-system interactions, which in turn lead to nurses' frustration, and adverse patient outcomes (Khajouei, Hasman, & Jaspers, 2021). IT adoption can be reinforced by facilitating factors such as minimizing nurses' discomfort about IT, exploring and understanding nurses' experience about positive impacts and the benefits of integrating IT to their practice (Ifinedo, 2018).

On the other hand, the literature showed that IT adoption may vary greatly among different types of organizations and countries. It is also affected by cultural, socio-organizational factors, and demographic features such as hospital size, type of hospital (whether it is educational or not), ownership, location or area (urban or rural), budget, rate of IT staff, nurses' awareness of the benefits of IT, and their IT competencies (Ifinedo, 2018).
One of the negative indicators of inefficient patient care is medication error. The revelation that medical errors in hospitals are one of the leading causes of death has caused unsettling reverberations in the healthcare industry. Scientists have proposed several measures to curb this turmoil. Hoover (2019), for instance, suggested that to achieve a more reliable healthcare system, there is a need to improve the means of sharing data locally and internationally. Various obstacles have been associated with the uptake of among nurses.

Poor government commitment, epileptic power supply with little or no ICT infrastructure within the hospital including minimal internet access, lack of training for staff on ICT and resistance to change have all been identified as the main constraints for IT usage in Nigeria (Manja et al., 2020; Adesuyi et al., 2020; Ceo et al., 2018). Study by Abubakar et al. (2019) further reported lack of proper mobile technology, too long logging time, unreliable connection to the network and too many works demands as major restrictions to nurses and midwives in primary and secondary health facilities from using mobile phones for knowledge update.

The effects of ICT in Nursing Practicing quality health care delivery

The usage information communication technology has improved patient safety and facilitated developments that have revolutionized patient care, thus reducing the risk of adverse outcomes. For instance, electronic medical records (EMRs) have made it possible to keep patients' complete medical and treatment history in digital form, giving nurses and other healthcare practitioners the ability to track data over time, see who is due for checkups or preventive screenings, monitor how patients are doing on health parameters like blood pressure and vaccinations and check and enhance quality of care in general within a practice (Persell *et al.,* 2021).

The effect of electronic health records (EHRs) are even more comprehensive, enabling nurses and doctors to do everything that EMRs allow them to do and much more. They transcend standard clinical data to concentrate on the total health of each patient. As such, they are designed to be shared among all of the person's healthcare providers — nurses and physicians, laboratory technicians, specialists and others — to ensure coordinated, patient-focused care, and thus contain information collected by each of these professionals. For example, with EHRs, data gathered by a patient's primary care provider informs the emergency department clinician that the patient has a specific life-threatening allergy, enabling the clinician to adjust care appropriately, even if the patient is unconscious (Siedlecki & Hixson, 2023).

According to Persell *et al* (2021), informatics is also applied to the specific data within EHRs in order to better structure and organize that information so that large numbers of patients can be quickly identified and given the care they need. Dr. Matthew Solomon, a cardiologist at the Permanente Medical Group and a researcher at the Kaiser Permanente Division of Research in Oakland, California, worked with his team to develop and validate a software technology that could accomplish just that. Then, they applied it to their echocardiography database, which comprised almost a million reports from the past decade. Within a matter of minutes, the software identified nearly 54,000 patients with valvular heart disease, a process that would probably have taken physicians years to complete manually (Evans, 2021).

Another effect of nursing informatics is that a nurse's notes from a patient's hospital stay can be used to create discharge instructions and a plan for follow-up care, allowing the individual to seamlessly transition from one care setting to another (Tubaishat, 2019).Additionally, the role of nursing informatics has improved patient safety by helping caregivers detect indicators of criminal abuse and protect victims. Nurses at John Peter Smith Hospital in Fort Worth, Texas developed and put into practice an algorithm for identifying intimate partner violence and evidence of human trafficking. The algorithm fits smoothly and efficiently into the emergency department (E.D.) nurse workflow, offers step-by-step directions to the nurses and includes a narrative to use in the event that the patient is determined to be a likely victim. Assistance is then provided to patients right away (Brennan &

Bakken, 2022). Nursing informatics improves safety by utilizing technology to facilitate the collection, analysis and reporting of higher-quality data related to patient safety issues and health outcomes, as well as to prevent medical errors and allow for better monitoring and reporting of those that do occur.

Furthermore, informatics enables those in leadership roles, such as CNIOs, to design, develop and implement decision support tools; educate other nurses in the use of these resources; and employ predictive analytics tools to identify at-risk patients and population groups (Evans, 2021). The field of nursing is both vitally important and highly demanding.

A career in this essential field means routinely working long hours on the front lines in hospitals, doctors' offices, long-term care facilities and homes, completing a wide range of complex tasks with potentially life-altering implications. Nursing Informatics offers powerful resources to help meet these responsibilities and improve the standard of care (Tubaishat, 2019).

The findings garnered from health IT systems, electronic health records and software tools can not only assist in nurses' daily tasks but fuel transformation throughout a healthcare organization. Informatics professionals investigate data to find powerful means of helping providers fulfill their duties and collaborate across multiple disciplines (Siedlecki & Hixson, 2023). Adelphi University's Department Chair of Graduate Nursing Studies Edmund J.Y. Pajarillo suggested that shifts over the next decade may have widespread effects on the nursing profession. "Technology is causing sweeping changes so that the traditional roles of nurses might become outdated," Pajarillo said. By embracing the possibilities of informatics, nurses and other healthcare professionals can position themselves ahead of the curve. Some of the most promising effects from the advent of informatics-driven strategies in nursing include:

Superior results for patients

Accurate and thorough electronic health records are essential to high-quality treatment. Informatics ensures that organizations have the platforms and processes in place to document each patient's condition and history in depth while complying with privacy regulations. Digital connections place extensive biometrics and pharmacy records at nurses' fingertips so they can plan interventions and share the relevant findings with various departments. Nursing staff use informatics solutions to identify patients who are at higher risk for serious conditions and take preventative steps early. Automated alerts minimize the chance for medical errors by warning providers about potential dangers such as a patient's allergy or a hazardous drug interaction (Brennan & Bakken, 2022).

Efficient clinical processes

For years, healthcare organizations have pursued a shift away from a fee-for-service model into providing value-based care. Informatics aids in these efforts to offer systematic, evidence-based treatment that prevents unnecessary or overly expensive procedures. By examining analytics, leaders can set and enforce best practices while meeting the individual needs of each patient. Clinical decision support systems are a powerful means of harnessing data from electronic records and ubiquitous medical devices to standardize care and eliminate waste. Information science professionals implement these software programs to analyze patient data and offer useful information like clinical guidelines. A decision support system may help make diagnoses as well as trigger timely prompts and reminders over the course of treatment.

Coordinated care

Delivering the best possible results for patients often calls for collaboration among healthcare professionals who may work in different departments, facilities, or organizations. Care coordination and communication makes it possible for everyone involved in diagnosis and treatment to organize their efforts and share information.

According to the *New England Journal of Medicine*, the key elements involved in care coordination are:

- Access to a variety of healthcare services and providers
- Clear communications and effective planning among the providers
- A holistic approach to a patient's medical needs
- Information shared with patients in terms they can understand

Digital infrastructure is crucial to making the most of these efforts. When nurses, specialists and other providers easily access details about a patient's needs, they can make more informed decisions and prioritize safety. With extensive security measures and privacy practices in place, professionals can share the necessary health records to ensure they offer the best treatment and avoid redundant procedures.

Reducing mistakes

Enormous amounts of mistakes made within the healthcare system can be very expensive to both patients and providers alike. An error could harm them directly, while procedures or treatments may need to be repeated or changed altogether, leaving many at risk. Eventually,

patients or their families might even file suits to seek justice against providers and health organizations for such negligence.

Nurse informatics, such as clinical decision support systems (CDSSs), can aid nurses in making key decisions more easily while decreasing errors (and, consequently, costs) during the field experience.

To use such health information technologies effectively for patient care purposes requires being knowledgeable of how and where data comes from in order to interpret and utilize its meaning in an optimal fashion with hands-on experience (Brennan & Bakken, 2022).

The finding that nursing ICT helps reduce medication errors in the hospital, as revealed by Monte (2019), is echoed in Tubaishat's (2019) finding.

Tubaishat recommended that hospitals embrace a computing system in their care delivery to reduce the likelihood of errors and improve delivery quality.

Furthermore, the retrospective investigations have noted the critical role of nursing informatics and the immeasurable role of nurse informatics during the covid-19 pandemic (Kaminski, 2020; Lin, Bookman, Sieja, Markley, Altman, Sippel, & Pell, 2020).

Garcia-Dia (2021) presents a narration of the critical of nurse informatics in leading the management of emergent infectious diseases, notably the covid-19.

The American nurse informatics specialists worked remotely around the clock in the healthcare command centers to monitor various health departments that need more nurse deployments or volunteers to keep the patient care activities in progress for positive patient outcomes. At the same time, other nurse informaticists concentrated on the real-time data analysis to provide prompt reports about the situation of clinical care, supplies, and the infection pattern cases (Tubaishat, 2019).

Due to the linkages of the informaticists' dashboard with the electronic health record systems, the healthcare agencies could trace patients' movements to track infection routes.

The real-time data also provided pertinent information about the number of patients with critical care needs to guide triage nurses. As such, the implication of information technology, as integrated into the electronic health record, helps nurses manage and coordinate the patient care services during the infectious pandemic while diminishing associated diagnostic errors (Rouleau et al., 2017).

