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The Impact of Artificial Intelligence and Robotics on the Nursing Labor Market: Transformations, Opportunities, and Challenges

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Abstract: This report critically analyzes the effects of Artificial Intelligence (AI) and robotics on the nursing labor market, focusing on shifts in job roles, skills, and workforce dynamics. Utilizing a systematic review, the study examines AI's transformative potential in nursing practice, particularly through automating routine tasks, augmenting clinical decision-making, and streamlining patient care processes. AI technologies such as predictive analytics, natural language processing, and robotics offer substantial opportunities to enhance efficiency, reduce administrative burdens, and improve patient outcomes. However, the rapid adoption of AI also presents challenges, including potential job displacement, the widening of skill gaps, and ethical concerns related to data privacy and patient safety. The findings highlight the need for continuous professional development with a strong focus on digital literacy and skill enhancement to prepare nurses for changing roles in a technology-driven healthcare environment. The report also stresses the importance of regulatory oversight to address ethical implications and ensure equitable access to AI tools across different healthcare settings. Ultimately, the study calls for a strategic approach to AI integration, advocating for technology that supports and enhances, rather than replaces the nursing workforce. By fostering collaboration between AI developers, healthcare providers, and policymakers, the nursing profession can adapt to the digital era while maintaining its critical role in patient-centered care.

Keywords: Artificial intelligence, Robotics, Nursing labor market

Introduction

The shortage of nurses in Bulgaria has remained an unresolved issue for the past 30 years (IME, 2024), significantly affecting the efficiency and quality of healthcare services. The healthcare system is under increasing strain due to an aging population, a growing burden of chronic diseases, and an overall rise in demand for medical care. At the same time, the number of active nursing professionals continues to decline, as many leave the profession due to low wages, challenging working conditions and limited career development opportunities. This persistent workforce crisis leads to staff shortages, increased workloads, and burnout among the remaining nurses, further exacerbating the problem.

Demographic trends indicate that Bulgaria will continue to face serious challenges in maintaining a sufficient nursing workforce. Another major concern is the aging nursing workforce, with a large number of experienced nurses nearing retirement while too few new professionals are entering the field to fill the gap. Furthermore, the emigration of healthcare workers to countries with better pay and working conditions worsens the crisis, creating an urgent need for systemic reforms and innovative solutions (Mihaylova & Alakidi, 2023; Shopov & Stoeva, 2022). In this context, artificial intelligence (AI) and robotics have been proposed as potential solutions to alleviate nursing shortage. According to research, these technologies can assist in various nursing-related tasks, such as diagnostics, patient monitoring, medication administration, and administrative processes (Bin et al., 2022; Raymond et al., 2022; Tiase & Cato, 2021). However, the integration of AI and robotics into healthcare raises critical questions about their impact on nursing roles, required skills, and workforce dynamics.

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This study critically analyzes the effects of AI and robotics on the nursing labor market, focusing on how these technologies reshape job roles, influence skill requirements, and alter workforce structures.

Materials and Methods

A systematic search was conducted for scientific articles investigating and assessing the possibilities and limitations of AI or robotics to replace the activities performed by nurses, which would lead to overcoming the chronic shortage of labor in this category of personnel.

