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APPLICATION OF MODERN TECHNOLOGIES IN NURSING: OPPORTUNITIES AND SIGNIFICANCE FOR IMPROVING PATIENT CARE

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Abstract. *Modern healthcare systems are increasingly integrating digital technologies and artificial intelligence-based tools to improve the quality, safety, and efficiency of healthcare. In nursing, these technologies have significant potential to improve patient care, particularly in terms of clinical decision-making, continuous monitoring, workflow optimization, and the development of nurses' digital competencies. The aim of this study was to analyze the ways in which the application of digital technologies in nursing contributes to improving patient care, with particular emphasis on patient safety, clinical outcomes, and nursing efficiency. The study was designed as a literature review. A search was conducted in the PubMed, Google Scholar, and SCIndex databases between April 26 and April 30, 2026. Papers published between January 2020 and January 2026 in English and Republic of Serbian were included. After reviewing titles, abstracts, and available full texts, 19 studies were included in the qualitative analysis out of a total of 38 identified publications. Further analysis was performed using a thematic approach through the identification of key areas of digital technology application in nursing practice. The results indicate that the most important areas of digital technology application include clinical decision support systems, electronic health records, continuous patient monitoring tools, and digital educational platforms. The analyzed studies show that the use of these technologies contributes to the standardization of nursing procedures, timely recognition of clinical deterioration, reduction of errors, and improved work organization. The importance of early warning systems and continuous monitoring in enhancing patient safety and supporting clinical decision-making is particularly emphasized. In addition, the implementation of information systems reduces administrative burden and enables nurses to devote more time to direct patient care. It can be concluded that digital technologies represent a valuable resource for improving the quality of healthcare, patient safety, and nursing efficiency. Their successful integration requires continuous education of healthcare professionals, development of digital competencies, and adequate organizational and technological support within healthcare institutions.*

Keywords: *digital technologies; nursing, healthcare; artificial intelligence; clinical decision-making.*

Introduction

Modern healthcare systems are facing increasing demands for high-quality, safe, and efficient care in the context of a growing number of patients, increasing complexity of health conditions, and more and more diagnostic and therapeutic protocols. Such changes place additional pressure on healthcare professionals, particularly nurses, who represent the largest and one of the most important professional groups within the healthcare system. In this context, digital technologies and artificial intelligence (AI)-based systems have become an important part of the ongoing transformation of healthcare delivery and nursing practice.

World Health Organization (WHO) defines digital health as the use of information and communication technologies to improve health services, health system organization, and health outcomes [1]. AI-based systems, as part of digital health, represent a specific area of development and include technologies capable of analyzing large amounts of data, recognizing patterns, and supporting clinical decision-making. The WHO further emphasizes that the implementation of these technologies has the potential to improve accessibility, efficiency, and safety of healthcare, while also raising important ethical, legal, and organizational challenges [2].

In nursing practice, the use of digital technologies includes a variety of tools and systems that have the potential to improve the quality of care, work organization, and patient safety. Previous research indicates that these technologies may contribute to improved clinical decision-making, optimization of work processes, and professional development of nurses [3,4]. In addition, the digitalization of healthcare is increasingly changing the way nursing care is organized and delivered, highlighting the need for the integration of digital competencies into everyday clinical practice [5].

However, in spite of growing implementation of digital technologies in healthcare, new literature show numerous challenges related to integration into everyday nursing practice. The effects of their use are not uniform, and successful implementation depends on numerous factors including among others: organizational conditions, availability of infrastructure, the level of digital competencies among healthcare professionals, and the existence of appropriate ethical and legal regulations [4,6]. In particular, issues of data privacy, algorithm transparency and accountability in the use of artificial intelligence-based systems represent significant challenges in modern digital healthcare [2].

The importance of this topic is further emphasized in the context of healthcare workforce shortages, the increasing prevalence of chronic diseases, and the need for continuous improvement in the quality of nursing care. Although numerous studies have examined the application of digital technologies in healthcare, the results are heterogeneous and often focused on individual aspects of their use. Therefore, there

is a need to synthesize existing evidence regarding their impact on nursing practice and patient care.

Literature review

Materials and methods

The study was designed as a literature review for which a search of publications was conducted in order to identify relevant scientific studies addressing the impact of digital technologies in nursing on the quality of nursing care. The literature search was carried out using both national and international electronic databases, including PubMed, Google Scholar, and SCIndex. The search was conducted between April 26 and April 30, 2026, and included studies published between January 2020 and January 2026. Studies published in English and Republic of Serbian were included in the review.