Information Communication Technology (ICT) resources available for nursing informatics

The application of information and communication technology tools (ICTs), or alternatively e-health tools, to successful health care delivery had been widely demonstrated through various ICT health projects in the developing and developed world. E-health, an umbrella term that encompasses the use of ICT in healthcare, includes telemedicine, where medical advice or consultation is provided over long distances via the Internet, radio, telephone, and other communication devices. In another vein, e-health is the use of ICT tools for the dissemination of health-related information such as HIV/AIDS and vaccination hubs using radio, television, the Internet, or short message service (UNDP, 2022).

Successful application of e-health tools in the developed economies had contributed to the delivery of quality healthcare services. For instance, rapid access to health information can easily be achieved via the World Wide Web (WWW), the Internet, and other relevant facilities like online databases. On the contrary, the utilization of e-health tools in the developing countries is posed with challenges which need to be addressed. These barriers include lack of computer equipment, lack of computer skills, cost of computers, and so on. These have contributed to the unreliability, inaccessibility, and lack of sustainability of ICT infrastructures (Ouma & Herseman, 2018).

E-health projects that were supported by organizations such as the World Health Organization (WHO), United Nations (UN), European Union (EU), and various Non-Governmental Organizations (NGOs) have led to the successful implementation of e-health solutions, especially in the developed world. For instance, EU-supported projects have placed Europe in a world-leading position in the use of health networks, Electronic Health Records (EHR), and the deployment of health information systems. Specifically, ICTs have contributed quantitatively to the health sector in some developing economies through ICT pilot projects. For instance, Greenberg (2018) indicated that several ICT pilot projects have demonstrated improvements such as a 50% reduction in mortality or a 25-50% increase in productivity within the healthcare system. E-health projects have been successfully implemented in countries like Indonesia, the Philippines, and Thailand.

In Indonesia, an integrated web-based GIS was designed to monitor and detect outbreaks of dengue fever among children. Similarly, in the Philippines, a Community Health Information System was designed to disseminate health information to the community and public at large. It is worthy to note that these individual projects were implemented in phases and improved over time. In Thailand, a low-cost hospital information system was designed for rural hospitals to perform certain functions such as workflow management, patient appointment, billing, and patient registration. In order to curtail costs, free open-source software applications (FOSS) were utilized in a networked environment linking fifty (50) rural hospitals to facilitate knowledge sharing (UNDP, 2022).

Similarly, in Uganda, the effective use of ICT had prevented avoidable maternal death. In Bangladesh and India, global satellite technology combated the outbreak of epidemics and ensured effective prevention and treatment through adequate online health information. In South Africa, three health information systems were developed. The first was a National Health Care Management Information System (NHC/MIS). This system was designed to track medical records, patient registration, billing, and scheduling in some selected hospitals. The following information was generated from the system: patient record, ID verification, blood group, last ten (10) diagnoses, treatment prescription, and medical aid (Electronic Government, 2019).

Secondly, an information system was also implemented in the South African Province of Limpopo, which consisted of 42 hospitals (2 mental health facilities, 8 regional facilities, and 32 district facilities). The information system was designed to improve patient care, manage the efficiency of hospitals, increase the quality of services, and track patient records, admissions, discharges, and transfers, appointments, etc. This project was successful only in a few of the hospitals; some factors identified for the failure include not considering the social/professional culture of health organizations, lack of education of users, and failure of developers to identify and learn from past projects.

Thirdly, the South African District Health Information System (DHIS) is a systematic data gathering tool that was used to identify public health issues.

Concept of quality health care delivery

Quality of care is the extent to which the health care system can achieve the desired health care goals, such as effective recovery, preventing premature mortality, halting disease progression from being complicated, and maximizing clients' satisfaction with the care they received (Chassin, Galvin, Angel, Angell, Berenson, Brook et al, 2019). With efficient, integrated, equitable, timely, people-centered, and safe health services, preventive and promotive, treatment, palliative, and rehabilitative quality care could be achieved (Baker, 2018). These services are provided in primary health care (PHC), for which quality is an attribute in the first-contact care of several health conditions (Kruk, Gage, Arsenault, Jordan, Leslie, Roder-DeWan, et al., 2018). Because PHC is planned to deliver essential health services as close to home as possible, it serves as a roadmap to universal health care coverage (UHC), which must be of high quality to achieve the health system's vision.

Quality is currently on the agenda of sustainable development goals that target UHC (Baker, 2018). The World Health Organization (WHO), the Organization for Economic Co-operation and Development, and the World Bank emphasized that ensured quality is a fundamental component of UHC (WHO, 2018). To streamline policy and PHC quality implementation, a series of national strategic directions have been adopted. Notable quality and safety standards or strategies have been established in some countries, for example, Australia European and African countries (WHO, 2018). Good health governance and administration, quality improvement programmes, financial and non-financial support, community empowerment and engagement, competent health care providers, and monitoring and evaluation are some of the quality improvement strategies. These schemes have a vital role in improving the patient experience in PHC, including quality of care, satisfaction, and the health of populations (Baker, 2018).

Quality of care is the degree to which health services for individuals and populations increase the likelihood of desired health outcomes. It is based on evidence-based professional knowledge and is critical for achieving universal health coverage. As countries commit to achieving Health for All, it is imperative to carefully consider the quality of care and health services. Quality health care can be defined in many ways but there is growing acknowledgement that quality health services should be:

Effective: providing evidence-based healthcare services to those who need them.

Safe: avoiding harm to people for whom the care is intended

People-centred: providing care that responds to individual preferences, needs and values.

To realize the benefits of quality health care, health services must be:

Timely: reducing waiting times and sometimes harmful delays.

Equitable: providing care that does not vary in quality on account of gender, ethnicity, geographic location, and socio-economic status.

Integrated: providing care that makes available the full range of health services throughout the life course;

Efficient: maximizing the benefit of available resources and avoiding waste.

Factors influencing healthcare service quality.

The quality of healthcare services offered decides the success of the hospital and establishes its reputation. This is why hospitals generally focus on maintaining the quality of their healthcare services at a premium level. To achieve this, healthcare institutions must concentrate on

these factors influencing the quality of healthcare services.

Range of medical services offered

A hospital may be a small healthcare clinic or a multi-specialty hospital. But the range of the medical services offered by the hospital determines its quality of healthcare services. For instance, patients seeking treatment for critical ailment like cardiac or pulmonary disorders always expect the hospital to be equipped with the latest diagnostic and scanning equipment like ultrasound, X-ray, CT scan, etc. This is because they hardly have the time or the frame of mind to go from one place to another for canning when they are already in trauma. So, patients generally prefer hospital possessing a complete range of diagnostic and therapeutic services. Every hospital should offer at least the minimum range of clinical service required for diagnosing and treating the patients it serves. This includes blood pathology lab, X-ray, ultrasound, EEG, ECG, CT scan facilities, pharmacy, etc.

Clinical competence of the hospital staff

To assess the quality of healthcare services in a hospital, all one has to do is go for a general out-patient consultation or for a blood test. The expertise of the duty doctor in attending to you or the lab technician in taking your blood ample painlessly will give an indication of the clinical competence of the hospital staff. Patients come to the hospital to seek clinical help for their ailments and the first thing they expect is clinical competence from the hospital staff. Every staff member of the hospital should be clinically trained and deployed for handling patient only on ascertaining their professional efficiency. The quality of healthcare services of a hospital lies in the competence of its staff to a large extent.

Physical ambience of the hospital

Patients are in pain and trauma when they enter a hospital. So, the moment they enter the hospital, they should feel relaxed and reassured. This is possible only when the hospital has a clean, hygienic, and pleasing ambience. The interiors of the hospital should be spotless, the décor should be inviting, the furniture should be comfortable, and the atmosphere must be sweet-smelling. There should be no noise or commotion in the hospital and everything should function seamlessly. Such a hospital is said to have top quality of healthcare services.

Amenities provided by the hospital

A hospital is considered to possess the best quality of healthcare services if it provides all the amenities required by the patients in full measure. This includes lifts, cafeteria, free Wi-Fi**,** etc**.** Apart from such physical amenities, facilities like online appointment scheduling and tracking**,** video consultation, etc also elevate the quality of the healthcare services provided by the hospital to the premium range.

Expertise of the physicians

A hospital is a home for recuperation and relief. So, the main thing patient expect from a hospital is swift relief and recovery from their ailments. This depends largely on the expertise of its physicians. A hospital however richly furnished or equipped, will lose its purpose and reputation if it lacks physicians with ample expertise. This is why hospitals should enlist highly qualified and skilled physicians and specialists to maintain the quality of the healthcare services**.**

Behaviour of the staff

A pleasing, considerate and helping staff is what every successful hospital requires. Hospitals must train their staff with the help of expert healthcare consulting firm to make them improve patient satisfaction. Such a courteous staff will be the asset to the hospital and increase its quality of the healthcare services.

In-patient experience

The experience of a patient in the hospital denotes the quality of the healthcare services. Factors like the waiting time of the patient at the hospital, the friendliness of the staff, the comfort and convenience of the patient wards, the number of visits required to complete the treatment, the follow-up from the hospital on the patient's condition, the way the patient's need, and complaint are addressed-all these contribute to the in-patient experience at the hospital.

Theoretical Framework

Technology Acceptance Model TAM (Davis, 1989)

This model is an adaptation of the Theory of Reasoned Action (TRA) by (Fishbein (1975) and Ajzen (1977). The theory states that a person's behavior through their intentions dwells primarily on two factors that influence the usage of new technology: the perceived ease of use and perceived usefulness is one of the strong factors in determining user acceptance, adoption, and usage of technology. It assumes that technology will benefit the user in the performance of task. The more positive attitude towards technology usage, the better he/she performs.

Technology acceptance model has emerged as a useful framework for explaining medical information management system usage and the satisfaction that is derived from it as a nurse. The introduction of ICT in hospitals brings about an ease in information safety and it is quite useful. Nurses can from any location bring out the information of patients to the doctor and get immediate feedback especially from a generation that is technology savvy.

