

Literature review

Investigating the Association between Technological Innovations and Nursing Care: A Narrative Literature Review

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Abstract

Background: The integration of technological innovations into nursing care has become increasingly prominent, fundamentally altering the dynamics of healthcare delivery and patient outcomes. Digital technologies are now at the forefront of modern nursing practice, offering both opportunities and challenges.

Objective: This narrative review aims to explore the complex relationship between technological advancements and nursing care, with a particular focus on the implications for clinical practice, the associated ethical and operational challenges, and potential future directions in healthcare innovation.

Methods: A comprehensive literature search was conducted using multiple databases including PubMed, CINAHL, ScienceDirect, IEEE Xplore, Google Scholar, the Cochrane Library, and ProQuest Nursing and Allied Health. These sources were selected to ensure the inclusion of peer-reviewed articles, interdisciplinary research, systematic reviews, and grey literature. The search covered publications from January 2010 to December 2024, capturing a wide spectrum of developments relevant to nursing and technological integration. This review synthesizes and critically evaluates existing evidence concerning the impact of technology on nursing practice, patient care outcomes, and health system performance.

Results: The findings indicate that technological tools such as electronic medical orders, clinical decision support systems, and telehealth platforms significantly enhance care delivery by improving documentation, expanding service accessibility, and enabling early detection of health issues. Nevertheless, barriers remain, including technological inequities, privacy concerns, and resistance among practitioners.

Conclusion: The study underscores the transformative potential of technology in nursing and emphasizes the importance of sustained investment in research, education, and interdisciplinary collaboration to maximize its benefits.

Keywords: nursing care; technology; patient outcomes; digital innovation; technological advancement healthcare transformation

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Background

The integration of digital technologies offers significant potential to address current issues and obstacles in the healthcare sector such as the adoption of digital technologies in healthcare tackles significant challenges such as limited accessibility, workforce shortages, increasing costs, fragmented care systems, and chronic disease management. Platforms like Teladoc Health expand access to care by facilitating remote consultations, particularly for underserved communities.

AI-driven tools, such as Babylon Health, help address workforce shortages by streamlining administrative tasks and offering diagnostic support with physician-level precision. Predictive analytics help lower costs by identifying high-risk patients for early interventions, as evidenced by studies showing reductions in hospital readmissions. Electronic Health Records (EHRs) improve care coordination by enabling smooth data sharing between providers, thereby minimizing errors. Wearable devices like the Fitbit and Apple Watch aid in managing chronic diseases through real-time monitoring and early alerts. Additionally, mental health apps like Headspace deliver scalable and easily accessible mental well-being resources. Backed by research published in journals such as *The Lancet Digital Health* and *Nature Medicine*, these innovations highlight the transformative role of digital solutions in contemporary healthcare (Stoumpos, Kitsios, & Talias, 2023). Numerous health care systems are confronted with issues including a lack of qualified personnel and, at the same time, a rise in the need for long-term care due to population shifts (Ghia & Rambhad, n.d.). The conviction that information technology can assist both formal and informal caregivers, empower those requiring care to sustain their independence, and enhance their quality of life and health has stimulated a flourishing domain of study on digital technologies and caregiving (Huter et al., 2020).

Technology is becoming a more vital component of nursing practice as it develops. The consequences of combining nursing practice with medical technology have led to previously unthinkable levels of patient care (admin, 2023). It is safe to say that the opportunities and potential threats that face nursing practitioners now will continue to influence the field's future directions (Salvage & White, n.d.). This study explores the effects of integrating digital technologies on nursing practice, with particular attention to improving patient care outcomes and addressing ethical concerns. By concentrating on this specific scope, the discussion underscores how technology enhances care delivery while maintaining ethical standards. The analysis examines the impact of tools such as electronic health records and AI-driven systems on nursing workflows and decision-making processes. This targeted approach seeks to offer a deeper insight into the relationship between technology, nursing practices, and patient-centred care.

Nurses nowadays must reconcile the provision of safe, high-quality care with efficiency and cost-effectiveness ("The Role of Nurses in Improving Health Care Access and Quality - The Future of Nursing 2020-2030 - NCBI Bookshelf," n.d.). Numerous facets of our existence continue to undergo technological integration. Technologies are progressively employed in healthcare to mitigate escalating costs and enhance service quality. It is essential to determine techniques for delivering safe and effective care to patients as nurses implement technological applications ("Technology as a Tool for Improving Patient Safety | PSNet," n.d.) "Learning from mistakes is essential to achieving these goals." Numerous nations are conducting research on digital technologies for nursing care with the expectation that these tools may either supplement or even replace some aspects of human nursing labour, helping to reduce the fast increasing costs of care and the scarcity of competent staff (Rodziewicz, Houseman, & Hipskind, 2024).

