



## Nurses' General Attitudes, Comfortableness, and Perceived Capabilities toward using artificial intelligence systems among nurses at Makkah city

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The primary focus of this review is to measure general attitudes, comfortableness, and perceived capabilities toward using artificial intelligence (AI) systems among Nurses in Makkah City. With growing evidence of the vital role of AI's applications in the healthcare system globally, there is still a lack of evidence of nurses' general attitudes, comfortableness, and perceived capabilities toward using AI systems in healthcare settings worldwide. Therefore, this review provides an in-depth analysis of studies concerning healthcare providers, including the nursing workforce. Recommendations: Nurse Managers need to cultivate positive attitudes toward AI and assist in its beneficial deployment in healthcare. There is a precise need to understand nurse managers' current view of AI because of their ability to envision a great future for healthcare which is an essential factor in successfully addressing the challenges associated with AI implementation. Managers should advocate for nursing involvement in designing, implementing, and evaluating AI systems and obtain the support and cooperation to implement the artificial intelligence system to promote optimism and comfort ability toward AI and its applications. Managers should empower staff with knowledge and guidance about the benefits, challenges, and issues concerning AI implementation.

**Keywords:** Artificial intelligence, Healthcare Professional, Nurse, Attitude, Comfortableness, Capabilities.

### INTRODUCTION

Artificial intelligence provides potential benefits for helping nurses, facilitating their cognitive insights, supporting their decision-making, and delivering higher-quality, evidence-based healthcare (Chang et al. 2022; Ronquillo et al. 2021). Hence, reducing workloads and increasing the time given to patient care could overcome the shortage of nurses. The current study measures the general attitudes toward using artificial intelligence systems, comfortableness level, and perceived capabilities of its applications among nurses.

With growing evidence of the vital role of AI's applications in the healthcare system globally, there is still a lack of evidence of nurses' general attitudes, comfortableness and perceived capabilities toward using AI systems in healthcare settings worldwide. Therefore, the review provides an in-depth analysis of studies concerning healthcare providers, including the nursing workforce.

### Significance of study

The Kingdom of Saudi Arabia's Vision 2030 lays out several major goals for improving the quality of the country's healthcare system. Crown Prince and Prime Minister of Saudi Arabia, Mohammed bin Salman Al Saud,

introduced Saudi Arabia's Vision 2030 in April 2016, which outlines the country's long-term objectives and aspirations of the Kingdom of Saudi Arabia (KSA). A Royal Decree established the Saudi Data and Artificial Intelligence Authority (SDAIA) in August 2019 to achieve Vision 2030's objectives and help KSA reach its full potential (Memish et al. 2021). As indicated by the Kingdom's technology use to manage the COVID-19 outbreak and how it hosted and organized the Global AI Summit, SDAIA has already made some progress toward its goals (Memish et al. 2021).

User acceptability of technology is a crucial factor in determining the success of adoption and utilization. This determinant may be affected by user attitudes. Adopting any new technology relies on user attitudes (Dillon, Blankenship, & Crews, 2005; Gunawardena & Duphorne, 2000; Joo, Bong, & Choi, 2000). Although, with growing evidence of the vital role of AI's applications in the healthcare system globally, nursing attitudes toward AI technology and its implementation in Saudi Arabia's health settings still need to be examined.

The nursing workforce should be urgently prepared to adopt AI in healthcare. However, an organization implementing this new technology may present some obstacles, which can be identified by understanding how the nursing workforce accepts AI. However, measuring the general attitudes toward using AI systems among nurses

could help health organizations' policymakers fully understand the nurses' readiness to embrace AI applications' impact. Hence, establishing and updating the guidelines for using AI applications in their organization.

**Significance of the review**

This review is important to identify evidence that can contribute to expanding knowledge on general attitudes toward using artificial intelligence systems, comfortableness level, and perceived capabilities of its applications. Through systematic empirical analysis and conceptual study, which checked general attitudes toward using artificial intelligence systems, comfortableness level, and perceived capabilities of its applications among nurses, examined and synthesized the studies into integrated best clinical research evidence.

**Purpose of Review:**

To identify general attitudes toward using artificial intelligence systems, comfortableness level, and perceived capabilities of its applications among nurses.

**PICO Question:**

Among the nurses in Makah hospitals (P), does the general attitude toward AI (I) correlate with perceived capability and comfortableness (O)?

**Search Strategy:**

**Key Search Terms**

Keywords created and searched in the databases from the PICO question included the following keywords

and Boolean connectors: "Artificial intelligence" AND ("Healthcare" OR "Healthcare professional" OR "Nurse") AND ("behaviour" OR "Perception" OR "Attitude") AND ("Acceptance" OR "Comfortable" OR "Comfortability" OR "Comfortableness") AND ("Capability" OR "Capable" OR "Capabilities").