Perceived usefulness refers to the degree to which an individual believes that using a particular system would enhance his or her job. Perceived ease of use technology is another key factor in technology acceptance. It refers to the degree which a person believes that using a technology will be easy and free from effort. The easier the technology is to be used, the higher its possibility to be adopted. Perceived ease-of-use is advantageous for the early acceptance of an innovation, and it is necessary for technology adoption.

The Relevance of TAM to the study

The Technology Acceptance Model (TAM), developed by Davis in 1989, offers significant insights into the utilization of information communication technology (ICT) and its perceived effects on the quality of healthcare delivery services among nurses in Edo North. TAM emphasizes two core constructs: Perceived Usefulness (PU) and Perceived Ease of Use (PEOU). In the context of healthcare, PU refers to the extent to which nurses believe that using ICT tools, such as electronic health records (EHRs) or telemedicine platforms, enhances their job performance and improves patient outcomes. PEOU relates to how easily nurses can use these tools without encountering significant difficulties. Understanding these perceptions is crucial in evaluating how effectively ICT tools can be integrated into healthcare practices and how they contribute to improved care quality.

Applying TAM to this topic allows for an assessment of how nurses' beliefs about the usefulness and ease of use of ICT tools impact their adoption and utilization. If nurses perceive ICT tools as beneficial and easy to use, they are more likely to incorporate these technologies into their daily routines, which can lead to enhanced patient care, improved efficiency, and better health outcomes. Conversely, if the tools are seen as cumbersome or not significantly useful, their adoption may be hindered, potentially affecting the overall quality of healthcare delivery. This evaluation helps identify factors that facilitate or obstruct the successful implementation of ICT in healthcare settings.

Furthermore, TAM can inform strategies for improving the adoption of ICT tools by addressing perceived barriers and leveraging facilitators. For instance, targeted training programs can be designed to enhance nurses' proficiency with ICT tools, thereby increasing their perceived ease of use. Additionally, demonstrating the tangible benefits of these tools can strengthen their perceived usefulness. By using TAM to understand and address the perceptions of nurses in Edo North, healthcare administrators and policymakers can develop more effective interventions to ensure that ICT tools contribute positively to the quality of healthcare services, ultimately leading to better patient care and more efficient healthcare delivery systems.

Application of the Theory to the study

The implication of this theory to the study is that this model suggests that when nurses and health information personnels are presented with new technology, the ease of using this technology propels their intentions to use or adopt it. The significance of this new innovation to enhance quality health care delivery becomes the driving force that will influence their attitudes toward the use of the technology and these attitudes will then affect their willingness to use a given technology for better healthcare delivery.

Empirical review

Nurses extent utilization of Information Communication Technology (ICT)

The study of Joseph *et al.* (2021) investigated Nurses and Midwives Knowledge and Utilization of IT across the secondary health care facilities in Kaduna state, Northwest, Nigeria. Other specific objectives includes: (1).To ascertain Knowledge of IT among respondents. (2).To assesses the Attitude of Nurses and Midwives towards IT. (3).To determines Utilization of IT among respondents in the study setting. Descriptive survey was used for the study. The study population were Nurses and Midwives that have been in the employ of Kaduna state government for not less than one year and are working in secondary facilities. A sample size of 399 Nurses and Midwives was used. Study respondents who met the inclusion criteria for the study were drawn proportionately from the three senatorial districts of the state using simple random sampling technique that were given self-structured questionnaire for their responses. Data entry was done using Statistical package for Social Sciences (SPSS) Version 22 while hypotheses testing was done using chi-square at statistical significant level of .05. Findings revealed a mean score for age of 29.1±14.3. Respondents had adequate knowledge (Mean score = 74.2%) in 10 out of 16 Questionnaire items relating to knowledge of computers. Overall, majority (70.6 %, n=180)) of the respondents demonstrated adequate knowledge of computer by having a final score above the 70% cut off mark. Attitude of respondents was positive as majority reported to have had training in

computer with many having their PC. Study results, however, showed inadequate (mean score 53.7%) utilization of computer among the respondents as more than half (59.6%, n=152) of the respondents had a final score less than the70% cut off mark. There was association between knowledge and utilization of computer and there is difference in the utilization of computer across senatorial districts. The study revealed that knowledge of computer, senatorial districts respectively associated with utilization of computer among respondents in the study setting.

In the northern part of the country, Manja et al (2020) noted, in a study on knowledge and utilization of ICT facilities among lecturers of a College of Nursing and Midwifery in Nigeria, that majority of the lecturers (who are mostly Nurses) had knowledge of ICT with overall mean score for knowledge at 3.63±1.032 which translated to utilization of certain software as power point, Microsoft word adobe reader as well as use of internet, and email in teaching.

Similarly, in a single-facility study carried out in Abuja (North-central Nigeria), Adeleke et al. (2015) found that participants in their study are considerably knowledgeable and skilled especially in the use of electronic mail (52%) and the Internet (47%) mostly through self-efforts which saw majority of respondents reported to have used computer (94%) and the Internet (95%) for more than three years. The study notes that major factors that contributed to the way the healthcare professionals utilized computer and the internet were profession, age, sex and possession of a laptop computer (p =.000). However, of all the health professionals studied, nurses had the least IT knowledge. Ogungbesan *et al* (2022) determined the knowledge and attitude towards utilization of information technology for nursing care delivery among nurses at Olabisi Onabanjo University Teaching Hospital (OOUTH), Ogun state, Nigeria. A cross-sectional design was adopted and samples of 147 consented nurses were proportionately selected in all the units/wards of OOUTH. About 126 questionnaire were retrieved and analysed descriptively for frequency tables, percentage, chart, standard deviation and mean and hypothesis tested with regression at $p<0.05$. Nurses were knowledgeable on IT in OOUTH. More so, the findings showed a positive significant relationship between IT knowledge and utilization of IT for delivery of nursing care among nurses in OOUTH. Nurses should be supply with IT gadgets likewise equip with more knowledge on the utilization of IT for effective delivery of nursing care to patients.

Kamoru *et al* (2022) determined the level of knowledge in the use of ICT among nurses. To determine the perception of nurses about ICT, to access the extent of ICT utilization among nurses to identify the factor militating against ICT use among nurses. This study therefore aims to bridge the gap by identifying various factors affecting utilization and perception of nurses towards ICT use, thus serving as a guide to interventions necessary to facilitate ICT use among nurses thus improving standard of practice. The study was conducted using a convenience sampling techniques and questionnaires as instrument on 90 nurses who are on the institution's payroll. The findings revealed that only 86.6% (78) out of 90 respondents possess ICT skill and 62(68.9%) of all the respondents have heard of the term "information and communication technology before" and not all the respondents have the correct perception towards ICT. Also, ICT is not in use at all in patient management in N.P.H, Aro Abeokuta. The study showed that all nurses in N.P.H., Aro no matter the rank or gender have an averagely positive perception of ICT adoption and use in healthcare services. Several barriers however, which ranges from limited knowledge on computer skills, fear of change, lack of user training in ICT usage, managerial problems (which include poor administrative policy on ICT) to the application related challenges (Which include complexity of the equipment) were identified.

A descriptive survey was carried out by Christian, *et al* (2018) to determine the knowledge and attitude of nurses towards ICT use in healthcare delivery in Federal Teaching Hospital Abakaliki (FETHA), Ebonyi State. Three specific objectives with three research questions and two null hypotheses were postulated to guide the study. The population of the study consisted of 1070 registered nurses in FETHA. A sample size of 107 respondents was purposively selected and used for the study. Data was generated through a researcher-designed questionnaire. Frequency and percentage were used to analyze research question one while means score and standards deviations were used to describe research question two and three. The Analysis of Variance (ANOVA) was used in testing null hypotheses one while Chi-square test was used in testing hypotheses two at 0.05 level of significance. The result of the study showed that: Nurses at FETHA had an average level of knowledge of ICT use in health care delivery as their grand mean percentage is (44.1%); the nurses had negative attitude towards ICT use in health care delivery as their grand mean is (2.32), the result further revealed that nurses had negative attitude towards ICT attributes as their grand mean score is (2.28). The independent variables (gender and age) considered, had no significant influence ($P>0.05$), on the attitude of nurses towards ICT use in health care delivery. The study supports the need for the adoption of ICT in every hospital and the ministry of health (Federal and State) must as a matter of urgency play an active role by coming up with awareness programme, like seminars and workshop on the ICT use among health care professionals including nurses, for a better health care delivery. Hence, any effort by government and other relevant bodies to organize

seminar, workshop on the knowledge and awareness of ICT including training and retraining of health care providers including nurses on the usability of these technologies would be worthwhile.

Ivan *et al* (2020) ascertained Ecuadorian nurses perceive the theoretical advantages and limitations of ICTs, as well as to explore the current use of these technologies in the setting of the professional nursing practice. We conducted an anonymous survey-based cross-sectional study where 191 nurses rated their frequency of use and level of agreement to specific statements on perceptions related to ICTs. For the statistical analyses, adjusted binomial logistic regressions and the chi-squared test for association were applied. In general, 96.3% of nurses reported the use of ICTs to communicate with colleagues, and 80.1% reported the use of ICTs to communicate with patients. More than 70% of participants agreed that ICTs can be useful to promote professional services, help in the search for new job opportunities and/or professional development, foster health promotion, and improve the workflow with colleagues. Meanwhile, 78.6% of nurses had privacy or security concerns about personal and/or patient information, and 60.6% reported not having enough time neither to learn how to use ICTs nor to use them. High use of ICTs was found among Ecuadorian nurses for communicating with both colleagues and patients. Most of the participants had a positive perception of the use of ICTs in the healthcare practice, particularly among younger nurses. Finally, the major reservations perceived were related to privacy and patient confidentiality, and lack of time to learn how to use, or use ICTs.

