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Review Article

Scope of technology in health care, special focus on nursing

ABSTRACT

Integrating artificial intelligence (AI) into health care reshapes nursing practices and education, enhancing patient care and clinical processes. This article discusses the transformative potential of AI in nursing, from streamlining documentation and diagnosis using AI applications to the evolution of nursing. The utilization of AI in primary care through automated communication strategies and the emergence of humanistic AI solutions are explored. As nurses adapt to AI-driven health-care technologies, balancing present needs with future demands becomes imperative. AI provides substantial advantages, but it's crucial to address challenges to ensure the successful integration of technology in healthcare and maintain the delivery of high-quality patient care in our tech-driven healthcare environment.

Keywords: Artificial intelligence in nursing, artificial intelligence, health-care innovative technologies

INTRODUCTION

A computer-operated system or robot attains the designation of artificial intelligence (AI) when it demonstrates capabilities akin to human intellect, such as learning, analysis, comprehension, interpretation, interaction, and decision-making on par with or surpassing human capacity.[1] AI encompasses an array of technologies, each serving specific functions based on the task at hand. Its integration into daily life through devices such as mobile phones, smart TVs, and electronic exercise equipment exemplifies its pervasive influence.[2]

The health-care sector is witnessing a surge in AI adoption, with emerging technologies revolutionizing various aspects. This spans from online appointment scheduling and digital health records to alert systems for follow-up consultations and pharmaceutical dosage algorithms. AI aids in identifying uncommon symptoms by drawing insights from extensive databases, enabling even resource-constrained health-care professionals to provide effective treatment. A large share of the health-care workforce globally is made up of nurses, and the rise of artificial intelligence driven health-care technologies (AIHTs) is poised to reshape their roles and responsibilities.[3] The evolution of nursing practices and education is inevitable, necessitating a shift in required skills and competencies to accommodate these new paradigms. AI applications in nursing offer a glimpse into the transformative potential of these technologies. For example, deep learning techniques facilitate the creation of tools that assist nurses in employing standardized terminologies, automatically suggesting relevant critical phrases based on their notes. Speech recognition expedites nursing documentation, enhancing accuracy and efficiency.[4]

As AIHTs stand poised to revolutionize nursing and education,[5] nursing professionals must embrace the

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impending integration of AI. Proficiency with AIHTs is essential for clinical practice, prompting the urgent need for upskilling among nurses. A concerted effort to equip nurses with the requisite knowledge and abilities to harness AI's potential is imperative.[6]

The client, the environment, health, and nursing are the four key elements that specifically make up the metaparadigm of nursing.[5] Nursing, biochemistry, educational psychology, sociology, and behavioral sciences are a few of the disciplines and humanities that nurses draw on to influence their work.[7] AI must be integrated into nursing education to guarantee that nurses are adequately prepared with the necessary knowledge to maximize patient health outcomes in an evolving medical and technological environment.[5]

Health practitioners must adjust their present practice methods to operationalize these technology advancements as emergent AI health technologies alter health practices.[8] As they co-create new models, frameworks, and theories that may be needed to support future technologies, nurses should be aware of how AIHTs might be incorporated into the conceptual underpinning of nursing practice.

In the era of AI, preparing nurses and nursing students for clinical practice necessitates striking a balance between training for present requirements and foreseeing future demands.[9] Significant developments in nursing informatics over the past several decades can be used to assist nursing educators in their efforts to change courses. Nurses need to be aware of how AI is used in patient care.[10] Boosting creativity, enhancing decision-making, streamlining and improving operations, and reducing expenses overall are some transformative applications of technology. Only 15%–20% of end users are utilizing AI in health care to change how patient care is delivered, even though it is considered a viable answer for handling significant increases in complicated medical data.[11]

Clinical analytics produce insights and enhance outcomes and care. Clinical pathway prediction, illness advancement estimation, specific health protection, determining risk scoring, and virtual agents integrated into health-care systems for workflow enhancements are just a few of the numerous applications of AI for clinical analytics.[12] AI may also help with illness management by aiding in differential diagnosis on medical pictures and merging patient data with safety regulations and academic research to create individualized treatment regimens.

