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Artificial Intelligence in Nursing: A Meta-Analysis

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Abstract

Background and Aim: Artificial intelligence can be used in nursing profession to improve decision-making, provide better care to patients, and improve the performance of the medical system. Its application in nursing is new in providing healthcare services. This study was conducted to assess the impact of artificial intelligence on nursing profession.

Materials and methods: In this review, we searched related keywords in different databases including PubMed, Web of Science, Scopus, Science Direct, Web of Knowledge, EBSCO, Wiley, ISI, Elsevier, Embase and Google Scholar from 2015 to 2024. A fixed effect model and inverse variance method were applied. All statistical analyses were performed with STATA/MP software (*ver.* 17) and significance level less than 0.05.

Results: Six studies were selected according to the inclusion criteria. Meta-analysis showed that the accuracy of artificial intelligence in the field of nursing is 88% (ES: 0.89, 95% CI; 0.87-0.90).

Conclusion: Based on the findings, the use of artificial intelligence in nursing has advantages and disadvantages. However, more studies are needed to confirm the results.

Keywords: Artificial Intelligence (AI), Nursing, Meta-Analysis.

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Introduction

Artificial intelligence (AI) in healthcare is evolving rapidly and numerous applications have demonstrated its potential value. The revolution of AI has started in medical and health care, covering various sectors. It has been about 70 years since this fascinating technology was born. In fact, in the 1980s and 1990s, interest in AI became more widespread and AI techniques were used in different fields of health care. In 2016, the largest amount of investment in AI research related to health care programs was expensed compared to other sectors [1, 2].

AI, in addition to reducing the cost of medical care, optimizes the use of hospital resources and increases care quality. However, the applications of AI in all fields and professions are limited and their use in the field of health care can create new ethical challenges [3].AI technology is used in nursing to improve decision-making, patient care, and service delivery [4]. AI can support nurses in clinical decision-making at difficult care situations and professional duties [5]. Its use helps nurses in performing their duties but cannot be a substitute for them. Nurses play an important role in providing healthcare services to patients, which improve their health. AI can be used in some tasks and services related to clinical decisions, but it cannot replace nurses as humans [6,7]. The ability of AI to improve decision-making, facilitate patient care and provide health services to patients and their families plays an important role in nursing. The use of AI has been increased as a new and effective approach in providing medical and care services, but in such fields as nursing, in spite of various advantages, there are still obstacles and challenges for the use of AI [8]. This study was an attempt to examine the impact of AI on nursing profession by reviewing related studies.

Methods

This meta-analysis covered articles from 2015 (the beginning of AI in nursing) to 2024 at library sources and databases as PubMed, Web of Science, Scopus, Science Direct, Web of Knowledge, EBSCO, Wiley, ISI, Elsevier, Embase and Google Scholar; Iranian databases like SID, Magiran, were also included. Additional sources were found from the references of articles. To avoid bias, the search was performed independently by two researchers with such keywords as artificial intelligence, nursing and nurse. Studies were in Farsi and English regardless of their region with full access articles. Review articles, case reports, letters to the editor were excluded from the study. Data collection by the two researchers was carried out with a pre-prepared

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standardized PRISMA 2020 checklist to reduce bias and reporting errors [9]. It included demographics, clinical information, and study results. All duplicates were manually removed and titles as well as abstracts of the studies were independently evaluated by three reviewers and their full texts were reviewed. All articles were independently extracted with a standardized form including bibliographic information (such as authors, titles, dates, and journals), purpose, type of study, demographics of participants, definitions of AI, and attitudes toward AI.

To evaluate the quality of the evidence, the grading method recommended by the GRADE system was used. According to GRADE, the quality of evidence is classified into four groups: 1. Studies with no change in the validity of the evaluation results regarding the therapeutic effect (high quality). 2. Studies more effective on the validity of the evaluation results regarding the therapeutic effect (moderate quality). 3. Studies effective on the validity of the evaluation results regarding the therapeutic effect and change the evaluation results (low quality). 4. Studies in which evaluation results of the therapeutic effect were unclear (very low quality).

Data were analyzed with STATA/MP software (*ver.* 17). At first, heterogeneity between studies was assessed using X2-based Q tests (25%: low heterogeneity, 25-75%: moderate heterogeneity, and more than 75%: high heterogeneity) ($P<0.05$). Diagnostic accuracy was considered with 95% confidence interval.