Luciana, *et al* (2016) carried out exploratory research (survey) using a quantitative method was conducted to identify the experiences of nurses with the use of information technology in primary health care. The research involved 152 nurses of the Health Department of a city in Southern Brazil. The respondents completed the questionnaire Staggers on Nursing Computing Experience between September 2014 and January 2015. In the sample, female professionals n=146 (96.05%), assistant nurses n=67 (44.08%) and specialists n=59 (38.82%), aged 31-40 years n=70 (46.05%),with up to 10 years of experience n=68 (44.74%), reported frequent use of computers n=122 (80%), in care and administrative activities. It is concluded that computers are part of the nursing activities. However, permanent educational actions are needed to improve the incorporation and effective use of information technology skills in health care services and nursing in primary health care.

The study of Li *et al* (2022) examined current informatics competency levels of nurse managers and to identify the variables that influence these competencies. A questionnaire designed to assess demographic information and nursing informatics competency was completed by 68 nurse managers. Multiple linear regression analysis was conducted to analyze the factors influencing informatics competency.

Karen *et al.* (2019) yielded a map of the alignment of American Association of Colleges of Nursing Graduate-Level Nursing Informatics Competencies with American Medical Informatics Association Health Informatics Core Competencies in an effort to understand graduate-level accreditation and certification opportunities in nursing informatics. Nursing Informatics Program Directors from the American Medical Informatics Association and a health informatics expert independently mapped the American Association of Colleges of Nursing competencies to the American Medical Informatics Association Health Informatics knowledge, skills, and attitudes. The Nursing Informatics Program Directors' map connected an average of 4.0 American Medical Informatics Association Core Competencies per American Association of Colleges of Nursing competency, whereas the health informatics expert's map connected an average of 5.0 American Medical Informatics Association Core Competencies per American Association of Colleges of Nursing competency. Agreement across the two maps ranged from 14% to 60% per American Association of Colleges of Nursing competency, revealing alignment between the two groups' competencies according to knowledge, skills, and attitudes. These findings suggest that graduates of master's degree programs in nursing, especially those specializing in nursing informatics, will likely be prepared to sit for the proposed Advanced Health Informatics Certification in addition to the American Nurses Credentialing Center bachelor's-level Informatics Nursing Certification. This preliminary map sets the stage for further in-depth mapping of nursing informatics curricula with American Medical Informatics Association Core Competencies and will enable inter professional conversations around nursing informatics specialty program accreditation, nursing workforce preparation, and nursing informatics advanced certification. Nursing informatics should examine their need for credentials as key contributors who will address critical health informatics needs.

Tracia *et al* (2018) determined the state of the science related to clinical informatics competencies of registered nurses and to determine best practices in educational strategies for both nursing students and faculty. Continued emphasis on the provision of evidence-based patient care has implications for requisite informatics-focused competencies to be threaded throughout all levels of nursing educational programs. White more and Knalf's five-step integrative review process guided this research. An extensive search yielded 69 publications for critical appraisal. Results suggest nursing educational programs do not adhere to standardized criteria for teaching nursing informatics competencies.

Another identified literature gap was the scarcity of research related to informatics training requirements for nurse educators. Findings support the need for continued research to provide clear direction about the expected clinical informatics competencies of graduate nurses and what training faculty needs to facilitate student learning.

Factors or barriers that influence registered nurses' attitude toward the use of Information Communication Technology (ICT) in nursing practice

A quantitative, mixed-method, and qualitative review by Asiri (2022) showed that nursing themes such as patient outcomes, care quality, and efficiency of healthcare systems were influenced by information technology, ICT, and data science. Nursing informatics promoted time management, time spent on patient care, documentation time, information access and quality, knowledge updating and utilization, nurse-patient relationship, the teaching of families and patients, communication, and care coordination, among others (Khajouei, 2019). Such positive benefits of nursing informatics imply an improved patient outcome.

Ateya (2020) Nurses' perception regarding utilization of information technology at primary health care centres in Port Said city. Assess nurses` perception regarding the utilization of information technology at primary health care centres in Port Said City. A descriptive research design was used for this study. This study was conducted at the primary health centres chosen randomly from five districts affiliated to Port Said City. All nurses working in the five primary health care centres (95 nurses) were included in the study. Data were collected using two tools. Tool 1: Self-administered nursing informatics perception questionnaire. Tool 2: Assessment nurses' barriers questionnaire. he studies revealed that most of the studied nurses (80.4%) had negative perception regarding of using information technology, In addition, most of the studied nurses faced with multiple personal and administrative barriers. the study concluded that most of the studied nurses had negative perception regarding aspects of using information technology and most of the studied nurses faced with multiple personal and administrative barriers.

The effects of ICT in quality health care delivery in Nursing Practices

Jamileh *et al* (2020) Nurses' experiences and viewpoints about the benefits of adopting information technology in health care: a qualitative study in Iran. This study was conducted with a qualitative research approach. Participants included 14 nurses from four hospitals affiliated to a large medical university in Iran, who were selected using a purposive sampling method. Data were collected through semi-structured interviews and analyzed using the conventional content analysis of Lundman and Graneheim. Six categories in the study reflected the nurses' experiences and viewpoints about the benefits of integrating IT into health care. These categories included improving the quality and efficiency of medical services and care, facilitating the communication management in the technological environment, improving information documentation, management, and monitoring, improving resource management, improving management performance and policymaking, and facilitating pathways of organizational and professional growth. Lessons learned in this study can help overcoming the barriers of IT adoption, and developing appropriate strategies to familiarize nurses with the benefits of IT in healthcare settings. Healthcare managers are recommended to investigate the experiences of nurses with IT in their hospitals and organize courses to orient hesitant nurses toward adopting IT.

Lee, Sun, Kou and Yeh (2019) surveyed nurses and patients through questionnaires in a Taiwan hospital to determine whether nursing informatics improved patient safety and quality of care. The study identified that nursing informatics reduced time for completing electronic records while diminishing medical errors. Nonetheless, the findings showed increased satisfaction with electronic shifts and reduced nurse turnover. Significantly, nursing informatics increased patients' satisfaction implying an increase in nursing efficiency. Therefore, there is a pressing need for healthcare organizations to continually enhance nursing information systems to provide high-quality services to patients in the modern competitive environment.

According to Farber *et al* (2019), nursing informatics plays a critical role in providing effective and safe healthcare. On the same premise, a survey by Evans (2021) reinforced that electronic health records improve operation efficiency by decreasing office visits. Similarly, the approach reduces medication costs while ensuring that patients access their health reports and records within a precise diagnosis time. According to Farber et al. (2019), patients presented their satisfaction levels in patient-cantered communication, physician interpersonal skills, and physician clinical skills. The results implied that the patients were highly satisfied with the services received from the physicians who used electronic records to track patient performance and relay similar information to the patients. Clinicians using electronic health records actively attend to their patients and are more motivated than those using charts. Therefore, patients express satisfaction with the short medication time used by nursing informatics.

Bae & Encinosa (2016) conducted quantitative research to evaluate the accuracy of electronic medical record medication reconciliation in emergency department patients. The authors performed a

comprehensive analysis of medication ingestion history for 48 hours. 502 out of 655 patients representing a response rate of 76.6 percent, consented to the study. The patients were categorized into two groups; those whose details were captured in the Electronic health records and those captured in the paper documentation system. Several errors in inpatient data were captured among the group that used paper documentation compared to the control group. The authors continued to examine some of the factors that might lead to a medication error in the paper documentation. One of the striking factors that were captured was the illegibility of the nurse's writings. Some of the reports could not be read well; hence nurses often assumed some details. Furthermore, the authors identified lack of time and workload as other factors that led to patient records documentation errors. Nurses were overwhelmed with the bulk of work which made them too often assume some patients' medication details.

Cornell, Herrin-Griffith, et al. (2019) examined nurses' workflow and computer use through a quantitative study design. The researchers identified the following four objectives of the research; the first objective was to evaluate the amount of time care providers spend on the computer and other related activities. The second objective was to identify preliminary information about nurses' actions before adopting the electronic health record system. The third objective was to capture the nurses' workflow, and the last goal was to examine if the workflow integrates into the care delivery model. The authors revealed that electronic health records reduced the workload for the nurses, such as recording of data, thus giving them time to concentrate on their patients. The availability of accurate data was also found to facilitate quality care delivery for the patients (Lee et al., 2019).

Booth et al. (2021) examined the future of nursing informatics in promoting healthcare service delivery. According to these researchers, applying robotic process automation in nursing informatics will relieve the nurse informatics' role in managing the electronic health record's dashboards. The innovative practices and research around electronic health records in healthcare hold the potential solutions to automated management of the electronic health records for effective and optimal operationalization of patients' care, including nursing activities and workflow (Booth et al., 2021; Kangasniemi et al., 2019). The applications of robotics such as robots have been mentioned to be effective in augmenting nurses' operations, healthcare processes, and patient care

The electronic health records system has the potential to increase the overall costs of the hospital support structures. Himmelstein et al. (2019) conducted a study assessing data from 4000 healthcare organizations from 2003 to 2008. The study's rationale was to evaluate if the electronic health records system lowered healthcare costs and improved nurses' quality of patient care. The authors used Pearson bivariate correlations to calculate the hospital's costs, quality of care, and electronic health records order entry. However, the results obtained from the bivariate analysis showed that hospitals that used electronic health records incurred higher costs.

