

Influence of nurses in the implementation of artificial intelligence in health care: a scoping review

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ABSTRACT

Objective. This scoping review maps the approach undertaken by nurses to influence the implementation of artificial intelligence in health care. It also provides evidence of how frequently nurses drive the implementation of artificial intelligence, and how often nurses collaborate within the technical team. **Methods.** A systematic search using the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guidelines was undertaken from 24 July to 22 August 2020 to identify six records that met the inclusion criteria. **Results.** Nurses influenced the implementation of artificial intelligence in health care by: problem solving; articulating contextual needs and priorities; providing real-world insight and solutions; providing examples of implementation; and determining end user satisfaction. There was one instance of nurses driving implementation, and four instances of nurses collaborating with a technical team approach. **Conclusion.** The expertise of nurses must be sought to ensure artificial intelligence can effectively meet the highly context-specific demands of the healthcare environment.

Keywords: algorithms, artificial intelligence, implementation, influence, involvement, nurse, robotics, technology.

Introduction

The rapid development of artificial intelligence (AI) began in the 1950s and has been impacting healthcare provision since 1976. In 1956, Professor John McCarthy coined the term Artificial Intelligence,¹⁻³ which he defined as ‘the ability of machines to learn in a way that is similar to human beings’ (p. 410).² AI was first applied to medicine in 1976, with the development of the causal-associational network (CASNET) model,¹ which provided physicians with information at their fingertips on specific diseases and patient management.⁴

Since 2000, there have been major advances in AI.⁴ In 2011, four major developments occurred; computer processing abilities advanced, access to vast amounts of data required to train AI was increasingly available, the ability of AI to process vast amounts of data had advanced and new algorithms had been designed.⁴

At the most basic level, AI is a technology that follows algorithms, which are a series of step-by-step instructions. When finished, these algorithms enable AI to perform hundreds of thousands of tasks in under a second.⁵

Robots are equipped with AI. The hardware performs the physical task, whereas AI is the software that is used to solve the problem and determine how the task is to be performed. An example of this type of robot in health care is the Da Vinci surgical robot.⁶ This robot can be remotely controlled by humans, whereas the AI software can control the precision and accuracy of the robotic instruments.⁶

AI has the potential to improve healthcare provision if planned effectively. In the retail market, AI companies are dedicated to ensuring AI is easy for their customers to use. Amazon Web Service, Google Cloud Platform, IBM and Microsoft Azure all offer AI products that they advertise as fast, cheap, and easy to use.⁷⁻¹⁰ All companies offer

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customers the opportunity to test and trial AI products for free,^{7–10} and Amazon Web Services⁷ has the option of adding features to their AI product to ensure it is ‘engineered for the most demanding requirements’.⁷ However, this is not always the case for the AI that is introduced in the healthcare setting.

As the end user of health AI, nurses should have the opportunity to influence the development and implementation of AI to ensure it is fast, safe, convenient and easy to use. Nurses belong to a profession that possesses a specialised body of knowledge and skill,¹¹ and comprise the largest number of the healthcare workforce.¹² Individually, nurses have experience in navigating the everyday complexities of patient care, while still treating the patient as a whole person.¹³ Collectively, this experience provides nurses with the ability to draw on their skills, knowledge and experience to provide valuable insights into how AI can be improved to meet the demands of the healthcare environment.¹⁴ Consulting nurses, as expert end users, will ensure that when AI is introduced into health care, it is safe, fast and easy to use.¹⁵

It is known that AI is a new and rapidly evolving field of technology, and nurses have reported negative impacts that AI can have when the end user is not included in the implementation process. A scoping review has been conducted to identify the extent of nursing influence, to date, on the design, development and implementation of artificial intelligence.

This scoping review reports the available evidence on: the influence nurses currently have had on the implementation of AI; the involvement nurses have had in driving AI design and implementation; and how often nurses have reported to collaborate in an AI team.

Methods

Search strategy

A comprehensive search of PubMed, CINAHL, Scopus, MEDLINE, Proquest, Web of Science and the Health Policy Reference Centre was undertaken for peer-reviewed literature. An example of the MEDLINE search is provided in Table 1 (other searches have been provided in the Supplementary Material section; Supplementary File S1). The inclusion criteria were: articles that reported on nurses’

Table 1. MEDLINE search.