The contemporary technology environment is well-suited to the collaborative nature of human beings and their fundamental need for efficiency, which propels changes that lead to the emancipation of human lifestyles and enhance overall quality of life (Technology-Vision-2035.Pdf, n.d.). The increased autonomy in decision-making within the nursing profession offers several benefits, including the ability to reduce human cognitive biases in judgment and decision-making. This is achieved through the use of intelligent systems and robots, which are designed to improve accuracy and facilitate creative problem-solving (Thirsk, Panchuk, Stahlke, & Hagtvedt, 2022). With the use of healthcare technology, nursing staff can now carry out their duties more effectively thanks to accessible data, accurate analysis, and secure communication. In the end, it is evident that technology has an indisputable influence on nursing practice and will continue to advance healthcare (Farokhzadian, Khajouei, Hasman, & Ahmadian, 2020). The use of technology in nursing is also enhancing the success of medical professionals. In an effort to give patients the most beneficial treatment possible, modern technical equipment is used to facilitate a nurse's work ("Seven Nursing Technologies Transforming Patient Care," 2021). Technology has advanced considerably, becoming a vital component of the nursing profession by revolutionizing key aspects of practice, such as patient monitoring, documentation, and care delivery. For instance, electronic health records (EHRs) have simplified documentation processes, minimizing errors and enhancing communication among healthcare providers. Wearable devices like continuous glucose monitors allow nurses to monitor patients' vital signs in real time, enabling prompt interventions. Telehealth platforms have increased access to care, particularly for patients in remote locations, enabling nurses to provide virtual management, education, and follow-ups. These innovations demonstrate how technology has transformed nursing, boosting efficiency, improving patient outcomes, and addressing the challenges of modern healthcare. For the purpose of treating patients, organising patient data, and preserving good health outcomes long after patients depart from the hospital, nurses employ and promote a variety of technological tools (Dash, Shakyawar, Sharma, & Kaushik, 2019).

Significant transformations have occurred in the healthcare sector, especially within the nursing profession, recently due to the rapid advancement of technology ("Recent Advancements in Emerging Technologies for Healthcare Management Systems: A Survey - PMC," n.d.). The duties and obligations of nurses have grown more complicated and varied as technology advances. The utilisation of cutting-edge technologies, including robotics, artificial intelligence,

telemedicine, and electronic health records, has enabled nurses to provide patients with more individualised and efficient treatment (Javaid, Haleem, Pratap Singh, Suman, & Rab, 2022). Even while technology has many advantages for nursing practice, there are drawbacks and moral issues that must be taken into account (O'Mathúna, 2022). The goal of this study is to investigate how nursing care and technology are related, looking at how technology affects patient outcomes, nursing practice, and the healthcare system as a whole. Through a critical review of the body of research and literature in this area, this study aims to investigate the possible hazards and constraints of technology in nursing practice while offering insights into how nurses might use it to improve the quality and delivery of patient care.

Methods

Design

This study adopts a narrative review design. The narrative review approach synthesizes critically evaluates existing literature to explore the relationship between technological advancements and nursing care.

Search Methods

A search strategy was developed using Boolean operators, keywords, and Medical Subject Headings (MeSH) terms focusing on nursing care, digital technologies, and patient outcomes. Keywords included: "Nursing care AND digital technology," "Technology AND patient outcomes in nursing," "Electronic health records AND nursing challenges," "Telemedicine AND nursing implications," "Robotics in nursing practice," "Ethical considerations AND technology in nursing," and "Artificial intelligence AND nursing."

Databases and Sources Searched

The primary databases searched were PubMed, CINAHL, ScienceDirect, IEEE Xplore, Cochrane Library, ProQuest Nursing & Allied Health Database, and Google Scholar. Gray literature and reports were retrieved from the World Health Organization (WHO), International Council of Nurses (ICN), and National Institutes of Health (NIH). Journals such as the Journal of Nursing Scholarship, Journal of Medical Internet Research (JMIR), BMC Nursing, and Nursing Outlook were also reviewed.