**Inclusion Criteria**

- Addressing healthcare professionals and nurses' attitudes and perceptions towards AI
- Addressing healthcare providers and nurses' comfortableness toward AI applications
- Addressing healthcare providers and nurses' perceived capabilities towards AI applications
- Published 2018-2022

**Exclusion Criteria**

- Studies focusing on general attitudes, comfortableness and perceived capabilities related to patients and the general public.
- Studies do not include healthcare professionals

**Search Strategy**

A comprehensive literature review of the inclusion criteria comprised the studies addressing healthcare professionals' and nurses' attitudes and perceptions towards AI. Addressing healthcare providers and nurses' comfortableness toward AI applications. Addressing healthcare providers and nurses' perceived capabilities towards AI applications was conducted in the online databases of the following sources: PubMed, ScienceDirect, and Medline (See Table 1 and 2)

**Table 1: Search Strategy**

Search number	Query	Filters	Results
15	#10	Free full text, English, from 2018 - 2022	71
14	#9	Free full text, English, from 2018 - 2022	360
13	#8	Free full text, English, from 2018 - 2022	437
12	#7	Free full text, English, from 2018 - 2022	367
11		#10 AND #5	10
10		#7 AND #4	169
9		#6 AND #5	843
8		#6 AND #4	950
7		#6 AND #3	906
6		#1 AND #2	15,327
5		((("capability") OR (capable)) OR (capabilities))	469,534
4		((((acceptance) OR (comfortable)) OR (comfortability)) OR (comfortableness))	570,454
3		((("behaviour") OR (perception)) OR ("attitude"))	1,221,600
2		((healthcare) OR (healthcare professional)) OR (nurs*)	2,734,612
1		artificial intelligence	182,376

**Table 1: Databases and search protocols utilized in searches**

<b>Science Direct</b>	
<b>Date of last searched</b>	10 November 2022
<b># of results</b>	9
<b>Query</b>	"Artificial intelligence" AND ("nurse" OR "healthcare") AND ("attitude" OR "perception" ) AND ("capability" OR "capabilities ") AND ("acceptance" OR "comfortableness"); Year(s): 2018-2023 Article type: Review and research articles Subject areas: Nursing and Health Professions Access type: Open Access & Open archive
<b>PubMed</b>	
<b>Date of last searched</b>	12 November 2022
<b># of results</b>	71
<b>Query</b>	((((((artificial intelligence) AND (((healthcare) OR (healthcare professional)) OR (nurs*))) AND (((("behaviour") OR (perception)) OR ("attitude")))) AND (((acceptance) OR (comfortable)) OR (comfortability)) OR (comfortableness))) AND (((("capability") OR (capable)) OR (capabilities)))) AND ((frft[Filter]) AND (2018:2022[pdat]) AND (english[Filter])))
<b>MEDLINE</b>	
<b>Date of last searched</b>	11 November 2022
<b># of results</b>	<b>10</b>
<b>Query</b>	Artificial intelligence AND (nurse OR healthcare ) AND ( attitude OR perception ) AND ( capability OR capabilities ) AND ( acceptance OR comfortableness ) Limiters - Linked Full Text; Date of Publication: 2018-2022 Expanders - Apply equivalent subjects Search modes - Boolean/Phrase