Search 1	Artificial intelligence OR robotics (keyword and subject headings)	98 363
Search 2	Nursing OR nurses OR nurse (keyword and subject headings) Subject headings; Nurses, Nursing, Nurse’s Role, Postanesthesia Nursing, Cardiovascular Nursing, Nursing Stations, Nursing, Supervisory, Nurse Clinicians, Family Nursing, Students, Nursing, Oncology Nursing, Obstetric Nursing, Nurse Administrators, Schools, Nursing	347 417
Search 3	Search 1 AND Search 2	217
Search 4	Role OR influence OR implementation OR stakeholder OR contribution OR impact	6 306 821
Search 5	Search 3 AND Search 4	98
Search 6	Limiters applied; English language and academic journals	98

involvement in the development, or implementation, of AI in health care.

Source of evidence screening and data extraction

Following database searches, the process of screening to identify records that met the inclusion criteria by title and abstract was conducted. Records were screened to ensure that they were written in English, and a full-text record could be retrieved. The reference list of the final records was also manually searched for titles of records that met the inclusion criteria. The process of data extraction followed the Joanna Briggs Institute’s Manual for Evidence Synthesis.¹⁶

Results

A total of 764 records were identified in the initial search of PubMed, CINAHL, Proquest, MEDLINE, Scopus, Web of Science and the Health Policy Reference Centre (Fig. 1).

Characteristics of the records

There was great variation in the study designs. Three studies^{17–19} had clearly stated research designs, one study²⁰ did not state the research design and two were expert opinion papers.^{3,21} Bettinelli *et al.*¹⁷ was a prospective, randomised cross-over trial with a non-probability convenience sample of 20 nurses. Lee *et al.*¹⁸ conducted a descriptive quantitative design with a non-probability convenience sample of 302 nurses. Palma and Bufarini¹⁹ reported a descriptive case study. Liang *et al.*²⁰ undertook a descriptive qualitative design based on phenomenology utilising a non-probability purposive sample of 23 nurses.

Half of the articles originated from the USA.^{3,17,21} Liang *et al.*²⁰ originated from Taiwan, Lee *et al.*¹⁸ from South Korea and Palma and Bufarini¹⁹ from Italy.

What approaches nurses are taking to influence the implementation of AI in health care

The influence that nurses have had on the implementation of AI is presented in Fig. 2. In the study by Palma and