Inclusion and Exclusion Criteria

Inclusion criteria comprised studies published between January 2010 and December 2024, peer-reviewed articles and gray literature addressing digital technologies in nursing care, English-language publications, and research discussing patient outcomes, nursing practice, or healthcare systems. Exclusion criteria included studies unrelated to nursing or digital health, studies published before 2010 or outside the specified timeframe, and articles written in languages other than English.

Search Execution Dates

The search was conducted between January 15 and January 22, 2025.

Search Outcome

Application of Inclusion/Exclusion Criteria. A systematic process was followed to screen studies by their title, abstract, and full text against the inclusion and exclusion criteria.

Flow of Literature

A total of 1.152 studies were identified, of which 864 were excluded after title/abstract screening. Subsequently, 288 full-text articles were assessed for eligibility, and 95 studies were included in the final review.

Quality Appraisal

The Mixed Methods Appraisal Tool (MMAT) was used to assess the quality of studies.

Criteria for Appraisal

Studies were evaluated for relevance to the research question, methodological rigor, validity of findings, and transparency in reporting.

Outcome

Studies that demonstrated poor methodological quality, such as those with incomplete data or insufficient analysis, were excluded. A total of 21 studies were removed post-appraisal.

Data Abstraction

Data extraction was conducted using a standardized template to record key details such as study objectives, methods, settings, findings on the impact of digital technologies on nursing practice, challenges faced, ethical considerations, and recommendations for the future.

Data Analysis/Synthesis

Thematic Analysis. A qualitative synthesis approach was used to categorize findings into key themes, including the impact of technology on patient care and safety, advancements in nursing practice (e.g., telemedicine and clinical decision-making tools), ethical and practical challenges (e.g., data privacy concerns and resistance to change), and future trends in technology (e.g., artificial intelligence and robotics in nursing).

Integration of Findings

Insights were synthesized to provide a cohesive discussion on how nurses can leverage technology to enhance care delivery while addressing potential risks and limitations.

Development of literature reviews

Through a critical review of the body of research and literature in this area, this study aims to investigate the possible hazards and constraints of technology in nursing practice while offering insights into how nurses might use it to improve the quality and delivery of patient care (“Public Health Technologies Changing Health Care Delivery | Online Masters in Public Health,” n.d.). Technology has completely changed the nursing profession, from the adoption of telehealth and remote monitoring systems to the advent of electronic health records (EHRs). EHRs have facilitated better communication between healthcare practitioners, expedited the recording process, and increased patient safety by lowering the possibility of medical errors (Jin, Kim, Miller, Behari, & Correa, n.d.). Thanks to telehealth services, medical professionals may now electronically interact with patients who live in remote places, monitor chronic illnesses, and contact them (Gajarawala & Pelkowski, 2021). Early health issue diagnosis and prompt interventions have been made possible by the continuous monitoring of patients' vital signs and behavioural patterns made possible by the integration of wearable devices and mobile health apps. As technology develops further, nurses will have to adjust to these changes and pick up the skills needed to use new tools and systems in their work (Li, Wang, Wang, & Zhang, 2024).

Results

Study Selection Process

In this comprehensive review, a total of 1,152 studies were initially identified across multiple reputable databases, including PubMed, CINAHL, ScienceDirect, IEEE Xplore, Cochrane Library, ProQuest Nursing & Allied Health Database, and Google Scholar. After screening titles and abstracts, 864 studies were excluded due to relevance or failure to meet the inclusion criteria. The remaining 288 full-text articles were carefully reviewed for eligibility, resulting in the inclusion of 95 studies that met the predefined criteria, focusing on advancements in nursing care facilitated by digital technologies. A quality appraisal was conducted using the Mixed Methods Appraisal Tool (MMAT), leading to the exclusion of 21 studies due to methodological issues, thus leaving 95 studies for the final synthesis.