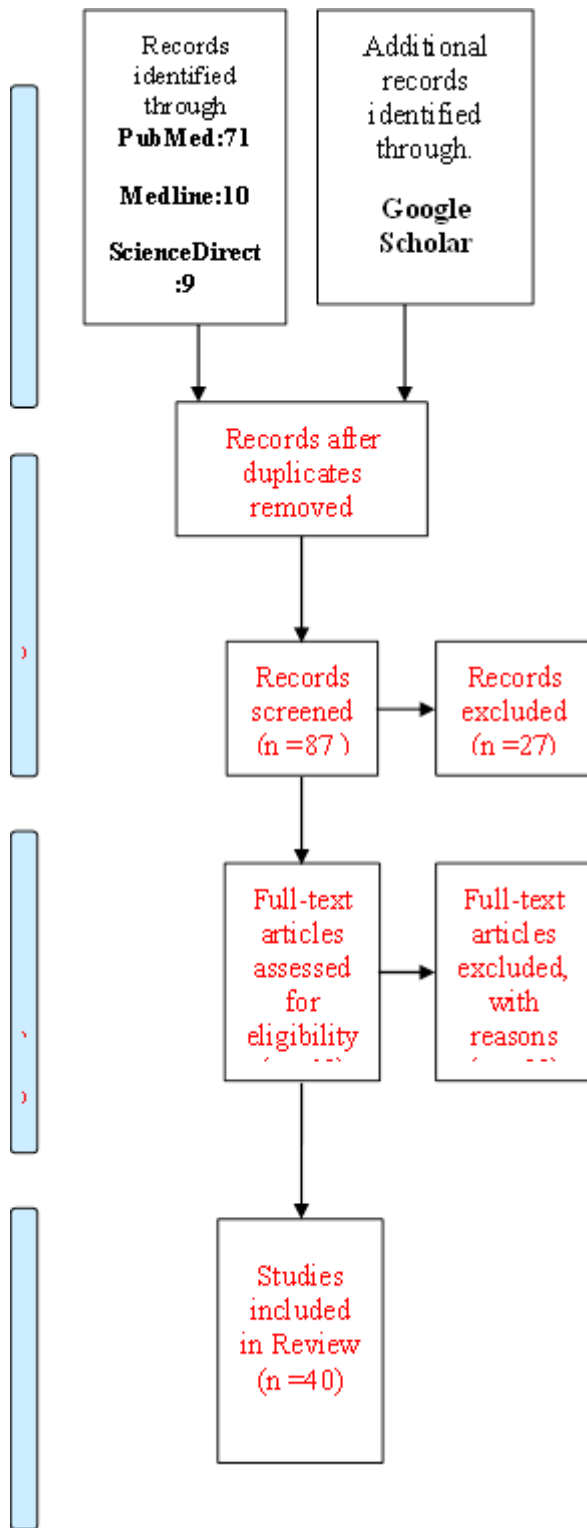
**Study Selection Process**

The search was further refined to include only English-language articles published between 2018-2022. This search provided 71 studies from the PubMed database, 10 from MEDLINE, 9 from ScienceDirect, and 45 from Google Scholar functional studies related to study questions limited to healthcare and nursing. The literature included in this review is sourced from multiple countries, thus providing a global perspective on the evidence. Therefore, each study has been reviewed as shown in the summary of studies (See Appendix 1); relevant data were extracted and arranged into evaluation and synthesis tables to facilitate the focused comparison of the research findings. The review process comprised two screening steps: (1) a title and abstract review and (2) a full-text review. The titles and abstracts of the papers collected in the search were read and checked by the researcher in the first stage of the collection to identify potentially qualified publications. In the second stage, the researcher ordered the articles to review the full-text articles to decide if they relate to the review topic. The duplicate studies, old studies published recently, studies that did not report the discovery, incomplete data for analysis, studies that focused on patients and the general public, and studies that did not include healthcare

professionals were excluded as they identified several unrelated articles. Figure 1 presents The PRISMA flow diagram used to report the studies screening; this diagram lists all the choices made during the research selection process (Peters et al. 2015). The final 40 studies chosen fulfilled the criteria for inclusion and were also relevant to the research questions. Therefore, Each study has been thoroughly reviewed, with relevant data extracted and organized into evaluation and synthesis tables. This facilitates a focused comparison of the research findings.

The current review is ordered as follows: in the first segment, After abroad range of research which was focusing on the general attitudes, comfortableness, and perceived capabilities toward using AI and its applications among healthcare providers, three themes were observed in the literature: Attitudes and perceptions towards AI systems. The second segment is presented comfortableness with using AI applications. The third segment emphases perceived capabilities towards using AI applications.

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### Findings

The present review, as defined by PRISMA, ultimately included a total of 40 articles, and a summary of research findings is presented in Appendix A. The results of this review suggest that earlier studies conducted in various workplaces and countries indicate nurses' general attitudes, comfortableness levels, and perceived capabilities towards using artificial intelligence system

### Attitudes and Perceptions Towards AI Systems

Over the next few decades, AI will significantly affect the world (Schepman & Rodway, 2022). How AI users perceive AI affects whether or not they will adopt or use it (Choudhury & Asan, 2022). In the literature, healthcare professionals' perceptions and acceptance of AI's application implementation have been persistent, with many misconceptions. The recent scoping review by Ng et al. (2022) agreed with previous study findings. This scoping review emphasized the importance and potential of AI technology in enhancing the quality of nursing care by providing an overview of prevalent use cases, such as predicting patients' conditions. In addition, the increased efficacy of patient monitoring systems, like those for vital signs, has decreased nurses' workload, providing them more time to focus on less routine and more cognitively effortless duties. In the same context, in another Saudi study, Alelyani et al. (2021) conducted a descriptive study to explore the attitudes of 714 radiologists toward the implementation of AI in radiology. The study's authors suggest that their findings could contribute to a better comprehension of the prospects of radiology as a long-term profession. The study revealed that most participants (61.2%) were aware of the use of AI in radiology, but further analysis indicated that AI awareness among participants was significantly influenced by their gender, education level, and age. Specifically, male participants were found to be more informed about AI's involvement in radiology than their female counterparts, and older participants were more likely to have knowledge of AI in radiology. The study also found a significant difference in the average scores among different education levels, indicating that male participants, highly educated radiologists, and older radiologists were more likely to be aware of AI in radiology. In addition, (44%) of participants, less than half, were eager to attend AI in radiology-related conferences or courses. Upon conducting a thorough investigation, it was discovered that females and younger participants exhibited lower attendance rates at AI radiology conferences than males and older individuals. According to the authors, 60% of the participants expressed positive attitudes towards using AI to improve treatment effectiveness, and 71.3% believed that AI could contribute to capturing high-quality images. The study also found that 65% of the participants believed that using AI could increase the accuracy of medical services. Furthermore, most of the study participants (80% and

86%, respectively) expressed agreement with the idea that AI technologies should be validated in a well-established clinical setting and that AI would play a crucial role in the future of radiology. However, the results also revealed variations in the attitudes of radiology staff regarding obtaining patient consent before implementing AI.

Nevertheless, all participants concurred that patients should be informed about using AI. In addition, 65% of the participants agreed that patients should be aware of AI and that their consent should be obtained, while 60% agreed that AI could cause patients stress and anxiety. Furthermore, most participants believed that the responsibility for the results obtained through AI should be shared between AI companies and organizations rather than borne by radiologists. Therefore, the authors suggested that medical and health science colleges' curricula should cover AI applications.

From The United States, two recent studies reported the health practitioners' perceptions of AI's impact on decision-making and the related factors that influence their perceptions. First, Romero-Brufau et al. (2020) conducted a pre-post study to explore healthcare staff's attitudes toward AI-based Clinical Decision Support (CDS). Interestingly, the study found that the staff felt that care coordination had improved following the CDS implementation. However, users were more likely to indicate that AI did not fully understand their job and were less enthusiastic about using AI in clinical practice.

Second, was an American study by Choudhury and Asan (2022) conducted an exploratory study among 265 healthcare practitioners. The study discovered that performance expectations, perceived risk, and trustworthiness influence practitioners' perceptions of how AI affects decision-making. Also, their findings showed that using AI was significantly affected by the perceived workload, perceived trustworthiness of AI, perceived risk of AI, and willingness to receive AI training.