Chatbots are computer programs that simulates conversation with human end users. Through Chatbots, AI can improve primary care and triage. Chabots facilitates communication with patients and offer quick conversational responses. They could save money by eliminating pointless doctor visits. If utilized effectively, Chabots can even assist health-care professionals in exceeding patients' expectations while improving patient outcomes. By utilizing an all-in-one communication strategy, Chatbots encourages patients to openly share their medical information, allowing doctors to provide better patient care at reduced costs and with happier patients.[12] Hence, with the help of AI, primary care may be automated and managed efficiently, freeing up physicians to focus on critical and urgent patients.

Health-care AI solutions are also moving toward a more humanistic approach. Health-care providers may quickly build and deploy digital-human personnel thanks to digital human platforms integrating with IBM, Amazon, Google, and Microsoft. Hospitals might use virtual humans as health-care aides to give patients compassionate care around the clock.[13] The necessity for virtual nursing assistants on call is eliminated by AI systems. By interacting with patients and directing them to the best treatment setting, virtual nursing assistants might help the health-care industry save $20 billion 3 years. They can keep an eye on patients, answer their questions, and give quick real-time replies. Today's majority of digitally approved nursing programs provide frequent and reliable communication between patients and medical personnel. As this happens in between patient visits to their doctors' offices, there are reduced chances of unneeded hospital stays or hospital readmission.[1,14] In addition to booking medical visits and keeping track of patients' health conditions, AI-powered virtual assistants offer individualized experiences to patients, assisting them in identifying their ailment based on the symptoms.

The objectives of this review are to explore the increasing integration of AI technologies into various aspects of health care, from appointment scheduling to treatment algorithms, and assess their transformative potential within the sector and to emphasize the crucial role of nursing professionals in adapting to AIHTs, underscoring the need for upskilling and integration of AI into nursing education to enhance patient care and outcomes.

SCOPE OF TECHNOLOGICAL INNOVATION IN NURSING CARE

Advances in technology and medicine have been closely intertwined for many years, resulting in significant improvements in health care. These innovations have saved countless lives and enhanced the quality of life for many individuals. As technology evolves, the potential for further

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medical breakthroughs becomes even more intriguing. Let us delve into the top groundbreaking medical technologies that emerged in health care in Figure 1.[15]

Smart inhalers

The mainstay of asthma treatment is inhalers, which, when used properly, are compelling. Surprisingly, research reveals that only about half of the patients effectively manage their condition and a staggering 94% misuse inhalers.[16] To empower asthma patients, smart inhalers with Bluetooth technology have been developed. These tiny devices attach to inhalers and record dosing details, ensuring proper administration. Patients can track and manage their condition through smartphones. Clinical trials indicate reduced reliance on reliever medicine and increased symptom-free days.[16,17]

Robotic surgery

Robotic surgery revolutionizes minimally invasive procedures by enhancing precision, control, and flexibility. Surgeons can now perform intricate operations that were previously exceptionally challenging or even impossible. This technology is evolving to incorporate augmented reality (AR), enabling surgeons to access real-time patient information during procedures.[18] Despite concerns about job displacement, robots are likely to serve as valuable tools, enhancing surgical outcomes.[2]

Wireless brain sensors

Advancements in plastic materials have led to bioresorbable electronics designed for placement within the brain. These sensors enable doctors to monitor brain temperature and pressure. As they dissolve over time, the need for additional surgeries is reduced, presenting a promising development for neurology.[19,20]

Three-dimensional printing

Three-dimensional (3D) printers have gained immense popularity, particularly in medical applications. Implants and joints used in surgeries can now be 3D printed, offering precise customization. Bespoke 3D-printed prosthetics provide unprecedented comfort and mobility. In addition, pills containing multiple drugs can be printed to aid medication organization, timing, and monitoring.[6]

Artificial organs

Bioprinting, an emerging technology, has enabled the creation of artificial organs. From blood vessels to synthetic ovaries and pancreas, these organs can grow within patients to replace dysfunctional ones. This breakthrough holds the potential to transform transplantation medicine and save countless lives.[21]

Health wearables

Wearable devices have gained popularity in recent years, tracking various health metrics. Apple's series 4 watch,