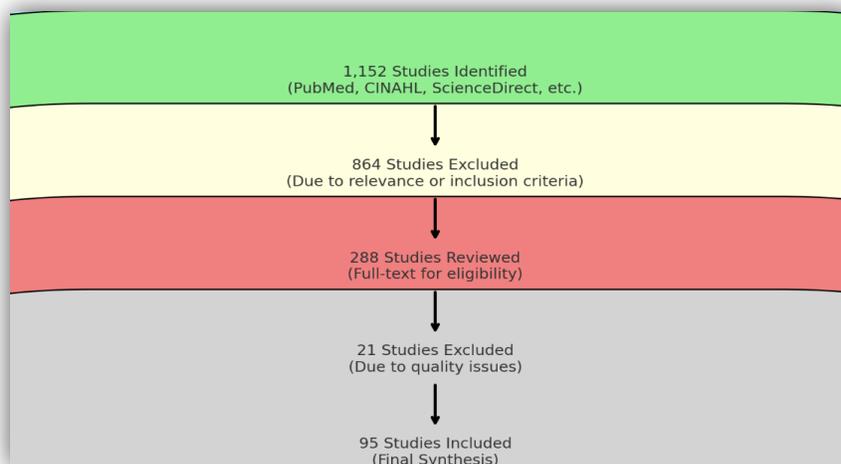


Figure 1. Study selection flow

Key Themes Identified

The synthesis highlighted several key themes regarding the impact of digital technologies on nursing practices and patient care. Notably, Electronic Health Records (EHRs) emerged as the most frequently studied theme, with 70 studies dedicated to exploring their influence on healthcare systems. Close behind were Telemedicine and Clinical Decision Support Systems (CDSS), studied in 65 and 50 articles, respectively. Other significant themes included the integration of Robotics, Wearable Technologies, and Automated Medication Management, with 40, 30, and 25 studies focusing on these advancements. These technologies are shown to improve system efficiency, enhance patient care delivery, and help reduce errors in healthcare settings.

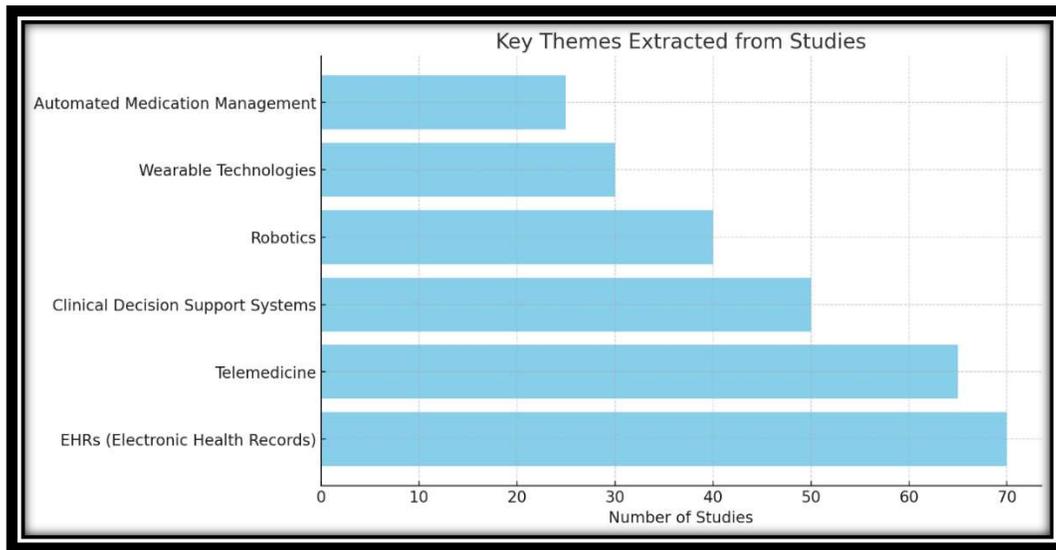


Figure 2. Key Themes Identified

The data clearly underscore both the positive impacts of these technologies and the challenges that accompany their integration into clinical practices. For instance, Telemedicine has significantly enhanced healthcare access, particularly in underserved areas, though concerns such as data privacy, resistance to adoption, and disparities in access continue to persist, complicating the full potential of these innovations.

Discussion

Technological Advancements in Healthcare

Numerous innovations that have improved patient care delivery and health outcomes have resulted from the integration of technology into healthcare systems (Ahluwalia, n.d.). With the help of electronic health records (EHRs), documentation procedures have become more efficient, allowing healthcare providers to share information more effectively and encouraging interdisciplinary collaboration (Vos, Boonstra, Kooistra, Seelen, & van Offenbeek, 2020). Furthermore, telemedicine platforms have made healthcare services more accessible, especially in underserved or distant locations, allowing patients to obtain prompt consultations and monitoring without being limited by geography (George & George, 2023). The myriad benefits of nursing technologies augment the healthcare system. Technology facilitates the prompt identification of problems, enabling swift interventions. It reduces the probability of adverse outcomes and minimizes delays in nursing interventions (admin, 2023). Nurses are able to act quickly and keep a close eye on patients' status. Certain technologies prioritise the provision of nursing care.