In Europe, most of the literature reported a positive attitude among healthcare providers towards AI applications in the medical field, which aligns with previous research. Therefore, Layard Horsfall et al. (2021) conducted a 2-stage, cross-sectional, mixed-method survey in two stages. First, a qualitative survey was used to thoroughly evaluate a surgical team's knowledge of AI, its current utility in healthcare, and their perspectives on AI applications in neurosurgery. The second stage used the themes revealed in the initial qualitative survey; a case-based quantitative survey was designed to examine the views of neurosurgeons further. However, the first stage was conducted among 33 of the surgical team identified as surgeons (42%), anaesthetists (30%), nurses (9%), operating room practitioners (12%), and others (6%). The first-stage survey used a thematic analysis, revealing the participants' perceptions about AI's role in neurosurgery. Also, the study reported that 33% believed the AI's role within neurosurgery is pre-operative data analysis, and

33% believed it is for pre-operative assessment.

In addition, 52% believed that the AI's role within neurosurgery is surgical augmentation, assistance, and automation. Also, 18% coordination of the surgical team, 21% postoperative assessment and prognosis prediction, and 12% believed that the AI's role in neurosurgery could assist surgical workflow efficiency. In addition, the first-stage survey found that 91% of participants were aware of AI and its current applications.

Moreover, the study uncovered the potential advantages of utilizing AI in neurosurgery, such as enhanced surgical outcomes (63%) and improved diagnosis (33%). However, the initial survey stage also revealed valid concerns about incorporating AI into neurosurgery, including the need for retraining and potential loss of surgical skills (33%), apprehensions regarding software or hardware reliability (33%), and the possibility of human healthcare delivery being compromised (21%). Additionally, the first-stage survey highlighted the importance of ethical considerations in the utilization of AI (15%).

During the study's second stage, the authors assessed the neurosurgical team's attitudes towards AI. One hundred participants from 25 countries, including neurosurgeons, anaesthetists, nurses, and operating room practitioners, were surveyed to gather their opinions. The results of the second-stage survey showed an overall favorable attitude towards the use of AI in neurosurgery. However, the authors noted that 62% of the participants strongly or somewhat agreed with using AI for imaging interpretation, 82% for operative planning, 70% for coordinating the surgical team, 85% for real-time alert of hazards and complications, and 66% for autonomous surgery. Although most respondents expressed a positive outlook towards AI in various contexts, the role of AI in postoperative patient management received less favorable responses, with only 49% strongly or somewhat agreeing with this use of AI.

(Coakley et al. 2022) conducted a cross-sectional study aimed at European radiographers to examine perceptions, knowledge, and expectations towards integrating AI into medical imaging and detect the present state of AI education. The study results indicated an overall positive attitude toward AI implementation among radiographers. A majority of the participants (83%) expressed excitement about the advancement of AI, while 29% remained apprehensive. Moreover, the study reported a significant lack of education on AI among the sample. However, this lack of concern may be attributed to the participants' limited technical background in AI technologies and training.

In Germany, Bettina (2019) conducted a descriptive study among 74 physicians, including 54 students in advanced medical education and 20 trained physicians from various specializations. The study aimed to measure their attitudes and ambivalence toward using AI. The study revealed that physicians had both strong positive

and negative attitudes towards using AI as a decision aid. However, the authors argued that physicians conflicted about the benefits and drawbacks of AI applications tend to prefer the status quo, which hinders the adoption of AI technology.

In line with previous evidence, healthcare providers generally hold a positive attitude towards AI technology; in a cross-sectional study conducted by Coco et al. (2018), which involved 286 care personnel in Finland and Japan (200 from Finland and 86 from Japan), a generally positive attitude towards care robots was observed among Japanese care personnel in comparison to their Finnish counterparts. However, the study also revealed that some care personnel were concerned that using care robots might contribute to the isolation of older adults. Finnish care personnel expressed slightly more concern than their Japanese counterparts regarding the potential threat of care robots to their jobs. Their apprehension was influenced by various factors, such as the fear that robots may replace human workers, the dehumanization of care, and the possibility of increased loneliness among the elderly. However, the authors noted that negative attitudes towards robots could be influenced by cultural variances.

Similarly, Sarwar et al. (2019) conducted a descriptive, survey-based study on 487 pathologists practising in 54 different countries to examine their perspectives on integrating AI into clinical practice. The study reported an overall positive attitude towards AI among participants, with almost 75% expressing optimistic views about using AI as a diagnostic tool to enhance workflow efficiency and quality assurance in pathology. However, the authors did note that many respondents had concerns about AI, such as the possibility of job displacement or replacement. Nevertheless, approximately 80% anticipated implementing AI technology in pathology laboratories within the next ten years.

In the same line with the previous literature, Pauwels and Del Rey (2021) conducted a multi Centre survey among 293 dentists and dental students in Brazil to assess their attitude toward the potential impact of AI in oral radiology and to assess the influence of an introductory AI lecture on their attitude. The study found that before the introductory AI lecture, there was an overall optimistic view regarding AI's various future roles and expected impact in oral radiology. However, one-third expressed apprehension about the possibility of AI programs replacing oral radiologists in the next 15 years. The authors reported that after attending the lecture, the participants' overall enthusiasm for AI increased, while their concerns about replacing oral radiologists decreased.