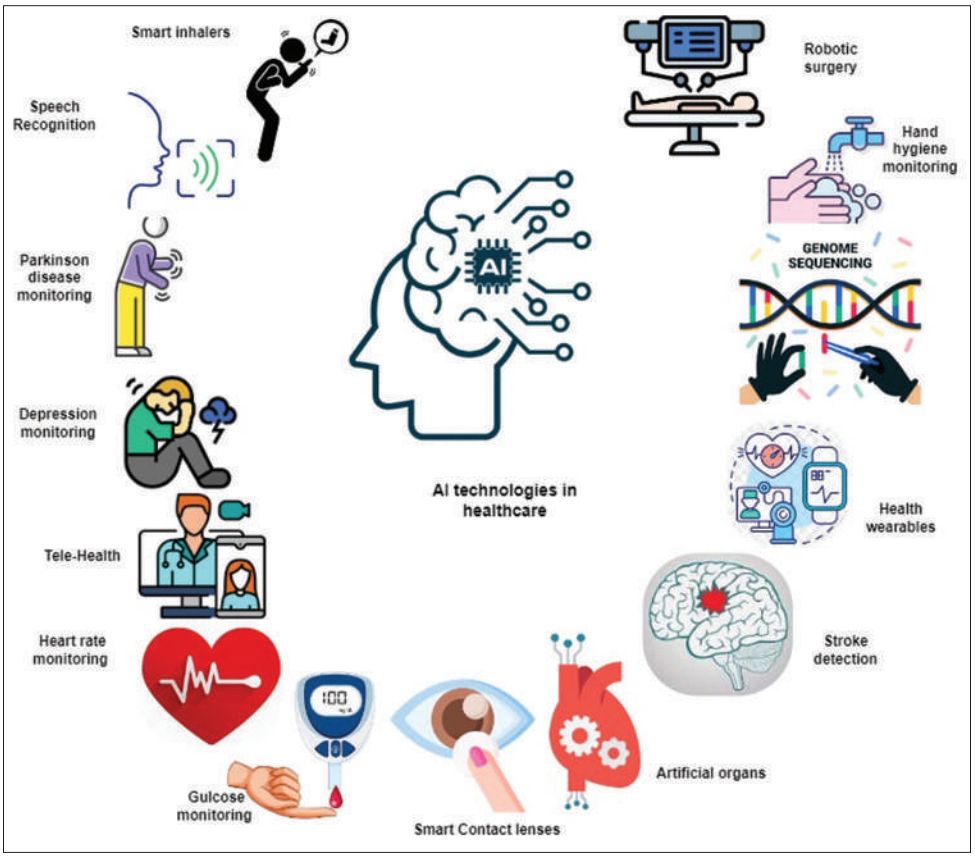

Figure 1: Artificial intelligence technologies in health care drawn by author, source 15

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equipped with an integrated electrocardiogram, garnered attention for its potential to detect heart conditions early.[22] These wearables aid in monitoring chronic diseases such as diabetes and cardiovascular issues, contributing to healthier lifestyles.[23]

Precision medicine

Medical technology is increasingly personalized, with precision medicine tailoring treatments based on individual genetic makeup. This approach proves highly effective in treating diseases such as cancer, targeting specific genetic mutations. Rheumatoid arthritis treatment also benefits from precision medicine's gene-targeting mechanism.[21]

Augmented and virtual realities

Virtual reality (VR) and AR are immersive technologies that improve learning and health-care delivery. They are used to reduce pain, manage procedural discomfort, and offer therapy for mental health conditions. Therefore, they are promising in various health-care settings, from training to patient care, and in aiding in procedure rehearsal, patient diagnosis, treatment planning, and rehabilitation. Patients can also benefit from VR, preparing them for procedures and facilitating recovery.[2]

Telehealth

Telehealth offers patients digital access to medical care, reducing wait times for face-to-face appointments. Mobile apps allow virtual consultations with health-care professionals, benefiting those managing chronic conditions. Telehealth provides consistent, convenient, and cost-effective care, with a projected global market value of $113.1 billion by 2025.[24] Telemedicine enables clinical care remotely through telecommunication technology. It includes audio, video, and text consultations. The National Health Service (NHS) is increasingly adopting telephone and video consultations to meet the rising appointment demand. While telephone triage is well established, online services integrated into the NHS or offered commercially are increasingly popular because they are more convenient for patients and can reduce nonattendance.[1]