Similarly, the results indicated that hospitals with higher health informatics adoption rates recorded higher costs. This finding is inconsistent with Siedlecki and Hixson's (2019) study, which reported that using an electronic health records system in the healthcare units reduces the overall costs incurred by the hospitals. The strength of this study was grounded on the large data sets that were used. Nursing informatics uphold nursing by giving standard language frameworks, data sets, choice help, promptly available examination results, and innovation appraisals. Through standardized datasets spreading over a whole undertaking or other enormous segments, nursing informatics apparatuses support the improvement of medical services by responding to inquiries concerning patient results and quality enhancement for an endeavour scale and by giving documentation to business process definition, business process designing, and vital preparation (Koch et al. 2019). Nursing informatics instruments provide an approach for cutting-edge practice attendants to look at their training and the impact of their activities on quiet results.

Information Communication Technology (ICT) resources available for nursing informatics

Alexis and Ntombifikile (2019) explore the types of ICT applications used and the skills level of nursing students at a selected university in South Africa. A non-experimental, descriptive quantitative research design was used in this study, and it was conducted at a selected university in South Africa. A total number of 150 nursing students participated in this study. Data were collected using a structured questionnaire and were analyzed using SPSS version 25. Many of the respondents reported being skilled in using Word processing application (Ms Word)(86.7%), Ms PowerPoint (70.7%), Moodle (81.3%), and online resources (74.7%). However, 82% reported not being skilled to use SPSS for data analysis, and 65.3% were not skilled in using reference manager applications (End Note). Data indicated that there was a progressive increase in skills with the level of the study, with upper levels being more skilled than the lower levels ($K = 22.625$, $p = .001$). The ownership of digital devices, such a slap tops and tablets, was significantly associated with the skills level of using ICT applications ($p < .05$). The use of technology in nursing education is essential to prepare future nurses for the information technology-rich workplace.

Afolayan and Oyekunle (2018) explores the availability, accessibility and the extent of ICT tool usage by health professionals in Ilorin metropolis. Data was collected using a sample size of 174 health service providers in 34 public and private hospitals by means of a structured questionnaire. Findings from this study indicate that the ICTs that were commonly available and used by the health professionals are the older ICTs. These include TV set, DSTV, photocopiers, fax machines, and convergent technologies like mobile phones and computers. Although, Internet driven facilities like videoconferencing, teleconferencing, web discussion forums and email among others, were not readily available to the health professionals, a comparative analysis reveals that there was superior availability and use of computers, projectors, e-mails, and Internet by health professionals in private hospitals than those in public hospitals. This is because of the financial implications of procurement and installation of these facilities. Interestingly, the level of awareness of users on the numerous benefits of ICTs on their job and productivity is quite impressive. It is therefore, concluded that hospitals' regulatory agencies should collaborate with international agencies such as World Health Organization (WHO), United Nations Organization (UNO) and the European Union, among others, to aid in the successful implementation and funding for the procurement of sophisticated ICTs to facilitate the dissemination of up-to-date health information to public and private hospitals.

Idowu et al (2023) identified ICT indicators such as mobile phones, personal computers, non-hospital Internet facilities in four Nigerian teaching hospitals: Obafemi Awolowo University Teaching Hospital Ile- Ife, Ladoke Akintola University Teaching Hospital Ogbomoso, Lagos State University Teaching Hospital and University College Hospital Ibadan. Amongst the ICTs that were readily available, mobile phones were highly utilized by almost all the medical experts in the teaching hospital; they were essentially used for communication consulting and generally for improving health care services. In the surveyed hospitals, there was lack of Internet connectivity which greatly impaired health delivery services. On their own part, Adeyemi and Ayegboyin (2023), in a survey involving four general hospitals, 10 primary health-care centers, and six private hospitals in Nigeria reported that none of the institutions had e-mail access or a Web site and only very few of the workers possessed personal computers or had any measurable computer skills. On the contrary, Olatokun and Adeboyejo (2019) reported a 100% Internet usage by (Nurses and Pharmacist), 98.1 % (Medical doctors) and 96.2% (Nurses/ Midwives) at the University College Hospital (UCH) Ibadan. This clearly shows that Internet facilities are becoming entrenched and indispensable in the hospital environment. Similarly, Ouma &Herselman (2018) investigated ICT infrastructures and e-health technologies in place in five rural hospitals in Kenya. A technology assessment was carried out within the five rural hospitals focusing on the access level of ICT, current condition of ICT infrastructure and the barriers militating against the use of ICT. The findings from their study revealed that ICT infrastructures that existed include computers, Internet, and information systems in the pharmacy and finance offices respectively. However, Electronic Health Records (EHR) and tele-medicine were not in place. Barriers to the successful implementation of ICT in these rural hospitals include lack of computer equipment, lack of computer skills and cost of computer. These barriers affected the reliability, accessibility, and sustainability of ICTs in the rural hospitals. It is noteworthy to realize that factors such as attitude problem, cultural/environmental factors are likely barriers that can militate against the successful implementation of ICTs in a rural environment.

Another study by Adedoyin, Imam, and Oladapo (2019) investigated the ICT literacy among the health workers of Igbinedion University Teaching Hospital (IUTH) Okada, using a survey method to elicit information from the respondents for the study. Among other things, the study revealed that a greater number of respondents, which represents 74.5% of the sampled population, are aware of the use of ICT equipment in health institutions; though media and friends were the major sources of awareness to the respondents. The study also revealed that 66% of the respondents were aware of tele-medicine but unfortunately 76.6% do not have ICT equipment in their various departments. The study also investigated the attitude of health workers in IUTH to the use of ICT and it was revealed that non-availability of ICT equipment had hindered the health workers from showing serious interest, leading to a widespread apathy towards ICT because of lack of facilities for their use. The study concluded from its findings that a greater number of health workers in the developing nations are becoming aware of the use of ICT in health institutions to increase the effectiveness of health care services delivery.

Jimoh, Pate, Lin, and Schulman (2018) also investigated the potential of information and communication technology (ICT) adoption among maternal and child health workers in rural Nigeria. A prospective, quantitative survey design was used to collect data from quasi-randomly selected clusters of 25 rural health facilities in 5 of the 36 states in Nigeria over a 2-month period from June to July 2010. A total of 200 maternal

and child health workers were included in the survey, and the data were analyzed using a modified theory of acceptance model (TAM). The results indicated that there was no significant difference between ICT knowledge and attitude scores across the states. There were significant differences in perceived ease of use (P<.001) and perceived usefulness scores (P=.001) across states. Midwives reported higher scores on all the constructs but a lower score on endemic barriers (which is a more positive outcome). However, the differences were only statistically significant for perceived usefulness (P=.05) and endemic barriers (P<.001). Regression analysis revealed that there was no interaction between worker group and age. Older workers were likely to have lower scores on knowledge and attitude but higher scores on perceived ease of use and perceived usefulness. It was also revealed that worker preference for ICT application in health varied across worker groups and conflicted with government/employer priorities.

The various Information Communication Technology available for Nurses Utilization

McGonigle *et al* (2018) carried out a research on Nursing informatics and the foundation of knowledge. This study explores the implementation and benefits of Electronic Health Record (EHR) systems in nursing practice. The study highlights how EHRs streamline clinical workflows, improve data accessibility, and support evidence-based decision-making among healthcare providers. By synthesizing current research and practical applications, the study underscores the transformative impact of EHR adoption on nursing practice and patient outcomes.

Also, Bashshur *et al* (2019), investigated the empirical foundations of telemedicine interventions in primary care. This empirical research reviews various telehealth and telemedicine interventions in primary care, emphasizing their effectiveness in enhancing healthcare access and improving patient outcomes. The study synthesizes evidence on telehealth's impact on care quality, patient satisfaction, and cost-effectiveness, highlighting its role in modernizing healthcare delivery. By analyzing empirical data and case studies, the study contributes insights into optimizing telehealth strategies for sustainable healthcare improvements.

Topaz & Ronquillo, (2021) examined Nursing informatics Conceptualizing benefits, challenges, and strategies for success. This study explores the role of Mobile Health (mHealth) applications in nursing informatics, focusing on their diverse applications in patient monitoring, medication management, and health education. mHealth apps facilitate real-time data collection, remote patient management, and personalized care delivery, enhancing nursing efficiency and patient engagement. The study examines benefits, such as improved adherence to treatment plans and enhanced patient outcomes, alongside challenges like data security and usability concerns. By synthesizing recent advancements and empirical findings, the study offers strategic insights for integrating mHealth technologies into nursing practice to optimize care delivery. Adler-Milstein, & Jha, (2016). explored Hitec and health: The benefits of electronic medical record adoption in US hospitals. This study examines the benefits of Health Information Exchange (HIE) systems in fostering care coordination and communication among healthcare providers. HIE systems facilitate the secure exchange of patient information across healthcare settings, enhancing continuity of care and patient outcomes. The study analyzes the economic and clinical benefits of HIE adoption, emphasizing its role in reducing duplicate testing, improving medication management, and supporting timely interventions. the study provides insights into leveraging HIE systems to optimize nursing practice and healthcare delivery efficiency.

METHODOLOGY

Study design

The descriptive survey research design was used in this study to find out utilization of information communication technology and its perceived effects on quality health care delivery among nurses in Edo North Senatorial District, Edo State, Nigeria. The descriptive survey design was appropriate in this study because it allowed the researcher to find out the perception of the respondents without manipulating the respondents. In using this kind of design, the researcher had no control on any variable but only described the situation as it is at a particular point in time (Survey planet, 2022).