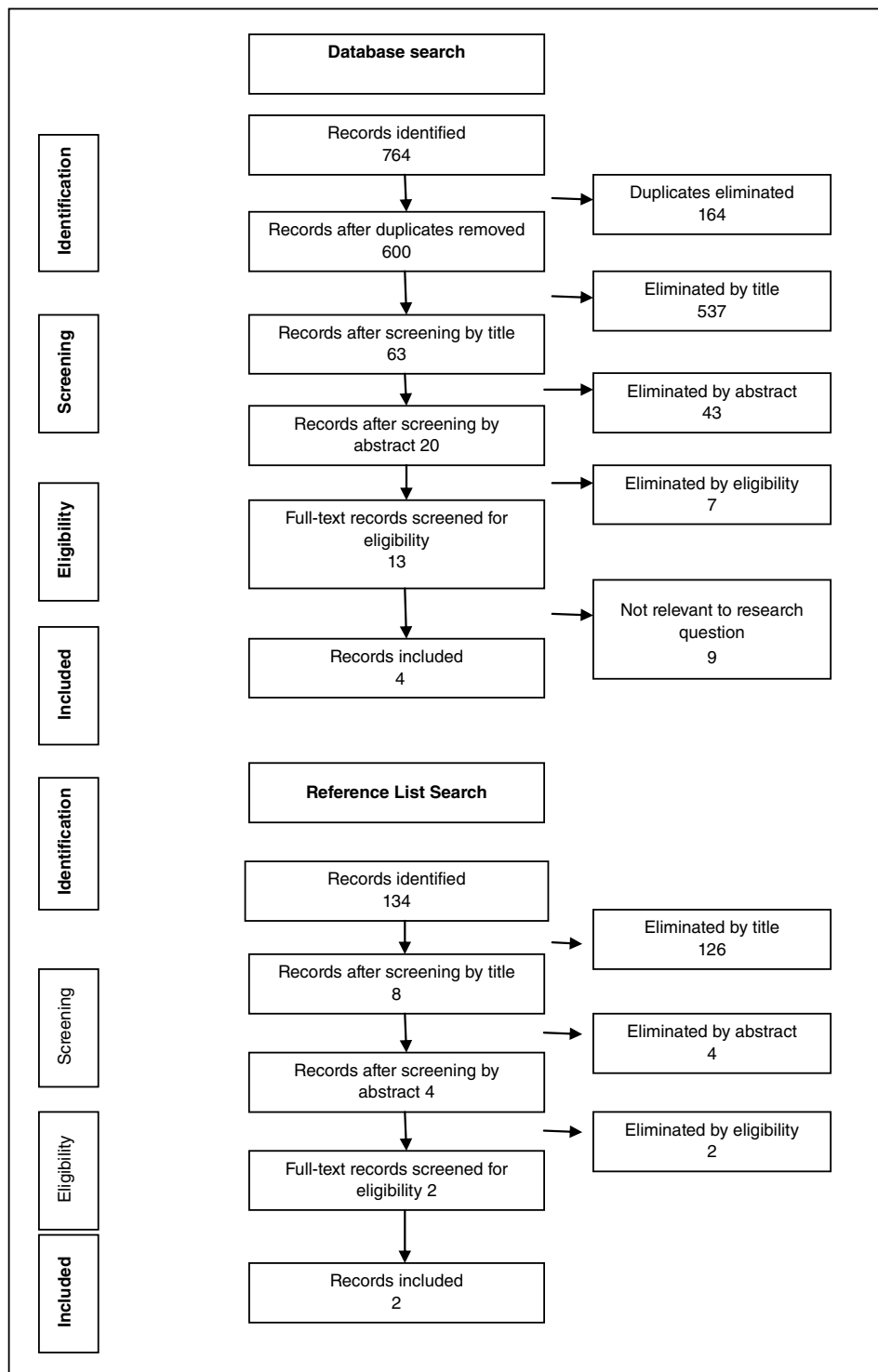


Fig. 1. PRISMA flow diagram for a systematic search. A total of 764 records were identified by searching PubMed, CINHAL, Proquest, MEDLINE, Scopus, Web of Science and the Health Policy Reference Centre. Duplicates were removed, leaving 600 records. The record's titles were screened according to the inclusion criteria, leaving 63 records. Next, the record's abstracts were screened according to the inclusion criteria, leaving 20 results. Full-text records were obtained for 13 records, which were assessed for eligibility by a second reviewer. It was decided that four records met the inclusion criteria. The reference list of the four included articles was also searched. This yielded eight records by title, which was reduced to four when eliminating by abstract. Two of these articles were relevant to the research question. This resulted in a total of six articles. These articles were also discussed with a second reviewer to confirm they met the inclusion criteria.

Bufarini,¹⁹ nurses were found to be problem solving by finding and correcting system errors. Lee *et al.*¹⁸ found that nurses voiced their needs for AI by completing a survey that indicated the areas they wanted robotic assistance with, which included patient monitoring, mobility, activity and safety.¹⁸ Liang *et al.*²⁰ recognised nurses had provided highly valuable

views on the potential advantages and disadvantages of robotics. In the study by Stokes and Palmer,²¹ nurses provided expert advice regarding how AI should be ethically implemented in health care. A survey by Bettinelli *et al.*¹⁷ found that there was no statistical difference between the nurses' satisfaction for the remote telepresence robot, or the telephone.¹⁷