Virtual fracture clinics

Implementing virtual fracture clinics has demonstrated its effectiveness in improving several critical clinical performance indicators. Their nationwide adoption promises to yield profound economic benefits for the NHS. Approximately 7.6 million trauma and orthopedic outpatient appointments place substantial demands on health-care resources annually. At least 50% of the appointments in the fracture clinic are shifted to virtual platforms in this context. Integrating virtual appointments within the fracture clinic paradigm curtails the number of necessary appointments. Extrapolating this approach to a larger scale could reduce around 570,000 15-min outpatient appointments.[25] In terms of tangible time savings, this amounts to an annual approximation of 142,000 h of outpatient clinic time, thereby liberating a significant portion of health-care professionals' valuable time for direct clinical care.

Smartphone apps myCOPD app

Chronic obstructive pulmonary disease (COPD) is a prevalent and chronic respiratory ailment, ranking among the top five causes of mortality in the UK.[26] The myCOPD app represents a pivotal innovation that seamlessly integrates education, symptom monitoring, and pulmonary rehabilitation, culminating in enhanced self-management of COPD.[27] Patients actively engaging with the app have effectively managed their condition, reducing unplanned hospital admissions. With approximately 835,000 individuals diagnosed with COPD in England alone, the burden of managing this condition is substantial. Annually, COPD contributes to around 115,000 emergency admissions, significantly straining health-care resources.[28] Utilizing the myCOPD app has translated to a notable 19% reduction in emergency admission rates, yielding consequential benefits in resource allocation and patient well-being. Even though adopting the myCOPD app may not be universally feasible among all COPD patients, envisioning its integration for 50% of diagnosed individuals underscores its potential impact. This projection entails a minimum annual saving of 84,000 hospital bed days, further translating to an advantageous reclamation of 150 nurses' hours dedicated to direct clinical care.[29,30]

Smartphone apps, GDm-Health app

Conventional management of gestational diabetes mellitus (GDM) traditionally involves regular hospital visits and using paper diaries for monitoring.[31] The GDm-Health app introduces a paradigm shift by enabling remote self-monitoring and specialist midwife-assisted tracking of diabetes progression. This digital solution fosters secure communication between expectant mothers and their health-care providers, potentially minimizing the frequency of clinic visits. Notably, users of the GDm-Health app have demonstrated improved blood glucose control and a decreased necessity for clinic attendance. Against the backdrop of approximately 80,000 women affected by GDM in the UK, the potential impact of the GDm-health app emerges vividly. By leveraging this digital tool, users experience an average reduction of up to two clinic visits throughout their pregnancy. GDm-health app substantially reduces approximately 160,000 outpatient appointments annually, sparing valuable clinical time and enhancing patient convenience. Consequently, deploying the GDm-Health app

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can unlock 40,000 h of outpatient clinic time, facilitating a greater focus on direct patient care.[3]

Remote monitoring Airedale and partners enhanced health in care homes vanguard

The Airedale digital hub embodies a pioneering approach to health-care delivery within nursing and residential homes, facilitated through teleconsultations with experienced clinicians, accessible around the clock. This digital interface is an efficient gatekeeper, effectively evaluating and prioritizing clinical inquiries, including the need for General practitioner (GP) visits.[3] The tangible impact of the digital hub is exemplified by statistics from 2017, revealing that a substantial portion of consultations resulted in patients remaining within the care home environment. Moreover, a significant reduction in GP referrals and ambulance conveyances further underscores the efficacy of this approach. The annual context is paramount, with a staggering 295,000 A and E attendances, 268,000 ambulance conveyances, and 107,000 hospital admissions associated with care home patients.[32] Against this backdrop, the potential of remote monitoring becomes apparent, capable of averting approximately 40% of ambulance conveyances, A and E attendances, and hospital admissions.[33] This transformation translates to an estimated 1,740,000 nurses' hours redirected toward clinical care, equating to an approximate annual conservation of 218,000 h of A and E consultation time and 53,000 h of ambulance time. However, while the benefits of the digital hub are evident, a balanced perspective is necessary. Scaling up such an initiative warrants careful consideration, accounting for the establishment and sustained operation of numerous digital hubs operating 24/7. This endeavor necessitates a substantial workforce and resource commitment.[3]