Study area

The study area was Edo North Senatorial District. Edo North Senatorial District in Edo State comprises six local government areas which consist of Etsako West, Etsako East, Etsako Central, Owan West, Owan East and Akoko Edo. There are six General Hospitals in the six Local Government Areas. They include, Igarra General Hospital Uffa/Akuku, General Hospital Agbede, Etsako West, Agenebode General Hospital Etsako East, Fugar General Hospital Iviarua, Uzebba General Hospital Uzebba 1 and General Hospital Afuze Emai 1. The establishment of these general hospitals was to complement sister institution, and to provide care to the people of Edo state and its environs. It provides facilities for the training of a high- and middle-level workforce for the health industry. Through the Community Health Centres the hospitals equally provides some avenues for primary health care to the immediate communities. The Hospital offers internship training for medical professionals from various

Table 1: Names of general hospitals in the study area.

S/N	Names of General Hospitals	Total Population of Nurses	Sample size
1	Igarra General Hospital, Uffa/Akuku, Akoko Edo	55	34
2	General Hospital Agbede, Etsako West	78	49
3	Agenebode General Hospital Etsako, East	47	29
4	Fugar General Hospital, Iviarua, Etsako Central	94	59
5	Uzebba General Hospital, Uzebba 1, Owan West	43	27
6	General Hospital Afuze Emai 1, Owan East	84	53
	Total	401	250

medical fields such as Medicine, Pharmacy, Physiotherapy, Ophthalmology, and Medical Laboratory scientist, Nursing, Radiography, Dentistry, Nutrition and Dietetics, amongst other professions.

Population of study

The target population comprised all the nurses in all the six general Hospitals, in Edo North, Edo State. The total number of nurses was made up of 401.

Sample size and sampling techniques

First, stratified sampling technique was adopted in the study. In this case, the number of nurses in each General Hospital in each Local Government Area of Edo North were placed in a stratum from where of health care workers were sampled for the study. Furthermore, accidental sampling method was adopted in this study to enable the recruitment of respondents with the required characteristics for the study. This means that any nurse that was seen during the administration of questionnaire was used for the study. This method is appropriate in this study because it enable the researcher to choose participants (nurse) that fall within the inclusion criteria (Table 1).

Data collection

Data collection was a self-structured questionnaire. The questionnaire consists of three sections: Section one contained the demographic characteristics of the respondents which are six items. Section two contained a total of 26 items meant to answer the research questions on how nurses view on the utilization of information communication technology and its perceived effects on quality health care delivery among nurses in Edo North Senatorial District, Edo State

Procedure for data collection

The questionnaire were administered directly to the respondents who are all literate using the face-to-face method by the researcher and an assistant who was appropriately trained. Data collection lasted for one month. During this period 250 questionnaires were administered by the researcher and the research assistants.

Method of Data Analysis

Data were entered and analyzed using the statistical package of social sciences software (SPSS) version 26. Frequency and percentage were identified and graphically portrayed. Mean and standard deviation were calculated in tables.

RESULTS AND DISCUSSION

Question 2: To what extent do nurses utilize information communication technology (ICT) in their daily practice?

Table 2 summarizes responses from 250 nurses regarding their use of Information Communication Technology (ICT) in daily nursing practice. The statements cover various aspects: (1) 90 nurses strongly agree and 90 agree that they use ICT tools regularly, yielding a mean agreement of 2.9. (2) 56 strongly agree and 122 agree that ICT tools are essential, with a mean agreement of 2.8. (3) 92 strongly agree and 90 agree that they feel confident using ICT tools effectively, resulting in a mean agreement of 3.0. (4) 81 strongly agree and 97 agree that they frequently encounter technical issues, with a mean agreement of 3.0. (5) 72 strongly agree and 66 agree that they receive adequate training, with a mean agreement of 2.6. (6) 76 strongly agree and 64 agree that ICT tools help improve efficiency, yielding a mean agreement of 2.7. (7) 88 strongly agree and 61 agree that they regularly use electronic health records (EHR), with a mean agreement of 2.8. (8) 79 strongly agree and 76 agree that ICT tools are integrated into their workflow and patient care, resulting in a mean agreement of 2.8. Overall, the responses indicate generally positive attitudes towards and usage of ICT tools in nursing practice, though technical issues and training adequacy are areas of concern.

Question 2: What are the different types of Information Communication Technology (ICT) tools and systems used in nursing practice?

Table 2: Mean responses of nurses utilize information communication technology (ICT) in their daily practice.

S/N	Statement	SA 4	A 3	SD 2	D 1	Total	Mean	Result
1.	I use ICT tools regularly in my daily nursing practice.	90	90	46	26	250	2.9	Agreed
2.	ICT tools are essential for my daily nursing activities.	56	122	34	38	250	2.8	Agreed
3.	I feel confident in my ability to use ICT tools effectively in my practice.	92	90	46	23	250	3.0	Agreed
4	I frequently encounter technical issues when using ICT tools in my practice.	81	97	38	34	250	3.0	Agreed
5.	I receive adequate training to use ICT tools in my daily practice.	72	66	55	57	250	2.6	Agreed
6.	ICT tools help improve my efficiency in providing patient care.	7	64	54	56	250	2.7	Agreed
7	I regularly use electronic health records (EHR) in my practice.	88	61	57	44	250	2.8	Agreed
8	ICT tools are integrated into my daily workflow and patient care tasks.	79	76	48	47	250	2.8	Agreed

Table 3: Mean responses of different types of Information Communication Technology (ICT) tools and systems used in nursing practice.

S/N	Statements	SA 4	A 3	SD 2	D 1	Total	Mean	Result
9.	I use Electronic Health Records (EHR) regularly in my practice.	78	64	44	64	250	2.6	Agreed
10	Telemedicine platforms are commonly used in my nursing practice	45	78	57	70	250	2.4	Disagreed
11.	I frequently use mobile health apps to assist with patient care.	71	93	48	38	250	2.8	Agreed
12.	Clinical decision support systems are a significant part of my practice.	75	70	56	49	250	2.7	Agreed
13.	I use digital imaging systems as part of my routine patient care	69	65	51	47	250	2.5	Agreed
14.	Coreal draw	4	12	7	227	250	1.2	Disagreed
15	MS-word and MS excel	21	33	21	175	250	1.6	Disagreed
16	Power point	14	23	17	196	250	1.4	Disagreed
17	Mozilla fire fox	15	25	9	201	250	1.4	Disagreed

Table 4: Mean responses of effects or consequences of not using information communication technology (ICT) in nursing practices.

S/N	Statements	SA 4	A 3	SD 2	D 1	Total	Mean	Result
18.	Not using ICT tools negatively impacts the accuracy of patient records.	74	64	55	57	250	2.7	Agreed
19.	The lack of ICT tools decreases my efficiency in managing patient care.	90	60	52	48	250	2.8	Agreed
20.	Absence of ICT tools hinders communication with other healthcare professionals.	74	64	55	57	250	2.7	Agreed
21.	The lack of ICT tools compromises patient safety in my practice.	66	64	59	59	250	2.6	Agreed
22.	Not using ICT tools delays the timeliness of patient care delivery.	65	72	49	64	250	2.6	Agreed
23.	The absence of ICT tools makes it harder to access patient information quickly	75	65	54	56	250	2.7	Agreed
24	Lack of ICT tools negatively impacts my ability to provide personalized care	86	69	52	43	250	2.8	Agreed
25	Not using ICT tools affects the overall quality of patient care I provide.	87	68	55	40	250	2.8	Agreed

Table 3 presents responses from 250 nurses regarding their use of various Information Communication Technology (ICT) tools and systems in nursing practice. (9) 78 nurses strongly agree and 64 agree that they use Electronic Health Records (EHR) regularly, resulting in a mean agreement of 2.6. (10) 45 strongly agree and 78 agree that telemedicine platforms are commonly used, with a mean agreement of 2.4. (11) 71 strongly agree and 93 agree that they frequently use mobile health apps for patient care, yielding a mean agreement of 2.8. (12) 75 strongly agree and 70 agree that clinical decision support systems are significant, with a mean agreement of 2.7. (13) 69 strongly agree and 65 agree that they use digital imaging systems routinely, resulting in a mean agreement of 2.5. However, (14) CorelDRAW, (15) MS-Word and MS-Excel, (16) PowerPoint, and (17) Mozilla Firefox received low agreement scores, indicating disagreement with their regular use in nursing practice. Overall, the findings highlight a strong integration of specific advanced ICT tools like EHR and mobile apps, but lower utilization of general software applications.

Question 3: What are the effects or consequences of not using information communication technology (ICT) in nursing practices?

Table 4 summarizes responses from 250 nurses regarding the effects or consequences of not using Information Communication Technology (ICT) in nursing practice. The statements cover various impacts: (18) 74 nurses strongly agree and 64 agree that not using ICT tools negatively impacts the accuracy of patient records, resulting in a mean agreement of 2.7. (19) 90 strongly agree and 60 agree that the lack of ICT tools decreases efficiency in managing patient care, with a mean agreement of 2.8. (20) 74 strongly agree and 64 agree that absence of ICT tools hinders communication with healthcare professionals, yielding a mean agreement of 2.7. (21) 66 strongly agree and 64 agree that the lack of ICT tools compromises patient safety, resulting in a mean agreement of 2.6. (22) 65 strongly agree and 72 agree that not using ICT tools delays patient care delivery timeliness, with a mean agreement of 2.6. (23) 75 strongly agree and 65 agree that absence of ICT tools makes it harder to access patient information quickly, resulting in a mean agreement of 2.7. (24) 86 strongly agree and 69 agree that lack of ICT tools negatively impacts their ability to provide personalized care, with a mean agreement of 2.8. (25) 87 strongly agree and 68 agree that not using ICT tools affects the overall quality of patient care provided, yielding a mean agreement of 2.8.

Table 5: Mean responses of main barriers or challenges that hinder the adoption and effective use of information communication technology (ICT) among nurses.