Results

In the initial search, 73 articles were found; all articles were entered into EndNote/X8 software. In the first stage, by reading the titles of the studies, 7 duplicated articles were removed. In the second stage, by studying the abstract of 66 articles, 57 unrelated articles (based on inclusion and exclusion criteria) were excluded. In the third stage, after detailed review of full texts of 9 articles, 3 articles were also removed due to incompatibility with the purpose of the research. Finally, 6 articles were used for this study (Flowchart 1).

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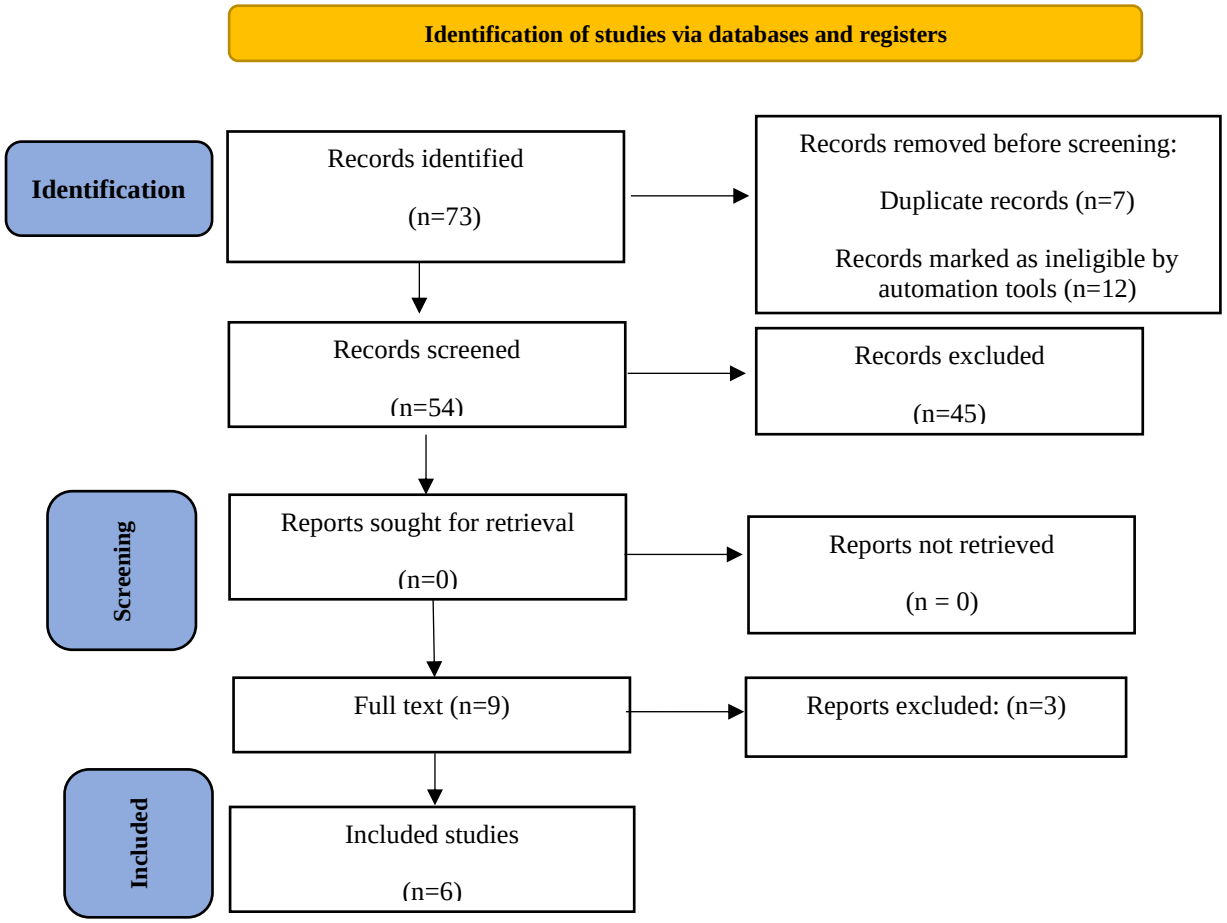

Flowchart 1. Based on PRISMA 2020 checklist

Totally, 893 patients with different characteristics were examined. The features of the selected studies are shown in table 1.