Automated image interpretation, diagnostic support in radiology

Within the realm of diagnostic support in radiology, a groundbreaking application of deep learning has emerged: automated image interpretation for the detection of breast cancer. AI algorithms, especially those associated with deep learning, have showcased impressive advancements in tasks related to image recognition. Techniques ranging from convolutional neural networks to variational autoencoders have been used extensively in various areas of medical image analysis. AI algorithms have significantly accelerated progress in this field.[34] Traditionally, in radiology, skilled medical professionals relied on visual inspection to analyze medical images to identify, describe, and track diseases. Conversely, AI techniques excel in autonomously identifying intricate patterns within imaging data, offering quantitative evaluations of radiographic attributes rather than relying solely on qualitative interpretations.[35] Since radiologists traditionally devote at least 60% of their time to image review, eliminating the necessity for a second reader translates to a remarkable 30% reduced workload. Automated image interpretation, in turn, resonates throughout health care, culminating in a significant 20% reduction in the hours they dedicate to image interpretation. The far-reaching implications become evident when considering the annual volume of medical images – a staggering 41 million – captured and examined by the dedicated NHS workforce 4204. Envisaging the potential applicability of AI technologies, such as deep learning, to other medical images mirrors the transformation witnessed in mammography. This potential shift signifies an immense stride toward efficiency, projecting an annual impact equivalent to approximately 8.2 million images and a consequential liberation of 890,000 h of radiologist time. The advancement aligns seamlessly with optimizing health-care resources to channel their prowess toward direct clinical care and patient well-being.[36]

Remote patient observation

The use of remote patient monitoring is a groundbreaking application of Internet of things (IoT) devices in health care. This technology enables health-care professionals to track patients' well-being from a distance, offering convenience and real-time insights. Patients' vital metrics such as heart rate, blood pressure, and temperature are automatically collected by IoT devices even when they are not physically present at a health-care facility. IoT devices eliminate the need for patients to make unnecessary trips and minimize manual data collection efforts.[37] The collected data are transmitted to a dedicated software application to which health-care providers and patients have access. Intelligent algorithms can analyze these data to suggest treatments or generate alerts. For instance, an IoT sensor detecting a meager heart rate can trigger an alert for health-care professionals to take immediate action. A significant challenge here is ensuring the security and privacy of the sensitive data collected by these IoT devices.[38]

Glucose monitoring

For the millions of individuals with diabetes, continuous glucose monitoring has been challenging. Traditional methods involve periodic checks and manual recording, often missing fluctuations in glucose levels. IoT devices are revolutionizing this by offering continuous, automatic monitoring of glucose levels.[39] These devices eliminate manual record-keeping and provide timely alerts when glucose levels are concerning. Creating IoT devices for glucose monitoring poses challenges, for example, they must be compact, continuously wearable and comfortable and keep energy efficiency to minimize the need for frequent recharging. Overcoming these challenges can transform diabetes management by providing real-time insights and enhancing the quality of life for patients.[3]

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Heart rate monitoring

Even in health-care facilities, competent monitoring of heart rates is complex. Conventional methods involve periodic checks that might miss sudden fluctuations. IoT devices are introducing small, wearable sensors that allow continuous heart rate monitoring. Patients can move freely while their heart rate is constantly monitored. Although achieving ultra-accuracy remains a challenge, modern devices boast accuracy rates of around 90% or more.[40]

Hand hygiene monitoring

Hand hygiene is critical in health-care settings to prevent contagion.[41] IoT devices have been introduced to remind health-care workers and patients to disinfect their hands. These devices offer instructions on proper hand hygiene techniques tailored to specific risks. While they cannot physically sanitize hands, research shows that they can significantly reduce hospital infection rates.[3]