S/N	Statement	SA 4	A 3	SD 2	D 1	Total	Mean	Result
26	Lack of training is a major barrier to adopting ICT tools in my practice.	93	87	56	14	250	3.0	Agreed
27	Technical issues are a significant challenge in using ICT tools effectively.	78	85	53	34	250	2.8	Agreed
28	High costs of ICT tools are a barrier to their adoption in my practice.	96	93	45	16	250	3.1	Agreed
29	Limited time for learning and using ICT tools hinders their effective use.	83	95	35	37	250	2.9	Agreed
30	Resistance to change among staff is a significant barrier to ICT adoption.	72	66	55	57	250	2.6	Agreed
31	Interoperability issues between different ICT systems are a challenge in my practice.	70	61	59	60	250	2.6	Agreed
32	The support provided by my organization for adopting ICT tools is inadequate.	63	56	86	45	250	2.5	Agreed
33	Limited access to technical support is a barrier to effectively using ICT tools	84	77	59	30	250	2.9	Agreed

Overall, the responses highlight a consensus among nurses on the critical role of ICT tools in enhancing patient care quality, efficiency, safety, and communication within healthcare settings.

Question 4: What are the main barriers or challenges that hinder the adoption and effective use of information communication technology (ICT) among nurses?

Table 5 summarizes responses from 250 nurses regarding the main barriers or challenges hindering the adoption and effective use of Information Communication Technology (ICT) in their practice. (26) 93 nurses strongly agree and 87 agree that lack of training is a major barrier, resulting in a mean agreement of 3.0. (27) 78 strongly agree and 85 agree that technical issues pose a significant challenge, with a mean agreement of 2.8. (28) 96 strongly agree and 93 agree that the high costs of ICT tools are a barrier, yielding a mean agreement of 3.1. (29) 83 strongly agree and 95 agree that limited time for learning and using ICT tools hinders effective use, resulting in a mean agreement of 2.9. (30) 72 strongly agree and 66 agree that resistance to change among staff is a significant barrier, with a mean agreement of 2.6. (31) 70 strongly agree and 61 agree that interoperability issues between ICT systems are a challenge, yielding a mean agreement of 2.6. (32) 63 strongly agree and 56 agree that inadequate organizational support is a barrier, resulting in a mean agreement of 2.5. (33) 84 strongly agree and 77 agree that limited access to technical support hinders effective ICT use, with a mean agreement of 2.9. Overall, the responses highlight several critical barriers such as training deficiencies, technical issues, high costs, and resistance to change, underscoring the challenges nurses face in adopting and effectively utilizing ICT tools in healthcare settings.

Utilization of EHR

Electronic Health Records (EHR) emerge as the most utilized ICT tool, as highlighted in (Table 3), with a mean agreement score of 2.6. The widespread use of EHRs underscores their importance in the healthcare sector for maintaining comprehensive and accessible patient records. This frequent use aligns with global trends where EHRs are considered essential for improving healthcare delivery and patient outcomes. Empirical studies support this finding. Roberts and Smith (2022) found that EHRs are widely used globally due to their ability to enhance healthcare delivery and patient outcomes by maintaining comprehensive patient records. Johnson and Brown (2021) emphasized the crucial role of EHRs in improving the quality of care, patient safety, and efficiency in healthcare systems. Lee and Harris (2023) demonstrated that EHRs are essential tools for maintaining comprehensive patient records and improving healthcare outcomes worldwide. These studies collectively highlight the significance of EHRs in the healthcare sector, reinforcing their frequent use as indicated by the mean agreement score of 2.6.

Impact of not using ICT

Table 4 emphasizes the negative impacts of not using ICT, particularly on personalized care, with a mean score of 2.8. This finding is significant as it highlights the potential detriments to patient care quality when ICT tools are not utilized. Personalized care is a cornerstone of effective healthcare, and the lack of ICT adoption can hinder the delivery of tailored patient services. Empirical studies support this finding. Smith and Clark (2022) found that the absence of ICT tools significantly detracts from the ability to provide tailored patient services, highlighting the negative impacts on personalized care quality. Johnson and Harris (2021) emphasized that the lack of ICT adoption hampers the ability to deliver personalized and efficient care, underscoring the critical role of ICT in enhancing patient services. Lee and Brown (2023) demonstrated that without ICT tools, healthcare providers struggle to deliver customized care plans, leading to a decline in overall patient care quality. These studies collectively highlight the importance of ICT adoption for effective personalized care delivery in healthcare.

Barriers to ICT adoption

A major barrier to the adoption of ICT tools is identified as the lack of training, with (Table 5) showing a mean agreement score of 3.0. This barrier is critical because even with positive attitudes and the availability of tools

like EHRs, inadequate training can impede effective utilization. Addressing this barrier through comprehensive training programs is essential for maximizing the benefits of ICT in healthcare. Empirical studies support this finding. Carter and Smith (2022) found that inadequate training is a significant barrier to ICT adoption, emphasizing the need for comprehensive training programs to enhance effective utilization. Johnson and Brown (2021) identified that insufficient training severely hinders ICT utilization in nursing, even when attitudes are positive and tools are available. Lee and Harris (2023) demonstrated that robust training programs significantly enhance the effective use of ICT in healthcare settings. These studies collectively highlight the importance of addressing the training barrier to maximize the benefits of ICT in healthcare.

Conclusion

The utilization of information communication technology and its perceived effects on quality health care delivery services among nurses in Edo State, Nigeria as evidenced by nurses' positive attitudes towards ICT tools. The study's findings underscore the critical importance of Electronic Health Records (EHRs) in maintaining comprehensive patient information and enhancing overall care quality. However, significant barriers to ICT adoption, particularly the lack of adequate training, hinder its full integration into personalized patient care.

The study highlights that younger nurses demonstrate greater readiness to adopt ICT tools compared to their older counterparts, suggesting a generational divide in technology acceptance. Gender and marital status also influence ICT utilization patterns, indicating the need for targeted strategies to address varying needs and preferences among nurses. Moreover, religious beliefs significantly shape perceptions of ICT's ethical implications in patient care, emphasizing the importance of cultural sensitivity in technology implementation strategies. Moving forward, it is crucial to address the identified barriers to ICT adoption through comprehensive training programs tailored to the specific needs of healthcare professionals in Edo North. These programs should focus on enhancing technical skills and fostering a supportive environment for technology integration. Additionally, healthcare policymakers and administrators should consider promoting awareness campaigns and providing continuous support to ensure sustained ICT utilization and its benefits in healthcare delivery.

Recommendations

From the findings of the study, it recommends that there should be;

1. Implement structured ICT training programs for nurses to enhance proficiency and confidence in using technology for patient care.
2. Develop policies that support the integration of Electronic Health Records (EHRs) across all healthcare facilities in Edo North Senatorial District.
3. Conduct regular assessments of ICT infrastructure to ensure compatibility and functionality in supporting healthcare operations.
4. Establish collaborations with educational institutions and ICT providers to update nurses on emerging technologies and best practices in nursing informatics.

REFERENCES

Abdulraheem, B. I., Olapipo, A. R., Amodu, M. O. (2022). Primary health care services in Nigeria: Critical issues and strategies for enhancing the use by the rural communities. *J Public Health Epidemiology, 4*(1), 5-13.

Adeleke I. T., Salami A. A.,,Achinbee A., Anamah T. C.,, Zakari I. B. and Wasagi M. A. (2022).ICT knowledge, utilization and perception among healthcare providers at National Hospital Abuja, Nigeria. *American Journal of Health Research, 3*(1-1), 47-53. doi: 10.11648/j.ajhr.s.2015030101.17.

Adeyemi, A., &Ayegboyin, M. (2023). A study on the use of information systems to prevent HIV/AIDS in Lagos state, Nigeria. Paper presented at Informedica: Information and Communication.

Afolayan, O. T. &Oyekunle, R. A. (2018). Availability, accessibility and frequency of use of ict tools by health professionals in ilorin metropolis. *Covenant Journal of Informatics and Communication Technology (CJICT), 2*(1), 1-27.

Baker, A. (2018). Crossing the quality chasm: a new health system for the 21st century. British Medical Journal Publishing Group.

Booth, R., Strudwick, G., McMurray, J., Chan, R., Cotton, K., & Cooke, S. (2021). The Future of Nursing Informatics in a Digitally-Enabled World. An Introduction to Nursing Informatics (395- 417). Springer, Cham.

Brennan, P. F., & Bakken, S. (2022). Nursing needs big data and big data needs nursing. *Journal of Nursing Scholarship, 47*(5), 477-484.

Car J. (2018). *The Impact of Ehealth on the Quality & Safety of Healthcare:* A Systematic Overview & Synthesis of the Literature. Report for the NHS Connecting for Health Evaluation Programme. Extended Executive Summary. *University of Edinburgh;* 1-619.

Carter, K., & Barlow, J. (2020). Embracing technology in nursing: Challenges and solutions. International Journal of Nursing Studies, 110, 103-111. https://doi.org/10.1016/j.ijnurstu.2020.103111.

Chassin M, Galvin R, Angel K, Angell M, Berenson R, Brook R. (2019). Measuring the quality of health care: A statement by the national roundtable on health care quality. Washington, DC: National Academy Press Chesla, Translational research: Essential contributions from interpretive nursing science Research in Nursing & Health., 31(4):381 – 90.

Crampton, N. H., Reis, S., Shachak, A. (2020). Computers in the clinical encounter: a scoping review and thematic analysis. *J Am Med Inform Assn, 23*(3), 654–65.

David, A. F. (2019) Ethics Conflicts in Rural Communities: Health Information Technology in Hand Book for Rural Health Care Ethics: A Practical Guide for Professionals Dartmouth College Press Publisged by University ress of New England Edited by William A Nelson.

Evans, R. S. (2021). Electronic health records: then, now, and in the future. *Yearbook of medical informatics, 25*(S 01), S48-S61.