The literature search was based on a combination of keywords using “AND” and “OR”. The following English terms were used: artificial intelligence in nursing, digital health in nursing, machine learning in nursing, clinical decision support systems, nursing informatics, patient outcomes, patient safety, efficiency in nursing, predictive analytics, patient monitoring, nursing workflow, and digital competencies in nursing. The following Republic of Serbian terms were also used: veštačka inteligencija u sestrinstvu, digitalne tehnologije u zdravstvenoj nezi, informatika u sestrinstvu, bezbednost pacijenata, ishodi lečenja i efikasnost rada medicinskih sestara, prediktivna analiza, kontinuirani monitoring pacijenata, organizacija sestrinske nege, and digitalne kompetencije medicinskih sestara.

The review included studies designed as systematic reviews, scoping reviews, integrative reviews, meta-analyses, randomized controlled trials, and observational studies. Study selection was conducted in two phases. In the first phase, titles and abstracts of the identified publications were screened, after which duplicates, irrelevant studies, and studies without available full text were excluded. In the second phase, full-text articles of the selected studies were analyzed. The analysis was conducted using qualitative analysis and a thematic qualitative approach, through which key thematic categories were identified that reflect the main mechanisms of action of digital technologies in nursing practice. The identified categories included: clinical decision support, continuous monitoring and predictive analytics, optimization of work processes and organization of care, education and development of digital competencies, and implementation and technology acceptance factors. Based on these categories, an interpretation of the key effects of digital technologies on patient safety, clinical outcomes, and nursing efficiency was performed.

Results

In the conducted literature review, 38 relevant scientific studies were initially identified. After screening titles and abstracts and removing duplicates retrieved from different databases, a final sample of 19 studies was included for qualitative analysis.

The main characteristics of the studies included in this review are presented in Table 1.

Table 1. Literature review

	Author	Year	Country	Sample (n of studies)	Category
1.	El Arab et al.	2025.	Internacional	18	Education and development of digital competencies
2.	Hassanein et al.	2025.	Internacional	18	Optimization of work processes and organization of care
3.	Wei et al.	2025.	China	-	Implementation factors and technology acceptance
4.	Rony et al.	2024.	-	-	Education and development of digital competencies
5.	Akbar et al.	2021.	Internacional	28	Clinical decision support
6.	Mebrahtu et al.	2021.	Internacional	36	Clinical decision support
7.	Porcellato et al.	2025.	Internacional	24	Continuous monitoring and predictive analytics
8.	Abdelmohsen et al.	2025.	Internacional	38	Continuous monitoring and predictive analytics
9.	Martinez-Ortigosa et al.	2023.	Internacional	21	Clinical decision support
10.	Ruksakulpiwat	2024.	Internacional	11	Continuous monitoring and predictive analytics
11.	Huter et al.	2020.	Internacional	154	Optimization of work processes and organization of care
12.	Michalowski et al.	2026.	USA	-	Optimization of work processes and organization of care
13.	Chew et al.	2022.	Internacional	26	Implementation factors and technology acceptance
14.	Lambert et al.	2023.	Internacional	42	Implementation factors and technology acceptance
15.	Peng et al.	2025.	Internacional	-	Education and development of digital competencies
16.	Adams et al.	2022.	USA	6,877*	Continuous monitoring and predictive analytics
17.	Albrecht et al.	2025.	USA	-	Optimization of work processes and organization of care

	Author	Year	Country	Sample (n of studies)	Category
18.	Stults et al.	2025.	USA	-	Optimization of work processes and organization of care
19.	Kanaparty et al.	2025.	Internacional	6	Optimization of work processes and organization of care
	*patients				

As shown in Table 2, the largest number of included studies consists of systematic reviews and an umbrella review, which represent the highest level of evidence according to the Polit and Beck hierarchy. In addition, part of the literature includes scoping and integrative reviews, whose primary aim is the exploration of potential applications of artificial intelligence and digital technologies in nursing. A smaller number of papers are classified as narrative reviews and expert/commentary articles, which represent a lower level of evidence but still provide an important theoretical and conceptual contribution to understanding the future development of nursing practice.