In addition, Holzner and colleagues (2022) conducted a descriptive study among 12 physicians in Germany to investigate their attitudes and opinions toward the acceptance of AI applications in medical care, and their findings were consistent with the results of previous studies. According to the authors, physicians in Germany

are generally optimistic and open to the use of AI in medical care. However, they still have concerns, such as data protection or lack of AI systems to provide clear explanations.

Zheng and colleagues (2021) conducted a cross-sectional study in China to assess medical workers' and professional technicians' familiarity, perceptions, and concerns regarding AI in ophthalmology. The study involved 562 participants, of which 291 were medical workers and 271 were professional technicians. The findings indicated that approximately one-third of the participants understood AI and ophthalmic AI well. The study also revealed that 59.07% of the respondents demonstrated a high level of acceptance towards ophthalmic AI, with 70% having a completely accepting attitude towards AI in ophthalmology. However, similar to previous research, 66.0% of the participants believed that AI in ophthalmology would partially replace doctors. The authors emphasized that medical workers better understood AI in ophthalmology than professional technicians, highlighting the need to encourage ophthalmic AI education among professional technicians. Although most respondents had no prior experience using AI in ophthalmology, they still demonstrated a relatively high level of acceptance towards the technology in this field.

In contrast with the positive views of AI reported in the literature, some evidence reported negative perceptions of healthcare professionals; in the United Kingdom, Castagno and Khalifa (2020) conducted a study where they assessed the awareness of AI technologies among 98 health professionals, including medical doctors, nurses, therapists, managers, and others and investigated their perceptions toward AI applications in medicine. According to the authors, although more than half (64%) of health professionals reported never working with AI applications, 79% believed that AI technology could be beneficial in the medical field. Furthermore, the study revealed that only a small percentage (5%) used speech recognition or transcription applications daily, while a majority (63%) never used them. However, the prevailing perceptions of the AI application use among healthcare professionals were reported as negative attitudes. For example, 80% of health professionals believed that AI is associated with serious privacy issues, and 40% considered AI to be potentially more hazardous than nuclear weapons. Moreover, 10% expressed concern that AI could eventually replace them in their job.

In Korea, Oh and colleagues (2019) conducted a descriptive study among 669 doctors to examine their awareness and attitudes toward using AI and its applications in the medical field. The study findings revealed that most doctors had limited familiarity with AI technology. However, most (83.4%) doctors agreed that AI is helpful in the medical field, specifically in disease diagnosis, and 43.9% agreed that AI is better than human doctors when making diagnoses. The authors stated that

the advantage of using AI was the real-time analysis of enormous amounts of high-quality, clinically relevant data. Moreover, among the reported downsides of AI applications, 29.3% of the doctors agreed that AI might be unable to assist in unexpected situations due to insufficient information. Consistent with previous studies' findings, replacing physicians with AI is a common concern in the literature; the study found that 35.4% of participants agreed that AI could potentially replace them in their jobs.

In the United Kingdom, Blease and colleagues (2019) conducted a web-based survey among 720 general practitioners (GPs) to investigate their views on how future technology could affect essential tasks in primary care. The findings showed that reducing administrative tasks for physicians was one of the potential benefits of future technology. Moreover, the GPs believed that AI's capabilities were limited and that skills such as communication and empathy are unique to humans. Many GPs also considered clinical reasoning and value-based care required physicians' judgments. Despite this, some GPs acknowledged that a failure to embrace technological advancements could adversely affect both patients and healthcare providers.

In line with international literature, Arabic literature has supported the perspectives of global healthcare professionals on AI, despite the cultural differences and technological developments; for example, a recent cross-sectional study from Syria by Swed and others (2022) was carried out on 1,494 doctors and medical students. The study aimed to identify AI's knowledge, attitude, and practice of doctors and medical students. According to the authors, the study found an overall optimistic attitude toward AI among doctors and medical students in Syria.

According to the study, 70% of the participants understood AI well. Additionally, most participants held positive attitudes towards the utility of AI and its potential application in the medical field. More than half of the participants found AI applications to be straightforward. However, 21.5% of the sample agreed that AI could replace physicians. Furthermore, 46.4% of the participants acknowledged the crucial role of physicians in implementing and evaluating AI in the medical field, while 78.6% expressed their willingness to use AI in the future.

Similarly, In Morocco, Chakiri and Lahlou (2021) conducted a cross-sectional, national survey to assess the attitudes of 183 dermatologists toward AI. The study found overall optimistic attitudes, most dermatologists believed that AI would improve diagnostic capabilities and dermatology, and they believed that AI should be part of medical training. However, only 7.7% of dermatologists strongly agreed that AI would replace humans. Furthermore, regarding the fear of using AI within dermatology, female dermatologists showed more fear.

In Saudi Arabia, an observational cross-sectional study by Abouzeid and others (2021) was conducted on 570 dental students, dental school graduates/ interns and

postgraduate dentists. The study aimed to assess dentists' knowledge, attitude and perception of the role of robotics (R) and AI in oral health and preventive dentistry. The study results revealed that over half of respondents reported an overall affirmative in knowledge, attitude and perception of R and AI. Also, participants were optimistic towards R and AI and agreed that they are beneficial in dentistry and would provide better outcomes. Moreover, most recommended treatments with R/AI were willing to be treated with R/AI. Although 40.3% of participants agreed that R/AI would not replace dentists completely, almost 35.2% agreed that this would happen in the future, and 24.5% were unsure. Therefore, the authors concluded that dentists had a positive attitude toward R/AI.