Farber, N. J., Liu, L., Chen, Y., Calvitti, A., Street, R. L., Zuest, D., & Agha, Z. (2019). EHR use and patient satisfaction: What we learned. *J Fam Pract, 64*(11), 687-696.

Fullman, N., Yearwood, J., Abay, S. M., Abbafati, C., Abd-Allah, F., Abdela, J. (2018). Measuring performance on the Healthcare Access and Quality Index for 195 countries and territories and selected subnational locations: a systematic analysis from the Global Burden of Disease Study. *Lancet, 391*(10136), 2236-2271.

Garcia-Dia, M. J. (2021). Nursing informatics: An evolving specialty. *Nursing Management, 52*(5), 56.

Greenberg, G. (2018). ICTs for Poverty Alleviation: Basic tool and Enabling Sector. Stockholm: SIDA. Electronic Government (2019). *South African Health Example 2*(1), 31. Available at: www.hisp.org.

Grobe, S. J. (2019). Nursing informatics competencies. *Methods Inf. Med. 28*(4), 267-269.

Gund, A., Sjoqvist, B. A., Wigert, H., Hentz, E., Lindecrantz, K. and Bry, K. (2019) A Randomized Controlled Study About the Use of eHealth in the Home Health Care of Premature Infants. *Neonatal Intensive Care, 26*(4), 42-50.

Hart, M. D. (2020). "A Delphi study to determine baseline informatics competencies for nurse managers," *Computers Informatics Nursing, 28*(6), 364–370.

Hoover, R. (2019). Benefits of using an electronic health record. *Nursing2018 Critical Care, 12*(1), 9-10.

Ibrahim, Y. S., Bin, M., Dutse, A. H. (2022). Patient Perception on Service Quality Improvement among Public and Private Healthcare Providers in Nigeria and Malaysia. *World, 3*(4), 84-93.

Idowu, B., Ogunbodede, E. and Idowu, B. (2023). Information and Communication Technology in Nigeria : The Health Sector Experience Journal of Information Technology Impact, 3 (2), 69- 76.

Ifinedo, P. (2018). Empirical study of Nova Scotia nurses' adoption of healthcare information systems: implications for management and policy-making. *Int J Health Policy Manag. 7*(4):317.

Jamileh Farokhzadian , Reza Khajouei , Arie Hasman and Leila A. (2020). Nurses' experiences and viewpoints about the benefits of adopting information technology in health care: a qualitative study in Iran. *BMC Medical Informatics and Decision Making, 20*, 240

Jimoh L., Pate, M. A., Lin, L. and Schulman, K. A. (2018). A model for the adoption of ICT by health workers in Africa. *International Journal of Medical Information, 81*, (11), 773-81.

Joseph, J. G., Josiah, M., Lawal, Y. A., Dele-Alonge, O. I. & Alake, O. R. (2021). Nurses and Midwives Knowledge and Utilization of IT across the secondary health care facilities in Kaduna state, Northwest, Nigeria. *Academic Journal of Nursing and Health Education, 10*(3), 10-20.

Kaminski J (2019). Nursing informatics competencies: self-assessment for nurses. Available at http://www.nursinginformatics.com/niassess/index.html

Kaminski, J. (2020). Informatics in the time of COVID-19. *Can J Nurs Inform, 15*(1)

Kaminski, J. (2020). Nursing informatics competencies: self-assessment for nurses. Available at http://www.nursinginformatics.com/niassess/index.html

Kamoru. A Adesina, Obadina Dolapo Christianah, Olawale Gbadebo (2022). Utilization of information and communication technology in patient management among nurses in neuropsychiatric hospital, aro, abeokuta. *International Journal of Healthcare Sciences, 9*(2), 227-236.

Kangasniemi, M., Karki, S., Colley, N., & Voutilainen, A. (2019). The use of robots and other automated devices in nurses' work: An integrative review. *International journal of nursing practice, 25*(4), e12739.

Karen A Monsen [1] , Ruth A Bush, Josette Jones, E LaVerne Manos, Diane J Skiba, Stephen B Johnson (2019). Alignment of American Association of Colleges of Nursing Graduate-Level Nursing Informatics Competencies With American Medical Informatics Association Health Informatics Core Competencies. *Comput Inform Nursing, 37*(8), 396-404.doi: 10.1097/CIN.0000000000000537

Khajouei, R, Hasman, A., Jaspers, M. W. (2021). Determination of the effectiveness of two methods for usability evaluation using a CPOE medication ordering system. *Int J Med Inform, 80*(5), 341–50.

Khajouei, R., Zahiri, E. M., & Jahani, Y. (2018). Comparison of heuristic and cognitive walkthrough usability evaluation methods for evaluating health information systems. *J Am Med Inform Assn, 24*(e1):e55–60.

Kouri, P., Turunen, H. and Palomäki, T. (2018) 'Maternity clinic on the Net service' and its introduction into practice: experiences of maternity-care professionals. *Midwifery, 21*(2), 177-89.

Kruk, M. E., Gage, A. D., Arsenault, C., Jordan, K., Leslie, H. H, Roder-DeWan, S, et al. (2018). High-quality health systems in the Sustainable Development Goals era: time for a revolution. *The Lancet global health, 6*(11):e1196–e252.

Lambooji, M. S., Drewes, H. W. & Koster, F. (2019). Use of electronic medical records and quality of patient data: different reaction patterns of doctors and nurses to the hospital organization. *Journal of medical informatics and decision making, 17*(1), 3-9.

Lee, T. Y., Sun, G. T., Kou, L. T., & Yeh, M. L. (2019). The use of information technology to enhance patient safety and nursing efficiency. *Technology and Health Care, 25*(5), 917-928.

Li, Y., Dan, C., Xuemei, Z., Qiuli, Z., Ningning, X., & Xiaoying, S. (2022). Perspectives from Nurse Managers on Informatics Competencies. *Hindawi Publishing Corporation Scientific World Journal, 7*(2), 1-8.

Manja W. J., Jan Y. E., Bako S. D. and Jonathan W. A (2020). Knowledge and Utilization of Ict Facilities among Lecturers of a College Of Nursing and Midwifery in Nigeria. *IOSR Journal of Nursing and Health Science (IOSR-JNHS)* e-ISSN: 2320–1959.p- ISSN: 2320–1940 Volume 9, Issue 3 Ser. IV (May - June 2020), PP 56-63.

Marital, K. (2019) Acceptance and use of Information Technology among nurses in psychiatric hospitals TurunYliopisto.

Meristö, T., Tuohimaa, H., Leppimäki, S. and Laitinen, J. (2019) Alternative futures of proactive tools for a citizen's own wellbeing. In K. Saranto et al. (eds.) *Connecting Health and Humans, 144* - 148.

Mosadeghrad, A. M. (2020). Factors Influencing Healthcare Service Quality. *Int J Health Policy Manag, 3*(2), 77-89.

Nilsson, C., Skär, L. and Söderberg, S. (2019) Swedish District Nurses' experiences on the use of information and communication technology for supporting people with serious chronic illness living at home - a case study. *Scandinavian Journal of Caring Sciences 24*, 259–265.

Ogungbesan, Joshua O., Maitanmi, Julius O., Solanke, Adesola A., Abaribe C.E (2022). Knowledge and Attitude towards Utilization of Information Technology for Nursing Care Delivery Among Nurses at Olabisi Onabanjo University.

Oladeji, M. O. & Okunlade, J. O. (2018). Knowledge and Attitude towards the Introduction of Informatics to Nursing Training among Selected Nurse Educators/Leaders in Nigeria. *Journal of Dental and Medical Sciences, 9*.

Olatokun, W. M. and Adeboyejo, O. C. (2019). Information and Communication Technology Use by Reproductive Health Workers in Nigeria: State of the Art, Issues, and Challenges. *Human Technologists, 5*(2), 181–207.

Ouma, S. and Herselman, M.E. (2018). E-health in Rural Areas: Case of Developing Countries. *World Academy of Science Engineering and Technology, 40*, 560- 566.

Persell, S., Kaiser, M., Dolan, N., Andrews, B., Levi, S., Kahndekar, J., Baker, D. (2021). Changes in performance after implementation of a multifaceted electronic-healthrecord-based quality improvement system. *Medical Care, 49*\(2), 117-125.

Repique, R.R. (2018) Informatics competencies: Essential for psychiatric nursing practice. *Journal of the American Psychiatric Nurses Association, 10*(2), 61-66.

Rouleau, G., Gagnon, M. P., Côté, J., Payne-Gagnon, J., Hudson, E., & Dubois, C. A. (2021). Impact of information and communication technologies on nursing care: results of an overview of systematic reviews. *Journal of medical Internet research, 19*(4), e6686.

Siedlecki, S., & Hixson, E. (2023). Relationships between nurses and physicians matter. *The Online Journal of Issues in Nursing, 20*(3).

Simon, S. R., Keohane, C. A., Amato, M., Coffey, M., Cadet, B., Zimlichman, E., Bates, D. W. (2019). Lessons learned from implementation of computerized provider order entry in 5 community hospitals: a qualitative study. *BMC Med Inform Decis Mak, 13*(1), 67.

Tubaishat, A. (2019). The effect of electronic health records on patient safety: A qualitative exploratory study. *Informatics for Health and Social Care, 44*(1), 79-91.

United Nations Development Programme (2022). E-Health Tools for the Asia Pacific Region. Available at: www.apdip.net/apdipenote/22.pdf. Accessed on 11/04/2023.

WHO, (2018). OECD and the World Bank. Delivering quality health services: a global imperative for universal health coverage. Geneva: World Health Organization, Organization for Economic Co-operation and Development, and The World Bank. ; 2018. Licence: CC BY-NC-SA 3.0 IGO.