Table 2. Study designs and level of evidednce hierarchy according to Polit andd Beck

Study design (N=19)	Number of studies (n)	Level of evidence
Umbrella review	1	I
Systematic review	6	I
Scoping and integrative reveiws	6	V
Impementation/observation studies	3	IV
Narrative reviews and expert/commentary papers	3	VII

Clinical decision support

Analysis of the included studies indicate that clinical decision support systems and artificial intelligence-based tools have a significant potential to improve the decision-making process in nursing practice. Implementation of digital technologies enables more accurate patient assessment, reduction of medical errors, and increased adherence to clinical protocols [7,8]. In addition, digital systems contribute to the standardization of nursing care and reduce variability in clinical practice, thereby improving patient safety and the quality of care provided [8]. A particularly important area of application is represented by Clinical Decision Support Systems (CDSS), which enable the integration of clinical data from electronic health records, laboratory results and therapeutic guidelines in order to generate relevant clinical recommendations and alert systems [7,8]. In nursing practice, these systems are used for risk assessment, monitoring of therapeutic guidelines and identification of changes in the patient's clinical condition, contributing to more efficient organization

of care and supporting clinical decision-making [7,8]. The integration of AI systems enables more efficient processing and interpretation of large volumes of clinical data in real time, contributing to more accurate and consistent clinical decision-making [4,6,9]. In this way, digital technologies function not only as technical support but also as tools that changes the way clinical assessment is organized and its performance.

Continuous monitoring and predictive analytics

One of the most important effects of digital technologies has been identified in the field of continuous monitoring and predictive analytics. The implementation of AI systems and digital platforms enables continuous monitoring of vital signs, automated analysis of clinical data, and the generation of early warning systems, allowing early recognition of clinical changes and earlier intervention [10,11]. These effects are most evident in intensive care units, where patients are more likely to experience a sudden change in clinical condition and require continuous monitoring [10]. Predictive models enable the identification of patients who have an increased risk of developing complications, thereby reducing the likelihood of adverse events and improving treatment outcomes [11,12]. Continuous monitoring systems also contribute to reducing the cognitive workload of healthcare professionals by prioritizing clinically relevant information and supporting early clinical decision-making [11].

Positive effects of the practical implementation of AI systems in this field have been demonstrated in the early recognition of sepsis and the detection of patient deterioration. TREWS (Targeted Real-time Early Warning System) integrates data from electronic health records, laboratory results and vital signs in order to generate alerts for the healthcare team [13]. The study reported earlier recognition of sepsis and faster initiation of therapeutic interventions when this system was used [13]. Within these systems, the role of nurses includes assessing the clinical relevance of AI alerts, performing additional patient assessment, continuously monitoring of the patient's condition, and ensuring early communication with physicians and other members of the healthcare team. Newer AI systems for continuous monitoring enable the analysis of physiological parameters in real time and identify schemes that may indicate early clinical changes in patients health. The included studies also reported the implementation of CLEWICU, an AI platform that uses machine learning algorithms to predict respiratory and hemodynamic deterioration. The platform generates alerts before obvious clinical signs of deterioration become apparent, providing nurses with additional support in prioritizing patient monitoring and identifying high-risk patients on time, before evident deterioration [10,11,13]. Rather than relying only on individual monitoring values, AI systems enable the analysis of trends over time and by that way improving continuous patient assessment and supporting early clinical intervention.

Optimization of work processes and organization of nursing care

The results of the included studies indicate that digital technologies have a significant impact on work organization and the optimization of nursing care. Their implementation contributes to the automation of administrative tasks, reduction of documentation burden, and more efficient management of resources [4,5]. This reorganization of work processes enables a more rational use of working time and increases the time available for direct patient care. Digital platforms improve communication and coordination among members of the healthcare team through electronic health record systems and communication platforms [9].

Particularly important direction in the development of AI systems in healthcare is the implementation of ambient AI technologies to support administrative processes and the automatic generation of clinical documentation. Platforms such as DAX Copilot and Abridge use natural language processing and speech analysis to create structured clinical documentation. Implementation studies indicate that these technologies may reduce the time spent on documentation and administrative tasks, thereby increasing the time available for direct patient care [14–16,21]. In addition, these systems may contribute to the standardization of clinical documentation [14,15].

However, the literature indicates that the implementation of new technologies may initially increase workload because of the need for learning and adaptation to existing clinical workflows [4,9]. Development of digital competencies and continuous education represent key factors for the successful integration of technology into everyday clinical practice [17,18]. Contemporary approaches also include the use of digital technologies as educational tools for learning and the development of clinical competencies [19,20], while future developments aim to reduce documentation burden and further automate routine clinical activities [21].

Education and digital competencies of nurses

The included studies indicate that the successful implementation of digital technologies largely depends on the education and digital competencies of nursing staff. A discrepancy has been identified between the rapid pace of technological development and the level of digital competencies among nurses, which has been recognized as a major barrier to the appropriate use of these technologies [17]. Continuous education and professional development have been identified as prerequisites for the successful integration of digital tools into clinical practice [18]. Digital technologies are increasingly used as educational tools that enable personalized learning, improve clinical skills, and contribute to the development of nursing competencies. AI platforms based on generative models, including tools such as ChatGPT, are used to simulate clinical scenarios, support the development of clinical reasoning, and facilitate problem-based learning [19,20]. The use of these technologies also contributes to improving nurses' readiness to work in an increasingly digitalized healthcare system and supports the development of competencies required for future nursing practice [20].