Another Saudi Arabian cross-sectional study by Qurashi and others (2021) was conducted among 224 radiology staff to evaluate their perception and knowledge regarding current and future applications of AI. The study found that the participants had a positive attitude towards AI and demonstrated a reasonable understanding of the technology. They were also highly motivated to learn and incorporate it into clinical practice. However, some participants expressed concern about the potential threat to their jobs due to the adoption of AI, but the authors suggested that this belief could be alleviated through proper training and education programs. The researchers emphasized that the radiology personnel's knowledge of AI plays AI is crucial to their openness to learning, utilizing, and adjusting to this technology in their clinical work.

However, the amount of technology-related literature in nursing sciences has dramatically expanded because the use of AI in the industry has already attracted the attention of scholars and scientists both inside and outside the healthcare industry. In addition, AI tools for nurses and other healthcare professionals have been gradually introduced due to the integration of AI in healthcare. One of the integration's significant advantages is the promise of access to technology-driven, useable, efficient, safe, client-specific, and high-quality care services (Dino et al. 2022).

Regarding the nurses' attitudes and perceptions regarding AI applications, In the United States, Swan (2021) conducted a prospective survey among 675 registered nurses (RN) to evaluate their knowledge and attitudes towards AI implementation in their field. The study results revealed an overall positive attitude among nurses. Such as, 70% agreed that AI supports health promotion and preventing disease, assists in creating personalized treatment plans, speeds up administrative tasks, and automates routine tasks. However, a few nurses reported that human nurses would be replaced and inter professional care team members would be replaced in future (5% and 10%, respectively). At the same time, 20% reported being frightened by AI. Furthermore, the researcher used a list of competencies to focus on knowledge, skills, leadership, problem-solving, and

communication and asked respondents (nursing students, practising nurses, and nursing faculty) which AI competencies should be posed.

The researcher stated that nursing students and practice nurses understand the importance of integrating AI in nursing and healthcare and need the skills, knowledge, and competencies in this field. These findings imply that, despite nurses' claims that they may not comprehend how AI is critical to nursing practice, their belief that AI will transform nursing and healthcare may make it easier for them to change their perceptions.

Consistent with the findings of a prior study, Ergin et al. (2022) performed a descriptive study using an online survey among 326 nurse managers in Turkey. The study aimed to explore nurse managers' opinions regarding artificial intelligence and robot nurses. The results revealed an optimistic view of AI integration in nursing care. Most nurse managers (86.2%) believed that AI applications and robot nurses would not supplant nurses' jobs; on the contrary, the AI applications would benefit nurses and lighten their workload.

Similarly, in Iran, a descriptive cross-sectional study was conducted by Mehdi pour (2021) to evaluate the attitude of nursing managers toward using artificial intelligence systems in nursing decision-making. The study was conducted on 130 nursing managers. The results indicated that the nurses' skill with the AI system was deficient, but the level of awareness and knowledge about AI applications was high. In addition, the overall attitude of nurses toward applying the AI system was positive. However, according to the authors, despite the positive attitudes and adequate knowledge, involving the AI system requires sufficient information about the benefits of AI and encourages nurses to use AI. The author suggested that if nurses properly harness the potential of AI, they might be able to provide care more effectively, more quickly, and more safely.

An Indian study by Sheela (2022) used a quantitative non-experimental design among 189 nurses. The study aimed to assess nurses' attitudes towards AI. The study reported that (63%) of nursing students had a negative attitude towards AI. In comparison, 37% had a favorable attitude towards AI.

In contrast with previous research results, in Korea, a cross-sectional study by Kwak and colleagues (2022) was conducted among 210 nursing students to determine the nursing students' intent to utilize AI healthcare technologies. The study employed the unified theory of acceptance and use of technology and used the General Attitudes Toward Artificial Intelligence Scale developed by Schepman and Rodway (2020).

The study results revealed that nursing students showed a moderate level of generally positive attitudes towards AI ( $3.68 \pm 0.47$  out of 5). And a low level of generally negative attitudes ( $2.94 \pm 0.55$  out of 5). The positive subscale, which included items that expressed enthusiasm and perceived usefulness of AI, had slightly

higher scores than the negative subscale. The study also revealed that positive attitudes were predicted by performance expectancy, self-efficacy, and effort expectancy. Also, the positive attitude toward AI and facilitating conditions indicated the intent to use it.

In a separate investigation, Kwak, Ahn, and their colleagues (2022) carried out a cross-sectional study involving 189 nursing students in Korea. Their research explored how AI ethics awareness, attitudes towards AI, anxiety, and self-efficacy impact nursing students' intentions to use healthcare technologies based on AI. The study revealed that third- and fourth-year students had significantly higher AI ethics awareness, positive attitudes towards AI, self-efficacy, and lower anxiety scores than first- and second-year students. Furthermore, the results indicated that students with positive attitudes towards AI and higher self-efficacy were more likely to have behavioral intentions to use AI-based healthcare technology. These findings underscore the significance of educational programs on AI technology in their settings to improve attitudes towards AI and self-efficacy. Moreover, they highlight the need for education on data literacy, technical literacy, systems thinking, AI algorithms, and AI's ethical implications to enhance nursing competencies.

From Arab countries, several studies reported nurses' attitudes and perceptions regarding AI applications in healthcare. For example, in Egypt, Elsayed and Sleem (2021) conducted a descriptive cross-sectional study to investigate nurse managers' perspectives and attitudes toward AI technology. Their study revealed that most nurse managers (84.6%) had moderate perceptions of using AI in nursing settings. Also, over half (65%) had a positive attitude toward AI applications. However, the researchers recommended that nurse managers increase their knowledge of AI.