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Table 1: Characteristics of the selected studies

Author	Year	Study plan	Sample size	Disease characteristic	Functional indicators
Jiang et al. [9]	2022	Clinical Trial	116	ovarian endometriosis	sensitivity specificity accuracy
Hong et al. [10]	2021	Clinical Trial	447	chronic obstructive pulmonary disease	sensitivity specificity accuracy
Xu et al. [11]	2022	Clinical Trial	86	intracranial aneurysms	sensitivity specificity accuracy
Du et al. [12]	2022	Clinical Trial	64	diabetic nephropathy	sensitivity specificity accuracy
Yin & Wang [13]	2022	Clinical Trial	60	pelvic organ prolapse	sensitivity specificity accuracy
Chen et al. [14]	2022	Clinical Trial	120	chronic kidney disease	sensitivity specificity accuracy

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According to the meta-analysis, accuracy of AI in the field of nursing was estimated 88% (ES: 0.88, 95% CI; 0.87-0.90). The heterogeneity test showed Q=97.80, p value<0.001, I2=86.71%, which indicates high heterogeneity among studies.

Discussion

AI has been used in different fields of nursing. Based on the findings of the studies, it has the potential to be extremely useful in nursing care. The articles in this study were used to investigate the accuracy of AI to investigate the characteristics of various diseases such as various types of ovarian endometriosis, Chronic Obstructive Pulmonary Disease (COPD), brain aneurysm, diabetic nephropathy, pelvic organ prolapse and chronic kidney disease (CKD). The study of the effect of nursing interventions on female ovarian endometriosis with AI improves the prognosis and recovery of patients [10]. The findings of a web-based knowledge exercise through AI in emergency nursing care for preventing acute exacerbations of COPD showed positive effects of AI on improving patients' quality of life and emotional as well as psychological status

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and decreasing rate of hospitalization as well as hospital stay [11].

Another study regarding the effects of AI on nursing interventions in patients with cerebral aneurysm indicated decreased hospitalization, higher performance of surgery, better treatment, fewer post-op complications, better prognosis, increased satisfaction with nursing care and improvement in patients' quality of life [12]. In a study, AI in nursing care of patients with diabetic nephropathy at home caused better therapeutic effects, increased satisfaction as well as quality of nursing services, and improved quality of life [13]. In rehabilitation training based on AI algorithm in postpartum recovery of pelvic organ prolapse, findings showed improvement in pelvic floor muscle strength and a positive effect on postpartum nursing of patients [14]. An interventional study on AI and CKD patients showed that the total health quality assessment score, nutritional screening score, patients' mental status, prognosis, satisfaction with nutrition nursing model, and the quality of life of patients with stages 3-5 of CKD were upgraded [15].

In general, AI can be used in nursing interventions, reducing nursing diagnosis errors, increasing the speed of immediate reactions to critical situations, improving the quality of care, physical as well as psychological support of the patient, and remote care for patients [3]. The limitations of AI in nursing include lack of human interactions, inability to interpret patient needs, provide physical care, or face complex conditions, dependence on the quality of information, ethical challenges, and costs [16, 17].

Additionally, the use of AI in nursing interventions presents obstacles and ethical issues, which include obtaining informed consent, safety and clarity of instructions and regulations, privacy in relation to patient information, impact on patient independence and his participation in the process of care and treatment decisions, timely response and clarification [18-21].

One of the limitations of this study was inaccessibility of some articles or their full text from reliable nursing databases due to their expenses and lack of Persian articles in this field. In addition, there were only a few articles, and this was beyond our control. The strength of our study was the newness of the topic in Iran because, few studies have addressed this. It is suggested that future studies be done to identify solutions for the challenges of AI in nursing.

Conclusion

The use of AI is one of the important achievements of technology that has a

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positive and direct effect on the performance of health and healthcare. It is recommended that healthcare policymakers provide the necessary infrastructure to use this technology for a better approach to treatment and care. More studies are needed to confirm the findings of the present study and provide stronger evidence.

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Conflict of interest disclosures

There is no conflict of interest in this study.

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