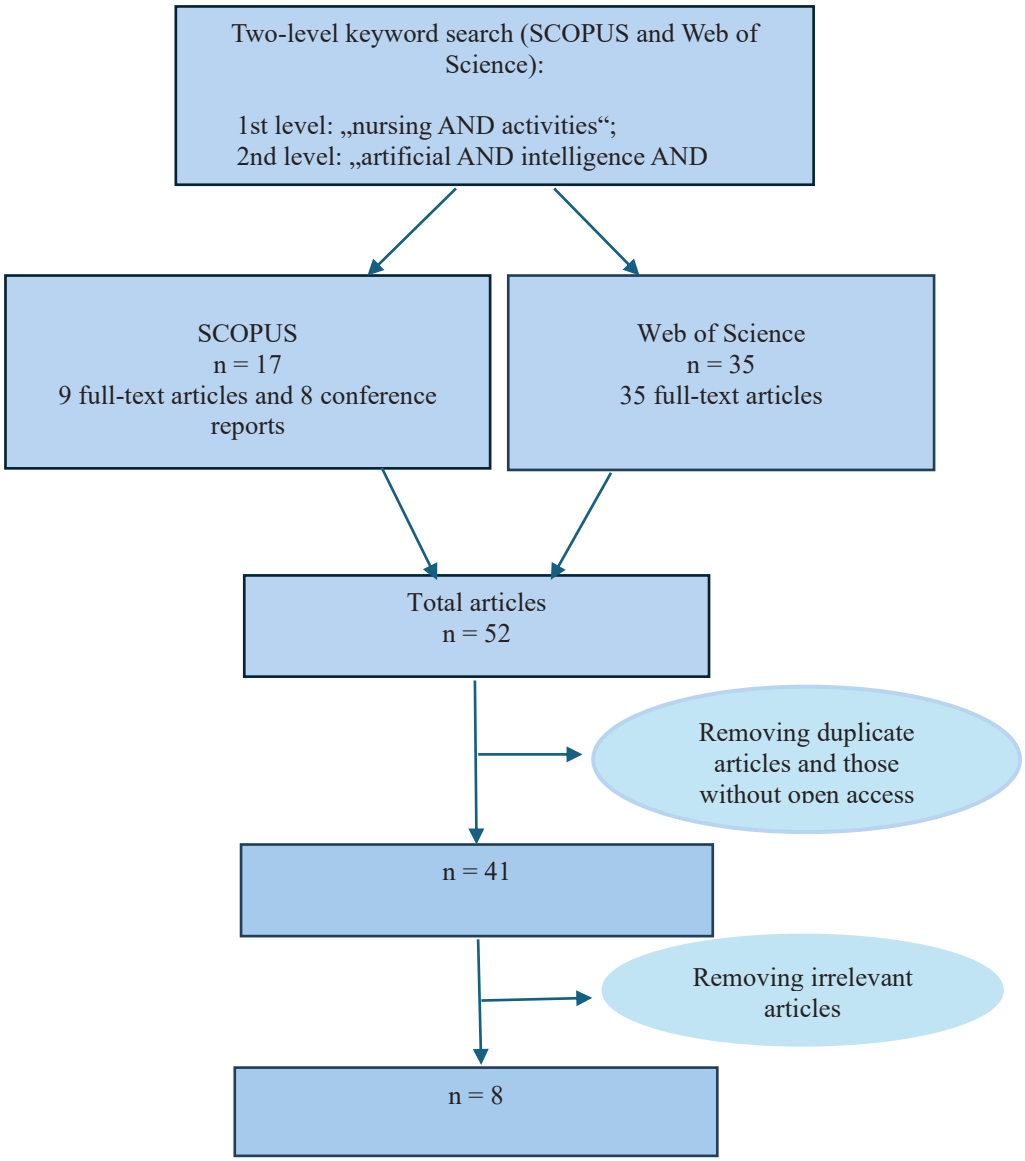

Figure 1. Stages in the selection of scientific publications.

The search was carried out using keywords in the international databases SCOPUS and Web of Science in early September 2024. In the first database, using the keywords “nursing AND activities” and subsequently “artificial AND intelligence AND robotics,” 9 full-text articles and 8 conference reports were found, while in the second, 35 full-text articles were identified. When comparing the results from the two databases, it was found that some of the articles overlapped, and a significant share did not refer to activities performed by nurses but rather by rehabilitators or other medical specialists (mostly in neurosurgery and neurology). After removing the duplicate articles, 41 publications remained, of which only 25 were open access and were subjected to content analysis. As a result of content screening, only 8 articles remained that met the research objectives (see Figure 1). They were subjected to critical analysis.

Results and Discussion

Studies show a consensus on the potential of AI and robotics to automate routine and administrative tasks, but not to completely replace nurses. For instance, a significant number of activities have been identified that can be taken over by technologies - such as monitoring, registration, medication dosing and patient transport. However, this automation does not reduce the demand for nurses; instead, it transforms their roles, necessitating new skills to collaborate effectively with technology. On the other hand, the conclusions of the studies clearly indicate that although AI and robotics can ease the burden on nurses, they cannot replace them in providing care that requires human attention, emotional support and complex medical decisions. These findings are synthesized in Table 1, which summarizes key insights from the reviewed studies.

Table 1. Summary of key findings

Study	Activities performed by nurses that can be done by new technologies	Study Conclusion
Bin et al. (2022)	1. Automation of patient registration, reducing administrative burden on nurses. 2. Assisted monitoring and initial screening, leading to faster referral to physician care.	1. Reduced nurses' workload, allowing focus on complex medical tasks. 2. Increased need for new technological skills. 3. Automation will not replace human care.
Pailaha (2023)	1. AI-driven automation of documentation. 2. Improved patient monitoring and diagnosis. 3. AI handling routine tasks.	1. Freed time for advanced care. 2.Need for reskilling and technological competencies.
Tiase and Cato (2021)	1. Monitoring vital signs and reporting anomalies. 2. Automated medication dosing. 3. Automated documentation.	1. Reduced demand for nurses in routine tasks. 2. Expanded nursing roles in technology management and advanced care.
Raymond et al. (2022)	1. Clinical decision-making and diagnostic support. 2. Risk assessment. 3. Patient triage and referral to specialized care. 4. Automated patient monitoring.	1. AI will enhance efficiency as a tool. 2. Necessity of nurse retraining.
Blechar and Zalewska (2019)	1. Robots performing routine tasks (e.g., delivering food/medications). 2. Robots conduct invasive/non-invasive procedures. 3. Robotic therapy for stress reduction.	1. Nurses gain time to focus on humanistic care. 2. Increased efficiency and reduced staff stress.
Zachariae et al. (2024)	1. Automated patient transport. 2. Transport of medical supplies. 3. Robotic monitoring for emergencies.	1. Relief from physically demanding tasks. 2. Need for new skills and training in robotic systems.
Mlakar et al. (2022)	1. Physical assistance and mobility support for patients. 2. Automated vital sign measurement. 3. Social support via humanoid robots.	1. Reduced nurse workload. 2. Need for additional training in robotic systems. 3. Concerns about dehumanization of care.
Georgadarellis et al. (2024)	1. Robotic systems for diagnostics and surgeries. 2. Patient-assistance robots.	1. Reduced workload through automation. 2. Nurses must acquire new technological skills.