Another Egyptian study by Mekawy and others (2020) conducted a descriptive correlational study among 128 nursing students to assess their digital health-literacy levels and their relation to their perception and attitudes towards the application of AI. The study's findings were inconsistent with previous research, as most students held moderate attitudes and feelings toward AI and had a medium to high level of digital health literacy. Additionally, nursing students had a higher perception regarding the application of AI in nursing.

In the same context, an exploratory cross-sectional study was conducted in the United Arab Emirates (UAE) to evaluate the knowledge, attitude, willingness, and organizational readiness of 555 nurses to integrate AI into nursing practice. The study revealed a lack of understanding of AI principles among nurses, but most were enthusiastic about incorporating AI into nursing and acknowledged the challenges that needed to be addressed. The majority also recognized the role of AI in nursing practice. Nevertheless, more than half (57%) of nurses believed AI would threaten or disrupt their professional careers. Most of them agreed that the nursing



curriculum should incorporate basic knowledge of AI. (Abuzaid et al. 2022). In Riyadh, Saudi Arabia, Abdullah and Fakieh (2020) conduct a descriptive-analytical study among 250 healthcare employees, including doctors, nurses, and technicians in Saudi Arabia. The study aimed to investigate their perceptions and attitudes toward implementing artificial intelligence technologies in healthcare institutions. According to the study's findings, 48.4% of the sample were nurses. Also, most participants lacked general awareness of the AI topic. In addition, the research revealed that healthcare workers in Saudi Arabia had a moderate acceptance of AI applications, with concerns that AI might replace their professions. According to the authors, the primary benefit identified by participants in this research was the acceleration of healthcare procedures. However, more than half (65%) of respondents felt that AI could only provide a small quantity of clinically relevant, high-quality data in real-time. In contrast to nurses and doctors, who require direct human contact with patients, technicians were more likely to be exposed to AI's technological developments, according to the study.

Milne-Ives and colleagues (2020) conducted a systematic review that evaluated the effectiveness and usability of conversational agents powered by artificial intelligence (AI) in healthcare. The review found moderate evidence supporting the effectiveness of AI-powered agents and positive user perceptions of their usability. In addition, the users reported that the agents are easy to use and access and help them to be accountable, contributing to the positive evaluations of usability and satisfaction outcomes.

While the studies generally reported positive usability outcomes, the study suggests that several barriers to the effective use of conversational agents in healthcare still need to be addressed. These barriers include difficulties understanding the agents, issues with repetition, and lack of interactivity. Additionally, users may have difficulty forming personal connections with the agents, hindering their effectiveness.

However, most of the literature argued that more educational initiatives devoted to AI are necessary to encourage the engagement and involvement of the healthcare workforce in AI technologies (Coakley et al. 2022; Kwak, Ahn et al. 2022; Qurashi et al. 2021; Teng et al. 2022; Zheng et al. 2021). Ng et al. (2022) stated that training nurses in applying artificial intelligence would enable them to lead technological transformations rather than passively follow others.

### **Comfortableness with using AI application**

The term comfortableness differs among studies and from author to author. According to Schepman and Rodway (2020), comfortableness with AI refers to a nurse's feelings of ease or security when performing each task. In the current literature review, the terms "acceptance" and "comfort" lead to the same concept of

the comfortableness variable.

Schepman and Rodway (2020) conducted an exploratory study to develop a measurement tool for assessing general attitudes towards artificial intelligence (AI) in different contexts and summarized with specific AI applications for rating comfortableness and perceived capabilities. The study was carried out on 100 participants. They were from various careers, including general practitioner, nurse, nurse specialist, office admin assistant, and office administrator.

The study found that participants held mixed attitudes toward AI. While some participants expressed positive views about AI's societal and personal benefits and even showed a preference for AI over human involvement in routine transactions, several items relating to emotional matters such as excitement, happiness, and enhanced well-being were also captured. Additionally, several items related to the personal use of AI, such as using AI in one's own job and showing interest in using AI, were present among the participants. On the other hand, regarding the negative items, the authors stated that the emotional statements and dystopian views of AI use were the most dominant such as dangerous, sinister, discomfort, unethical, and spying. In the overall results, the utility was the dominant positive item, while the negative emotions and dystopian concern were in negative items, as the authors stated.

Meanwhile, their comfortableness and perceived capabilities results with specific AI applications compared to humans revealed that the participants held positive views of applications assisting humans in their endeavors, like detecting fraud. In contrast with applications that could replace humans or gain autonomy or control. Furthermore, the participants felt discomfort and perceived low capabilities toward AI performing selections or making a decision for staff. Moreover, Health interactions received the lowest ratings regarding both comfortableness and capabilities. The study data also showed that psychotherapy applications have a very low rating.

Regarding the healthcare providers' feelings of ease in using AI applications, recent literature agreed that most healthcare providers were comfortable with the applications of AI (Horsfall et al. 2021). At the same time, 26 studies out of the 3666 articles were involved in a systematic scoping review conducted by Chew and Achananuparp (2022) to provide an overview of AI perceptions and the need to increase its adoption in healthcare. According to the authors, the application of AI was seen positively due to its accessibility, ease of use, and potential to increase efficiency and lower the cost of providing healthcare services.