Implementation factors and technology acceptance

The analyzed studies emphasize that the successful implementation of digital technologies depends not only on their technical characteristics but also on organizational, educational, and system-related factors. The most frequently identified barriers include inadequate digital infrastructure, limited digital competencies, and ethical and legal challenges [9,17]. On the other hand, technology acceptance, access to education, and institutional support have been recognized as key factors that facilitate the successful implementation and sustainable integration of digital solutions into everyday clinical practice.

Discussion

The results of this review indicate that the implementation of digital technologies in nursing operates through interconnected mechanisms that include improvement of clinical decision-making, continuous patient monitoring, and optimization of work processes. Their impact is not reflected only in individual technological functions, but also in changing the way nursing practice is organized and delivered. The findings suggest that digital technologies achieve their effects through the standardization of clinical procedures, improved availability of clinical information, and reduced variability in clinical practice, which together contribute to patient safety, clinical outcomes, and the efficiency of nurses' work.

One of the most important findings relates to the improvement of clinical decision-making through the implementation of artificial intelligence-based systems. These systems enable the analysis of large amounts of data and the identification of patterns that are not always easily recognized in routine clinical practice, allowing more accurate and consistent decision-making [4,9]. These findings are consistent with previous systematic reviews showing that automated decision support systems reduce variability in clinical practice and improve adherence to clinical protocols [7,8]. In this way, digital technologies contribute to reducing uncertainty in clinical decision-making, providing a basis for further improvement of the quality of nursing care.

In the context of clinical decision-making, the role of digital systems in continuous monitoring and early detection of patient deterioration is particularly important, especially in high-risk settings such as intensive care units [10,11]. Continuous monitoring of vital signs, automated analysis of clinical data, and early warning systems enable timely recognition of clinical deterioration and earlier intervention, thereby reducing the likelihood of adverse events and complications. In this context, the identified outcomes, including patient safety and improved clinical outcomes, should not be viewed as separate effects, but rather as the result of the same underlying mechanisms through which digital technologies operate in clinical practice.

The implementation of systems such as TREWS and CLEWICU demonstrates that the application of AI technologies in clinical settings is not limited only to the

automation of data analysis, but also includes changes in the organization of patient monitoring, prioritization of nursing care, and communication within the healthcare team. In this context, nurses have an important role in interpreting AI-generated alerts, assessing their clinical relevance, and ensuring timely escalation of care [10,11,13].

The improvement of patient safety and treatment outcomes can be interpreted as a consequence of enhanced clinical decision-making and the standardization of nursing care. The reduction of medical errors, better adherence to clinical protocols, and earlier recognition of complications represent the key mechanisms through which digital technologies positively influence the quality of healthcare [7,8]. In addition, clinical decision support systems contribute to reducing medication errors through optimization of drug dosing, identification of potential drug interactions, and standardization of therapeutic procedures [11]. Therefore, patient safety can be considered an intermediate mechanism through which digital technologies influence clinical outcomes.

However, the literature indicates that the effects of digital technologies on clinical outcomes are not completely consistent. Although most studies report improvements through earlier interventions, more efficient coordination of care, and better organization of healthcare delivery [12], considerable heterogeneity of findings is still present. This variability may be explained by differences in study design, the types of technologies implemented, and the level of their integration into routine clinical practice, which has already been recognized as one of the major challenges in the evaluation of digital interventions in healthcare [8].

Besides direct clinical effects, digital technologies also have a significant impact on organizational aspects of nursing practice, primarily through the automation and optimization of work processes. The findings of the included studies indicate that the implementation of digital systems contributes to reducing administrative workload, improving work organization, and enabling more efficient management of time and resources [4,5]. In this context, ambient AI systems for automated clinical documentation are of particular importance, as they may reduce the time spent on administrative tasks and increase the time available for direct patient care [14–16,21], which is directly reflected in the quality and safety of nursing care. However, studies also indicate that the implementation of new technologies may initially increase workload due to the need for training, adaptation, and integration of these technologies into existing clinical workflows [4,9]. These findings further emphasize the importance of education and the development of digital competencies among healthcare professionals as a key prerequisite for the successful implementation of digital technologies.