Depression and mood monitoring

Depression and posttraumatic stress disorder are prevalent mental disorders worldwide.[42] Monitoring and managing these conditions can be challenging due to the fluctuating nature of symptoms. However, IoT devices are introducing new possibilities for continuously monitoring and managing these conditions. IoT devices equipped with mood-awareness capabilities address this challenge by analyzing data such as heart rate and blood pressure to infer a patient's mental state. Advanced devices even track eye movement. Although these metrics cannot predict depression symptoms with complete accuracy, they offer insights that can aid health-care providers in understanding patients' well-being.[43]

Parkinson's disease monitoring

For effective Parkinson's disease treatment, health-care providers need to understand how symptoms fluctuate throughout the day. IoT sensors make this easier by continuously collecting data on Parkinson's symptoms. In order to minimize lengthy hospital stays, patients can continue their normal activities while being monitored, avoiding extended hospital stays.[44]

Ingestible sensors

Ingestible sensors offer a less invasive way to gather internal health data. These sensors dissolve or pass through the body, providing insights into digestive health and internal bleeding. Developing ingestible sensors that are easy to swallow and safe for the body is a focus of ongoing research.[20,21]

Connected contact lenses

Smart contact lenses are being explored for health-care data collection. They could include micro-cameras for imaging. Besides health applications, intelligent lenses could revolutionize digital interactions by turning the eyes into a powerful tool.[6]

Genome reading

The ability to sequence and analyze an individual's genome has grown exponentially.[45] Initiatives such as the 100,000 genomes project and the NHS genomic medicine service are advancing genomic diagnostics. Whole-genome sequencing is becoming more affordable, leading to potential disease prevention and management breakthroughs.[46]

Speech recognition

Smart speakers and voice assistants are transforming health-care tasks. Automated speech recognition allows users to interact with devices through voice commands, benefiting clinical documentation and patient care. Speech recognition technology is entering mental health triage, aiding in emotion analysis and suicide risk assessment.[47]

Predictive analytics

AI-powered predictive modeling is gaining traction in health care. It helps in risk assessment, personalized treatment algorithms, and patient triage. These models use electronic patient records and advanced algorithms to predict outcomes, aiding health-care professionals in making informed decisions.[48]

Genome writing

Advanced gene-editing tools like CRISPR-Cas9 enable scientists to modify genes, potentially leading to cures for genetic diseases. Genome writing holds the promise of targeted therapies, where faulty genes are corrected or replaced with healthy ones, opening new avenues for precision medicine. The emergence of potent genome-editing tools and synthetic biology techniques holds immense promise in reshaping patient outcomes by enabling the interpretation of genetic information and its active manipulation. Among these transformative tools, CRISPR/Cas9 is a groundbreaking system for precision gene editing, allowing for targeted modifications within an individual's DNA.[49] If wielded responsibly, this technology offers the potential to unlock cures for once-intractable rare diseases, ushering in novel and meticulously tailored therapeutic approaches.[50]

Early detection and diagnosis of stroke

Stroke is a prevalent and frequently occurring ailment that impacts over 500 million individuals worldwide. It is China's primary cause of mortality and ranks fifth in North America. The global economic toll due to stroke-related medical expenses has amounted to approximately

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US$689 billion, significantly burdening both nations and families. Hence, pursuing research into stroke prevention and treatment holds immense importance.[51] In recent times, the realm of stroke-related studies has increasingly embraced AI techniques. In this context, we provide a condensed overview of pertinent AI methodologies within the three primary domains of stroke care: early disease prediction and diagnosis, treatment, outcome prediction, and prognosis assessment. Cerebral infarction, responsible for 85% of strokes, often arises from vessel thrombosis. However, due to challenges in promptly recognizing early stroke symptoms, only a minority of patients receive timely interventions. Nowak *et al*. devised a movement-sensing apparatus designed for the early prediction of strokes. The device was designed to construct a model using two machine learning algorithms – a genetic fuzzy finite state machine and principal component analysis (PCA).[52] When a patient's movement significantly diverges from the regular pattern, an alert indicating a potential stroke is activated, prompting swift evaluation for treatment. Similarly, Maninini *et al*. introduced a wearable device that collects data related to normal/pathological gaits, aiding in stroke prediction.[53] By employing hidden Markov models and support vector machines, they processed and modeled the data, achieving an accurate classification rate of 90.5% for subjects within the appropriate groups.[54]