Mugabe (2021) conducted a descriptive study in New Zealand among 101 participants, including radiation oncologists, medical physicists and senior radiation therapists. The study found that participants agreed they are comfortable with AI application tools (got a mean score of 3.81 out of 5). Also, the respondents believed that

AI tools are facilitators in providing healthcare, and they are likely to adopt AI in their practice.

In contrast with previous findings, the previously mentioned German study by Bettina (2019) reported that physicians were uncomfortable with implementing AI applications in their practice, which caused them to discourage the use of the technology. However, it has been suggested that doctors' discomfort results from their confused sentiments toward implementing AI. However, Chew and Achananuparp (2022) reported that healthcare providers had raised concerns regarding implementing AI in healthcare. These concerns include a lack of trust in data privacy and patient safety, doubts about the technological maturity of AI systems, and the possibility of full automation.

In UAE, Almarzouqi et al. (2022) conducted a cross-sectional design among 259 who were categorized into administrative and clinical staff. The study aimed to investigate the aspects that predict and explain an Electronic Medical Record (EMR) system adoption in the healthcare system using an integrated approach of the Unified Theory of Acceptance and Use of Technology (UTAUT) and Technology Acceptance Model (TAM) using various external factors. The study's data proved that perceived usefulness and perceived ease of use of AI applications are significantly and positively affected by self-efficacy and trust and hence influential in the adoption of AI.

### **Perceived capability toward AI applications**

Over the past decade, there have been significant advancements in the healthcare field due to artificial intelligence. According to recent evidence, AI brings capabilities and the potential to improve nursing care. However, perceived capabilities in AI refer to how capable nurses view AI compared to human abilities. Many studies in the literature explored the healthcare professionals' views on AI capability; in the United Kingdom, a web-based survey was distributed among 720 general practitioners to explore their opinions about the potential impact of future technology on critical tasks in primary care. Most GPs considered AI's capability in primary care to be limited (Blease et al. 2019). In line with the previous study, according to a quality improvement project by Romero-Brufau et al. (2020) in the United States. The authors found that recommended interventions by AI were frequently perceived to be poorly tailored, unsuitable, or not practical. Therefore, most staff did not anticipate that AI would render their jobs obsolete, and they believed that AI would not understand their jobs.

However, In Finland, a descriptive qualitative study by Laukka et al. (2022) applied to explore perceptions of AI's future role in specialized medical care among nurse leaders and digital service developers; the study results revealed that respondents believed that AI applications would have a significant future role in healthcare. However, it will likely reinforce clinicians or traditional care

rather than replace them. Conversely, Chikhaoui et al. (2022) conducted a descriptive study in Saudi Arabia among 86 participants (doctors 29%, technicians 24%, radiologists 6%, and nurses 41%). Although, participants agreed that AI not only improves healthcare but also saves manpower and facilitates healthcare practices. In addition, the respondents acknowledged that AI reflects human intellectual competencies and pushes its limits. Nevertheless, 70% of the participants agreed that AI has the potential to replace doctors, radiologists, and nurses with minimum errors.

Similarly, four studies indicate that healthcare providers believed AI capabilities could replace them in Saudi Arabia. Abdullah and Fakieh (2020) found that Saudi healthcare workers moderately accepted AI applications, with most participants expressing concern that AI may displace their professions. Khafaji et al. (2022) reported mixed perceptions among radiology residents; the study sample was divided into two halves; the first half did not expect AI to affect their jobs, while the others anticipated job positions would decrease (43.5% and 42% respectively). In Turkey, Ergin et al. (2022) found that only 13.8% of nurse managers believed that AI applications would replace nurses' jobs. Finally, in the UAE, Abuzaid et al. (2022) reported that 57% of nurses believed AI would threaten or disrupt their professional careers.

### **Literature Review Gap**

Various sub-disciplines in healthcare, including image recognition, diagnosis, and precision medicine, have already implemented AI-enabled systems. These solutions hold great promise as time-saving tools that can enhance the quality of care by automating repetitive tasks. Therefore, Nurses' attitudes, comfortableness level, and perceived capabilities are considered critical drivers for the successful implementation and uptake of AI systems. Different tools measured nurses' attitudes, comfortableness, and perceived capabilities. Moreover, while searching in the electronic database, the researcher could not find published research on nurses' attitudes, comfortableness and perceived capabilities worldwide, up to the researcher's knowledge. Also, the lack of Medical Subject Headings related to nurses' comfortableness and perceived capabilities, requiring free-text searching, which may rely on poorly defined terms often misused throughout the research—using several potentially relevant keywords created an extensive collection of irrelevant results that needed refining. Thus, developing a search strategy using a set of keyword combinations maximizes the identified studies' relevance. Moreover, few studies related to these variables have been reported in nursing. Therefore, discrepancies have been noted in the existing literature, indicating warranted further research regarding understanding Nurses' attitudes, comfortableness, and perceived capabilities.

## CONCLUSION

Consequently, this study will add knowledge to fill the current, national, and international research gaps. Additionally, it will offer a background for nurses' attitudes, comfortableness, and perceived capabilities toward using AI systems and their applications, thus enhancing the acceptance of implementation for developing nursing practice, management, and research.

## CONFLICT OF INTEREST

The research investigators declare not to have any financial and non-financial competing interests regarding the publication of this paper.

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## AUTHOR CONTRIBUTIONS

The author DYOA contributed to the design and implementation of the research, to the analysis of the results and to the writing of the manuscript with support from NE. NE supervised the project. All authors provided critical feedback and helped shape the research, analysis and manuscript.

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