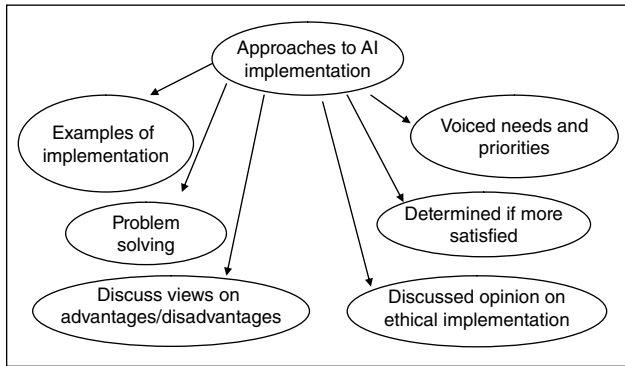


Fig. 2. Approaches nurses are taking to influence the implementation of AI in health care. The scoping review found six different approaches used by nurses to influence the implementation of AI in health care. Some nurses exerted their influence by problem solving and correcting system errors. Nurses exerted their influence by speaking up: voicing their needs and priorities for AI technology, as well as voicing their opinion regarding how AI should be ethically implemented in health care. Nurses also discussed what their views were on the potential advantages and disadvantages of robotics. Nurses determined whether they are more satisfied with AI, or the more conventional telephone. They exerted their influence by detailing examples of how nursing colleagues had led, or collaborated on the implementation of AI.

Instances of nurses driving the implementation of AI in health care

The evidence suggests that there was only one published instance where nurses had driven the implementation of AI in health care. The study by Robert³ reported a nurse-led project to launch a telehealth robot, which resulted in more satisfying interactions between nurses and patients.

AI team collaboration

The evidence reported that in recent years, nurses had been consulted by AI development teams (Fig. 3). The study by Robert³ described three instances of nurses working as part of a team to develop or improve AI products. In the first, nurses are described as working in collaboration with the Microsoft company to develop AI products that support nurses in spending more time at the bedside. In the second instance, nurses at the Cincinnati Children's Hospital Medical Centre were described collaborating in teams to design and deploy new AI systems that will help to predict disease and adverse events.³ In the third instance, nursing and engineering students were described collaborating on a remote controlled robot designed to perform nursing tasks on infectious patients.³ Palma and Bufarini¹⁹ stated that nurses, pharmacists and engineers worked together to improve the safety of their AI system.

Discussion

Nurses have influenced AI by discussing their opinions on how AI could be ethically implemented in health care.

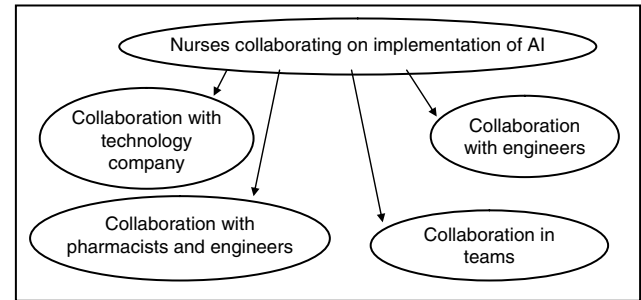


Fig. 3. Instances of nurses collaborating in a team approach in the implementation of AI. One article describes three instances of nurses working as part of a team. In the first, nurses are described as working in collaboration with Microsoft. In the second instance, nurses are described collaborating in teams to design and deploy new AI systems. In the third instance, nursing and engineering students are described collaborating on a tele-robotic nursing assistant. Another article stated that nurses, pharmacists and engineers worked together to correct system errors in their AI system.

Stokes and Palmer²¹ used the core values of nursing as a guide on how to ethically implement AI in health care. Rubeis²² instead uses risk as a guide on how to ethically implement AI in healthcare settings for elderly patients. Rubeis²² suggests that AI could be ethically implemented when the risk of depersonalisation, discrimination, dehumanisation and the use of discipline had been eliminated.

Nurses have influenced AI by detailing examples of how nursing colleagues have lead or collaborated on its implementation.³ Servaty *et al.*²³ found implementation was enhanced by nurse involvement in decision-making, and nurses perceiving AI to be useful and improving the quality of patient care. Vanderboom *et al.*²⁴ emphasised a much deeper level of engagement, describing nurses co-leading an implementation project, as well as giving feedback in the planning and the implementation phase. Gonçalves *et al.*²⁵ also emphasised a deep level of nursing engagement at every stage of implementation. Gonçalves *et al.*²⁵ described how nurses conveyed the user experience to computer scientists in the planning stage, how they taught colleagues in the implementation phase, and suggested improvements in the post implementation phase. Randell *et al.*²⁶ instead suggested that a whole team approach where leaders are engaged at all levels, and that the whole team should train together on the new AI technology.²⁶