In addition to all these positive aspects, the literature also emphasizes the importance of ethical and legal issues related to the implementation of AI systems in healthcare [2,4]. The most common challenges include the protection of patient data, transparency of algorithms, and accountability when using automated systems for

processing clinical data and generating recommendations for further treatment and therapy [2,9]. In this context, the implementation of systems such as TREWS, CLEWICU, and ambient AI is accompanied by the need for continuous human oversight, clinical validation of AI recommendations, and clearly defined professional responsibility of healthcare professionals [4,14,15,21].

The importance of education and the development of digital competencies represents another important aspect identified in this review. The identified gap between the rapid pace of technological development and the preparedness of healthcare professionals to use digital tools indicates that, without adequate education, the potential of digital technologies remains underutilized [17]. The literature emphasizes that continuous professional development and the integration of digital competencies into formal education provide the foundation for the successful integration of technology into everyday clinical practice [18]. At the same time, contemporary approaches increasingly include the use of digital technologies themselves as educational tools for learning and developing clinical skills [19,20]. In this way, adequate education represents not only a factor for successful implementation but also a mechanism that may reduce the initial workload associated with introducing new technologies into the healthcare system.

Conclusion

The implementation of digital technologies in nursing represents significant potential for improving the quality of nursing care, patient safety, and the efficiency of nurses' work. The results of this review indicate that digital technologies contribute to the advancement of nursing practice through support for clinical decision-making, continuous patient monitoring, and the optimization of work processes.

Although most of the analyzed studies reported positive effects of their implementation, the successful integration of these technologies depends on adequate infrastructure, the development of digital competencies, and the acceptance of technology by healthcare professionals. Future research should focus on evaluating the long-term effects of digital technologies and on the standardization of their implementation in everyday nursing practice.

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PRIMENA SAVREMENIH TEHNOLOGIJA U SESTRINSTVU: MOGUĆNOSTI I ZNAČAJ ZA UNAPREĐENJE NEGE PACIJENATA

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Sažetak. *U cilju unapređenja kvaliteta, bezbednosti i efikasnosti zdravstvene nege, savremeni zdravstveni sistemi sve više integrišu digitalnu tehnologiju i alate zasnovane na veštačkoj inteligenciji. U sestrinstvu, ove tehnologije imaju značajan potencijal u unapređenju nege pacijenata, posebno u smislu donošenja odluka u zdravstvenoj nezi, kontinuiranog monitoringa, optimizacije radnih procesa i razvoju digitalnih kompetencija medicinskih sestara. Cilj ovog rada je bio da se analiziraju načini na koje primena digitalnih tehnologija u sestrinstvu doprinosi poboljšanju nege pacijenata, sa posebnim osvrtom na bezbednost pacijenata, kliničke ishode i efikasnost rada medicinskih sestara. Studija je dizajnirana kao pregled literature. Pretraga je sprovedena u bazama PubMed, Google Scholar i SCIndex u periodu od 26. do 30. aprila 2026. godine. Uključeni su radovi objavljeni od januara 2020. do januara 2026. godine, na engleskom i srpskom jeziku. Nakon pregleda naslova, sažetaka i dostupnih punih tekstova, od ukupno 38 identifikovanih publikacija, 19 studija je uključeno u kvalitativnu analizu. Analiza je sprovedena tematskim pristupom kroz identifikaciju ključnih oblasti primene digitalnih tehnologija u sestrinskoj praksi. Rezultati ukazuju da najznačajnije oblasti primene digitalnih tehnologija obuhvataju sisteme za podršku donošenja odluka u zdravstvenoj nezi, elektronsku zdravstvenu dokumentaciju, alate za kontinuirani monitoring pacijenata i digitalne edukacione platforme. Analizirane studije pokazuju da primena ovih tehnologija doprinosi standardizaciji sestrinskih postupaka, pravovremenom prepoznavanju kliničkog pogoršanja, smanjenju mogućnosti greške i efikasnijoj organizaciji rada. Posebno se ističe značaj sistema ranog upozorenja i kontinuiranog monitoringa u unapređenju bezbednosti pacijenata i efikasnijoj proceni njihovog zdravstvenog stanja. Dodatno, primena informacionih sistema smanjuje administrativno opterećenje i omogućava medicinskim sestrama više vremena za neposredan rad sa pacijentima. Digitalne tehnologije predstavljaju značajan resurs za unapređenje kvaliteta zdravstvene nege, bezbednosti pacijenata i efikasnosti rada medicinskih sestara. Njihova uspešna integracija zahteva kontinuiranu edukaciju medicinskih sestara, razvoj digitalnih kompetencija i adekvatnu organizacionu i tehnološku podršku zdravstvenih ustanova.*

Ključne reči: *digitalne tehnologije; sestrinstvo; zdravstvena nega; veštačka inteligencija; kliničko rasuđivanje.*