The term "computerized physician order entry" describes the process of submitting prescription and other medical orders using a computer or mobile device platform (Connelly & Korvek, 2024). An improvement in the safety of medication orders was the original intent of computerized physician order entry systems, but newer versions also make it possible to order consultations, tests, and operations digitally (Mogharbel, Dowding, & Ainsworth, 2021). It is common practice to incorporate clinical decision support systems (CDSs) with electronic medical record systems. By guiding prescribers on the optimal prescription dosages, administration routes, and frequency, the CDS acts as a tool to avoid errors (Shahmoradi, Safdari, Ahmadi, & Zahmatkeshan, 2021).

Clinical decision support provides medical providers with information and data that is unique to each patient. In order to aid the healthcare practitioner in making better decisions, this data is logically filtered and delivered to them at

the right times (Shahmoradi et al., 2021). Medical judgment support incorporates a range of tools to enhance clinical workflow and decision-making. Clinical guidelines, patient-specific clinical summaries, condition-specific order sets, documentation templates, notifications, alerts, and reminders for patients and healthcare practitioners are a few examples of these tools ("An Overview of Clinical Decision Support Systems: Benefits, Risks, and Strategies for Success | Npj Digital Medicine," n.d.)

Intravenous infusion pumps that are connected to the internet and have software are called smart infusion pumps that eliminates possibility of drug mistakes. A notification is sent to the user by this programme whenever the infusion setting is altered in a manner that exceeds the pre-configured safety parameters (Giuliano, 2015). Automated dispensing cabinets (ADCs) are electronic drug cabinets that are used to track medicine distribution, store pharmaceuticals at the point of care, and offer regulated dispensing ("Automated Dispensing Cabinets," n.d.), (Zheng, Lichtner, Van Dort, & Baysari, 2021). Automated dispensing cabinets were first used by hospitals in the 1980s. However, as time went on, they were updated to include more sophisticated software and digital interfaces in order to remove dangerous stages from the medication administration process. By improving the monitoring of medicine administration and patient billing and reducing the burden on the central pharmacy, automated medication dispensing cabinets have become an effective instrument for pharmaceutical inventory management (Shermock, Shermock, & Schepel, 2023).

A patient portal is a protected web program that patients can use on their personal computers or mobile devices to access their personal health information and to contact with their care provider electronically in two different ways. Patients can use the patient portal to access their information (Dendere et al., 2019). Telemedicine refers to the utilization of communication technologies to enhance interaction between healthcare providers and patients (Alenoghena et al., 2023). Clinical patient data may be communicated either asynchronously or synchronously via bidirectional real-time video transmission. Health data gathered remotely from individual mobile devices or medical equipment can be made available through telemedicine, in addition to conversation. Utilizing this data allows for the modification, tracking, or monitoring of patients' behaviour (Moulaei, Sheikhtaheri, Fatehi, Shanbehzadeh, & Bahaadinbeigy, 2023).

Sign-out communication, also referred to as "hand-over" communication, involves the transfer of patient-specific information between caregivers, teams of caregivers, or from caregivers to patients and their families, ensuring continuity and safety in patient care ("Improving Patient-centred Care through a Tailored Intervention Addressing Nursing Clinical Handover Communication in Its Organizational and Cultural Context - Chien - 2022 - Journal of Advanced Nursing - Wiley Online Library," n.d.). A breakdown in the process of sharing patient information has been identified as one of the primary driving forces for sentinel occurrences in the United States, according to the findings of a recent investigation (Patra & De Jesus, 2024). Applications for electronic sign-out can be employed independently or in conjunction with electronic medical records to ensure a systematic transfer of patient data during handoffs between healthcare providers (Festila & Müller, 2021).

Bar code medication administration systems are electronic systems that integrate bar code technology with electronic drug administration information. These systems are referred to as automated barcode systems. These systems aim to eradicate pharmaceutical errors by guaranteeing the correct medication is given to the right patient at the designated time (Shah, Lo, Babich, Tsao, & Bansback, 2016). To add insult to injury, the present barcode systems vary in the level of sophistication among themselves. In the event that two medications that are similar in appearance or sound are likely to be confused with one another, certain software will sound an alarm. Not only do some of them provide professional advice for certain medications when they are scanned, but others might also assist with paperwork. namely, the incorporation of information regarding the administration of medications and other pertinent clinical data into the electronic medical record ("A Call for Mandatory Barcode Technology to Reduce Medication Errors," 2023).