BENEFITS OF TECHNOLOGY IN NURSING

Technology has significantly transformed the nursing field, bringing numerous benefits that enhance patient care, streamline processes, and improve health-care delivery. Here are some of the critical advantages of integrating technology into nursing practice:[5]

Improved patient care and safety

Accurate documentation

Electronic health records (EHRs) enable nurses to maintain comprehensive and up-to-date patient records, reducing the risk of errors due to manual record-keeping.[55]

Medication management

Technology aids in accurate medication administration through barcoding and automated dispensing systems, reducing the likelihood of medication errors.[43]

Enhanced communication and collaboration

Telehealth and telemedicine

Nurses can provide remote consultations, monitor patients, and offer timely interventions through telehealth platforms, extending care to underserved areas and patients with mobility constraints.[56]

Care coordination

Digital communication tools facilitate seamless communication among health-care teams, allowing nurses to collaborate effectively with physicians, specialists, and other care providers.[57]

Efficient workflow and time management

Automation of routine tasks

Technology automates vital sign monitoring and data collection, freeing nurses' time to focus on critical patient interactions.

Mobile applications

Nursing-specific apps enable quick access to reference materials, clinical guidelines, and patient information, aiding in prompt decision-making.[58]

Real-time data and clinical decision support

Evidence-based care

Technology provides access to the latest medical research and evidence-based guidelines, assisting nurses in making informed clinical decisions.

Alerts and notifications

Automated alerts for critical laboratory results or changes in patient conditions empower nurses to respond promptly to emergencies.[59]

Enhanced patient education and engagement

Health education resources

Nurses can use technology to provide patients with educational materials, videos, and interactive tools that help them understand their conditions and treatment plans.

Remote monitoring

Patients can actively participate in their care by using wearable devices and apps to monitor vital signs and track their health progress.[60]

Increased efficiency in administrative tasks

Scheduling and staffing

Technology aids in managing nurse schedules, ensuring appropriate staffing levels, and minimizing scheduling conflicts.

Billing and documentation

Automated billing and documentation systems streamline administrative processes, reducing paperwork and enhancing accuracy.[61]

Professional development and education

E-learning platforms

Nurses can access online courses and resources to stay updated on the latest healthcare and nursing practice advancements.

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Simulation and training

Technology offers realistic simulation scenarios for training, enabling nurses to practice skills in a risk-free environment.[15]

Research and data analytics

Evidence collection

Technology facilitates patient data collection, contributing to research studies and the development of evidence-based nursing practices.

Quality improvement

Data analytics tools help identify trends and patterns in patient outcomes, enabling nurses to make data-driven improvements in care delivery.[1]

CHALLENGES NURSES FACE IN A TECHNOLOGY

The constantly changing world of health-care technology presents several difficulties for nurses as they operate intricate digital systems. While technology has brought many benefits, it has also introduced new complexities and demands. Here are some key challenges that nurses face in this digitally advanced health-care landscape:[36]

The intersection of technology and patient care

As medical devices incorporate advanced software that requires regular updates, nurses must be adept at managing these updates. Inadequate training or mismanagement can lead to compromised patient care and potential medical negligence. This can result in malpractice claims, highlighting the importance of a comprehensive understanding of the technology nurses use in their practice.[8]

Human touch versus technological efficiency

The emergence of robotics in health-care settings raises questions about the future of nursing roles. While technology offers efficiency, robots lack the empathetic human touch, a cornerstone of nursing care. Nurses must adapt to the coexistence of robots and humans in patient care and maintain empathy as they pursue technological advances.[16]

Remote care and communication

Telehealth presents new opportunities for remote patient care but poses challenges. Access to the internet can help effective communication between nurses and patients. Furthermore, the variations in medical licensure requirements across states can limit the potential of telehealth services and hinder nurses' ability to provide comprehensive care across geographic boundaries.