Nurses have influenced AI by voicing their needs and priorities to researchers. Lee *et al.*¹⁸ conducted a survey of registered nurses to determine if they had a need for robots, and what areas of their practice they would like to prioritise for implementation. Jin and Kim²⁷ asked the same questions, but of paediatric nurses. These nurses indicated a need for robots, and wanted robotic assistance with: helping children to adjust to the hospital inpatient setting, encouraging children to co-operate with nursing carers and educating children on medical tests, procedures and treatments.²⁷

Nurses have influenced AI by determining if they were more satisfied after using the technology. Bettinelli *et al.*¹⁷ conducted a survey to determine if nurses were more satisfied with physician collaboration when using the telephone, or when using a remote telepresence robot. Romero-Brufau *et al.*²⁸ also conducted a survey to explore nurse attitudes pre and post using an AI-based clinical decision support system. The results of the study conducted by Bettinelli *et al.*¹⁷ suggested the nurses' satisfaction scores for the remote telepresence robot were slightly, but not significantly, higher than for the telephone. In the Romero-Brufau *et al.*²⁸ study, there was no change to nurses' negative attitudes towards the clinical decision support system. Similar to the study by Bettinelli *et al.*,¹⁷ the nurses in the study by Romero-Brufau *et al.*²⁸ expressed greater familiarity with AI post implementation. Despite the greater familiarity, the nurses in the study by Romero-Brufau *et al.*²⁸ felt the clinical decision support system did not sufficiently 'understand' their work.

Nurses have influenced the implementation of AI by discussing their views, and concerns. Liang *et al.*²⁰ focused on nurses' expectations of robots, which were that robots would reduce workloads, and medication errors.²⁰ McBride *et al.*²⁹ focused instead on nurse attitudes towards robots, which were neutral regarding the potential benefits of robots for their patients, themselves and their job satisfaction.²⁹ The nurses in the study by Liang *et al.*²⁰ expected the disadvantage of robots to be the inability of robots to provide human connection, and a lack of standards to protect patient privacy and data. The nurses in the study conducted by McBride *et al.*²⁹ had a more practical set of concerns regarding the Da Vinci robot, which centred around: work health and safety, care and handling, space and location, as well as financial pressure. Nurses in the study by Kang *et al.*³⁰ also expressed more practical concerns regarding: safety, the handling of expensive robotic equipment and having to manage unexpected robotic malfunctions. Ginestra *et al.*³¹ focused on nurse perceptions of a machine learning alert system, where less than half the nurses found the alert helpful.

The case study by Palma and Bufarini¹⁹ briefly stated that nurses played a fundamental role in the implementation of AI by finding, and correcting errors. Kwon *et al.*³² instead went into specific detail regarding how nurses suggested three ways to improve an AI algorithm which were: filling the gaps in algorithms with nursing-relevant data to provide context; improving techniques for data processing; and evaluating the potential usefulness of algorithms for their practice.³²

Limitations

An extensive search of seven databases was conducted; however, it is feasible that relevant sources may have been missed. This scoping review does not rate the quality of evidence; therefore, it does not include any implications for practice.

Conclusion

Nurses have influenced the implementation of AI in a number of ways. Nurses have discussed their opinions on how AI could be ethically implemented into health care. They have also discussed their views on the advantages, and disadvantages of AI technology. Nurses have detailed examples of how nursing colleagues have either driven, or collaborated on the implementation of AI. Nurses have determined if using AI made them feel more satisfied. They have also played a fundamental role in implementation by correcting errors.

AI can have a negative impact when nurses are not involved in its implementation. This is because it is nurses who have the knowledge, skills and experience to ensure that AI can meet the demands of the healthcare environment.

Companies that develop AI products for health care must do more to include nurses. Companies need to develop procedures to ensure bedside nurses are involved in the development, and testing of AI products. Companies can then incorporate expert nursing feedback into product improvements for improved usability, and smoother implementation. In addition, the clinical immersion of developers, engineers and computer scientists would improve companies' understanding of the demands of the healthcare environment. Bedside nurses must be satisfied that AI products will reduce their workloads, and are safe and easy to use.

Supplementary material

Supplementary material is available [online](#).

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Data availability. The data that support this study are available in the article and accompanying online supplementary material.

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