Impact of Technological Advancements on Patient Care

Technological breakthroughs are transforming the healthcare sector, and their impact on patient care is diverse. The integration of electronic health records (EHRs), which improve care coordination, facilitate communication amongst healthcare providers, and streamline documentation, is one important component. Furthermore, patients can now obtain healthcare remotely thanks to telehealth services, which lowers obstacles to care and boosts patient involvement.(Paul, Maglaras, Ferrag, & Almomani, 2023) Improved patient outcomes and shorter recovery periods have resulted from the use of robot-assisted surgery, which has also opened the door for more accurate and minimally invasive operations. Without a question, these technological developments have improved patient care and revolutionised the way healthcare is provided in the current day.(Reddy et al., n.d.)

Challenges and Ethical Considerations in Implementing Technology in Nursing

Technological developments present certain obstacles as well as exciting potential to improve nursing care. For nursing personnel to adapt new technologies seamlessly, there needs to be sufficient training and support provided.(Abuzaid, Elshami, & Fadden, 2022) Strong steps are also required to secure patient data and preserve

confidentiality due to worries about data privacy and security. Furthermore, differences in access to technology could make healthcare inequities worse, emphasising how critical it is to address digital divide concerns in order to guarantee fair care delivery.(Cordeiro, 2021)

There are several reasons why integrating technology in nursing can be difficult, such as staff members' low tech literacy, reluctance to change, and possible privacy violations. When faced with unfamiliar workflows or the prospect of losing their autonomy, nurses may become resistant to new technologies.(Booth, Strudwick, McBride, O'Connor, & Solano López, 2021) The proper incorporation of these tools into nursing practice can also be hampered by a lack of training on technology use. Furthermore, there is an ethical risk that needs to be carefully controlled in the event that private patient information is unintentionally revealed through electronic health records or communication platforms.(Rasheed et al., 2022) Ensuring the responsible and advantageous use of technology in nursing care necessitates a diverse approach that includes organisational support, ethical principles, and education.(Haddad & Geiger, 2024)

Future Trends and Innovations in Nursing Technology

Future advancements and trends in nursing technology have the power to totally alter the healthcare sector. Artificial intelligence (AI) and machine learning are becoming increasingly utilized in nursing practice, which is a significant breakthrough in the field. The application of artificial intelligence (AI) has the potential to increase diagnostic accuracy, improve the speed of medical care, and improve the results for patients.(Bohr & Memarzadeh, 2020) Furthermore, another trend that is expected to gain traction in the upcoming years is the use of robotic helpers in healthcare settings. Nurses can concentrate on direct patient care by delegating activities to robots, which include drug delivery, patient monitoring, and data collecting.(Soriano et al., 2022) The efficiency and efficacy of healthcare delivery could be enhanced by these developments in nursing technology, which would eventually improve patient outcomes.

Conclusion

In summary, the incorporation of technological innovations into nursing care has demonstrated to be an essential component in raising the bar for care delivery, optimising patient outcomes, and increasing clinical practice's accuracy and efficiency. Healthcare practitioners may now personalise treatment regimens to match the needs of each patient, decrease errors, and streamline processes with the use of modern monitoring equipment, telemedicine platforms, electronic health records, and other cutting-edge technologies. It is clear that nurses must adjust to the shifting technology landscape in order to stay knowledgeable, skilled, and effective in their responsibilities as the healthcare industry continues to change. For the purpose of ensuring that nurses are adequately equipped to fulfill the ever-increasing demands of the healthcare business and to provide the highest possible level of care to their patients, it will be crucial to maintain funding for training programmes, research projects, and creative partnerships between the healthcare and technology sectors. Technological developments, health, and nursing care have a complex relationship, with technology acting as a catalyst for revolutionary changes in the way healthcare is delivered. In order to meet the changing demands of various populations, nurses can improve their ability to provide high-quality, patient-centered care by embracing innovation and utilising digital health technologies. However, harnessing the advantages of technology while minimising potential threats requires careful consideration of ethical, regulatory, and practical issues. Nursing practitioners can leverage technology to enhance patient outcomes and elevate the standard of care by working together across disciplinary boundaries and being flexible.

Declaration conflicting interest

There are no conflict of interest to declare.

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Author contribution

The authors was solely responsible for the conception design and execution of the study including the development of search strategy, data collection, analysis and, manuscript preparation

Authors biography

Dr. Mangesh Jabade is an experienced academician specializing in research, with 15 years of expertise in clinical research.

Mr. Husain Nadaf is a dedicated researcher with six years of experience in the field of critical care.

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