Education gap in a rapidly evolving field

The health-care industry is undergoing rapid technological changes, but nurse education has yet to keep pace. Nurses often need to be equipped to operate new, digitally advanced equipment. Outdated curricula and a lack of training opportunities mean that nurses may need help to leverage the full potential of technological advancements in their practice.[47]

Balancing old and new systems

While the focus is often on embracing new technologies, some health-care settings still rely on outdated systems. Bridging the gap between generations of nurses becomes essential to ensure smooth transitions and effective patient care across varying technological landscapes.[62]

Navigating complexity in critical situations

Medical equipment frequently features user interfaces that can overwhelm nurses, especially in high-pressure situations. The challenge lies in distilling essential information quickly and accurately from these interfaces. Streamlining the user experience is crucial to prevent errors and enhance patient safety.[20]

Electronic health records: Blessing or burden?

While EHRs offer a streamlined approach to patient information tracking, poorly designed systems can lead to stress and frustration for nurses. Simplifying these systems and optimizing the user experience can contribute to more efficient and accurate patient care.[57]

Rapid changes and adaptation

The rapid implementation of new technologies can leave nurses struggling to keep up. The rapid changes, resource constraints, and time limitations can impede nurses from wholeheartedly embracing and efficiently using these new tools.[14]

NURSING IMPLICATION OF THIS PAPER

Nursing education

Integration of technology

Nursing education programs must adapt to the evolving technological landscape. This includes incorporating training on EHRs, telehealth platforms, and other health-care technologies.

E-learning

The paper emphasizes the importance of e-learning platforms for nurses. Nursing schools should invest in online courses and resources to update students on the latest advancements.

Simulation and training

Nursing programs should utilize technology for realistic simulation scenarios. This allows students to practice skills risk-free, preparing them for real-world patient care.

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Interdisciplinary learning

With technology integration into health care, nurses must collaborate with other health-care professionals. Nursing education should include interdisciplinary learning to promote effective teamwork in a tech-driven health-care environment.

Nursing research

Data collection and analysis

The availability of technology for data collection and analysis should be leveraged for research studies. This facilitates evidence-based nursing practices and contributes to the development of nursing knowledge.

Quality improvement

Data analytics tools can help nurse researchers identify trends and patterns in patient outcomes. This informs quality improvement initiatives, ensuring that nursing practices are continually refined based on data-driven insights.

Ethical considerations

Nursing research involving technology should also address ethical considerations, such as patient data privacy and informed consent, to ensure that research is conducted ethically and responsibly.

Nursing practice

Enhanced patient care

Technology supports nurses in providing better patient care. Accurate documentation, automated medication management, and real-time clinical decision support improve the quality of care and patient safety.

Patient engagement

Nurses can use technology to engage patients in their care, providing educational resources and enabling remote monitoring. This encourages patients to take an active role in managing their health.

Administrative efficiency

Nursing practice benefits from administrative efficiency through technology. Scheduling and staffing management and billing and documentation processes become more streamlined, reducing administrative burdens on nurses.

Interdisciplinary collaboration

Nurses must collaborate with other health-care professionals as technology integrates health-care disciplines. Effective communication and collaboration ensure comprehensive patient care in a technology-driven health-care setting.

CONCLUSIONS

Integrating technology into nursing practice brings forth many benefits that elevate patient care, streamline processes, and empower nurses to provide safer and more effective health-care services. As technology continues to evolve, nurses can leverage its potential to enhance their practice and contribute to improved patient outcomes. However, while technology has revolutionized health care, nurses face various challenges as they integrate and navigate these digital advancements. The nursing profession must address these challenges to ensure that nurses have the necessary skills and support to provide high-quality patient care in an increasingly technologically advanced health-care landscape.

Availability of data and materials

Collaborating with our research team, we engaged the expertise of a health science librarian to formulate and enhance an extensive search strategy. The search terms encompassed title and abstract fields, consisting of keywords such as "nurse," "nursing," and other pertinent terms associated with artificial intelligence and machine learning technologies, methodologies, and algorithms. These terms included variations like "Supervised learning," "Support Vector Machines," and "Similar Relevant MeSH terms encompassing concepts like" "Speech Recognition Software," "Machine Learning," "Decision Support Systems, Clinical," "Artificial Intelligence," "Deep Learning," and "Unsupervised Machine Learning."

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Conflicts of interest

There are no conflicts of interest.

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