The analyzed studies underscore the increasingly significant role of artificial intelligence (AI) and robotics in healthcare, particularly within nursing. The primary impact of these technologies lies not in replacing nurses but

in transforming their responsibilities and enhancing the efficiency of healthcare delivery. One key finding is that AI and robotic systems can automate numerous routine tasks, including patient registration, medical documentation, vital sign monitoring, triage, patient allocation, medical supply transportation, and medication dispensing. By alleviating administrative and physical burdens, these innovations enable nurses to dedicate more time to complex, patient-centered care.

Conversely, research unanimously emphasizes that automation, while improving efficiency, cannot supplant the irreplaceable human element in nursing. Emotional support, clinical decision-making, managing complex medical conditions, and personalized care remain inherently dependent on human expertise. Rather than reducing the demand for nurses, technological advancements necessitate the acquisition of new skills, such as collaborating with AI systems. This shift highlights the urgent need for updated nursing education programs and continuous professional development.

It is important to note that despite the advantages of AI and robotics, their implementation poses several challenges. Among these are ethical concerns related to the dehumanization of healthcare, the risk of dependency on technology, and potential algorithmic errors. Additionally, there are concerns about possible resistance from medical personnel and shifts in the labor market that may require the retraining of a significant number of professionals.

Another crucial challenge is the issue of accountability - who will bear responsibility for errors caused by artificial intelligence? The lack of clear regulatory frameworks could complicate the integration of these technologies into clinical practice. Furthermore, while AI offers substantial benefits in terms of efficiency, risks remain related to algorithmic biases and the lack of personalized care for patients.

In the future, hybrid work models may become necessary, in which nurses and AI work in synergy. This will require a reevaluation of existing medical protocols and the establishment of new standards for working with intelligent systems. It is also possible that the demand for specialists who oversee AI operations and ensure patient safety will increase.

In conclusion, artificial intelligence and robotics represent powerful tools for improving nursing care, but they cannot fully replace nurses. Instead, they lead to a redefinition of their role and require a balance between technological innovations and the preservation of the human aspect in healthcare. To achieve successful integration, strategic planning, effective staff training, and the establishment of clear regulatory frameworks for these technologies are essential.

Conclusion

The integration of AI and robotics into the nursing labor market presents transformative potential for addressing Bulgaria's persistent nursing shortage. By automating routine tasks such as patient registration, medication administration, and documentation, these technologies can alleviate administrative burdens and physical strain on nurses, enabling them to prioritize complex care, patient interaction, and critical decision-making. However, the findings underscore that AI and robotics are not replacements for human nurses but tools to augment their roles. The human elements of empathy, ethical judgment, and personalized care remain irreplaceable.

To harness these technologies effectively, Bulgaria must prioritize workforce adaptation through targeted upskilling programs, integrating digital literacy and AI management into nursing education. Ethical challenges - such as algorithmic bias, accountability for errors, and data privacy: require robust regulatory frameworks and collaboration between policymakers, healthcare institutions, and AI developers. Additionally, addressing concerns about dehumanization and ensuring equitable access to AI tools across healthcare settings will be critical.

Strategic implementation should focus on hybrid models where nurses and AI systems collaborate synergistically. This approach not only enhances healthcare efficiency but also preserves the core values of patient-centered care. For Bulgaria, leveraging AI and robotics could mitigate workforce strain, improve retention by reducing burnout, and attract new professionals through modernized roles. Ultimately, the successful integration of these technologies depends on balancing innovation with ethical governance and continuous investment in the nursing workforce.

Recommendations

To optimize the integration of AI and robotics in nursing, healthcare institutions should prioritize workforce reskilling through targeted training programs that equip nurses with technological competencies, such as managing AI-driven systems and robotic tools. Concurrently, workflows should be redesigned to delegate routine tasks (e.g., patient registration, medication delivery) to automation, freeing nurses to focus on complex care and human-centric interactions. Ethical guidelines must be established to prevent dehumanization, ensuring technologies complement - rather than replace - human judgment, particularly in emotionally sensitive scenarios. Policymakers should advocate for funding to support infrastructure upgrades and update nursing curricula to include digital literacy and AI ethics. Finally, interdisciplinary collaboration between clinicians, engineers, and ethicists is critical to designing systems that align with clinical needs while monitoring outcomes like reduced burnout and improved diagnostic accuracy. By balancing automation with workforce development and ethical oversight, healthcare systems can enhance care quality, reduce administrative burdens, and ensure sustainable adaptation to technological advancements.

Scientific Ethics Declaration

* The author declares that the scientific ethical and legal responsibility of this article published in EPSTEM Journal belongs to the author.

Conflict of Interest

* The author declares that there is no conflict of interest

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