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ORIGINAL PAPER

Integration of artificial intelligence into nursing practice

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Abstract

Background Artificial Intelligence (AI) is developing at a rapid pace and finding new applications across the health service team. Some professionals have voiced concerns over the implementation of AI, whilst others predict greater job opportunities in the future. Nursing practice will be directly affected and further information is required on the knowledge and perceptions of nurses regarding the integration of AI in practice. The study aims to assess the knowledge, attitude, willingness, and organizational readiness in integrating AI into nursing practice.

Methods An exploratory cross-sectional survey of nurses working in health organisations. A survey link was emailed to participants. Nurses working in the United Arab Emirates (UAE) health organisations were invited to participate. Eligibility criteria included registered nurses in government or private hospitals. The survey captured the nurses demographic, knoweldage, preceptions, orgianizational readinesss and challenges regarding implementation of AI into nursing practice.

Results 553 responses were returned from 650 invitation giving a response rate of 85%. 51% of respondents stated their knowledge on AI was obtained through self-taught measures for most of the participants, while 20% of them gained it through various courses. Only 8% stated they learned through postgraduate courses, while 9% stated they lack knowledge of AI. 75% of all respondents agreed that the nursing curriculum should include some basic knowledge of AI.

Conclusions There is a lack of understanding of the principles of AI across the nursing profession. Further education and training is required to enable a seamless and safe integration of AI into nursing practice.

Keywords Nurse · Artificial intelligence · Acceptance · Integrate into practice · Future applications of AI · Technology in nursing

1 Introduction

Artificial intelligence (AI) works by developing computer systems that can usually perform tasks done by humans. Different methods of AI exist, i.e. Machine learning (ML) is a branch of AI that comprises teaching algorithms to complete tasks using data to understand patterns and characteristics. In contrast, Deep learning (DL) is a type of ML in which a job is completed using deep neural networks containing numerous layers of mathematical Eq. [1].

There is a vast growth of AI applications across all aspects of healthcare. Nursing practice is critical where AI technology will enhance practice and patient outcomes [1]. Currently, there are numerous AI applications used in nursing practice, such as speech recognition [2], data mining [2], and prediction of physical deterioration [3]. Nevertheless, the future applications of AI technology will help nurses provide individualized, evidence-based care and integrate relevant data [1]. In contrast to the vast majority of AI research, which focuses on developing and testing AI algorithms and their related prediction models, few studies explored the perceptions of nurses and nursing students [4]. A recent survey of 675 nurses in the US reported that 30% of respondents know how AI is used in clinical nursing practice, while 70% had fair or no knowledge of the technology employed in AI [5]. It is possible that this lack of knowledge exists across the discipline and needs to be addressed. There is no doubt that the application of AI will continue to increase in healthcare practice and education [4].

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Successful implementation of AI into clinical practice requires a thorough understanding of the attitudes and behaviours of the nurses as end-users towards the existing and future AI applications. Moreover, assessing the current knowledge of AI among nurses is essential to identify future training requirements, as they are the technology users and have direct contact with patients.

Numerous AI applications have been developed to improve patient care and change nurses' jobs. In the context of healthcare, AI often refers to a computer's capacity to autonomously transform data into knowledge to inform decisions or autonomous actions [6–8].

With limited staff and resources, mobile health (mHealth) and sensor-based technologies offer chances to redefine a nurse's capacity to give care and monitor patients. For example, nurses regularly communicated with patients remotely during the COVID-19 pandemic using voice assistants and robotics to cut down on the need for personal protective equipment and recurrent viral exposure. These technologies may also shorten the time nurses spend gathering information and documenting it per visit.

This study assesses the knowledge, attitude, willingness, and organizational readiness to integrate AI into nursing practice.

2 Methods

An exploratory cross-sectional electronic survey of nurses working in the United Arab Emirates (UAE) health organization was conducted. The participants' eligibility included registered nurses working across government or private hospitals, clinics, or medical centres during the data collection period. The research team adapted a previously validated survey used in similar studies [9–11]. The survey was modified to suit the nurse's practice. Three senior nurses and two nurse educators piloted the survey to ascertain whether participants understood the questions, as well as the accuracy and dependability of the information. Based on the working environment in the UAE, the comments and ideas were used to make the survey easier to understand.

The survey was designed in two parts. (i) The first part recorded the participants' demographic information, including gender, age, qualifications, clinical experience, and country obtained the latest academic degree. (ii) The second part captured the nurses' knowledge, perceptions and organizational readiness regarding integrating AI into nurses' practice.

Convenience sampling was utilized in this study because it is a simple way to reach out to people in different parts of the UAE. Nurses were invited to participate in the online survey using the "Google Forms" link. A research assistant emailed the survey link to the manager of nursing departments to be shared with nurses. The invitation email had detailed information about the objectives of the study and requested consent to participate in the study. Participants had to click to confirm consent to enable progression to the survey and were informed that completing the survey also implied consent to participate in the study.

The survey was completely anonymous, and participants were informed that they could withdraw at any time before the submission with no repercussions. The data collection period was over three months (July to November 2021), with regular email reminders every second week.

Data analysis was performed using the Statistical Package for Social Sciences (SPSS) version 22. All questions that the participants responded to were included in the study. In addition, descriptive data was conducted for all questions extracting the frequencies and percentages of the responses. Statistical Package for the Social Sciences (SPSS), version 24®, Armonk, NY: IBM Corp., was used to classify and analyze the quantitative data. Percentages, mean, median, and standard deviation were used to present the quantitative data. The Chi-Square test and P-values were used to compare the results.

Ethical Approval: The research ethics committee at the University of XXXXX approved the project. The committee's norms and restrictions followed the study's goal, protocols, and techniques (reference number REC-20-05-06-01).

3 Results

3.1 Demographic information

Six hundred and fifty participants were invited, and data was collected from 553 nurses giving a response rate of 85%. Most respondents were female (n = 490, 89%), and a minority were male (n = 63, 11%). Most of the participants (n = 482, 87%) had a Bachelor's degree, (n = 66, 12%) had a Diploma, and only (n = 5, 1%) had a Master's degree in nursing as their highest qualification. The majority of respondents (n = 211, 38%) were 30–39 years old, followed by 20–29 years (n = 167, 30%), 40–49 years (n = 126, 23%), 50–59 years (n = 41, 7%), and those above 60 years of age were (n = 8, 1%). The participants of the study graduated from a multitude of different countries; (n = 218, 39%) from Philippines, (n = 131, 24%) India, (n = 68, 12%) UAE, (n = 36, 7%) western education and (n = 99, 18%) from Arab Universities.

Most respondents (n = 409, 74%) worked in public hospitals, while (n = 144, 26%) were from private hospitals. The study included respondents who had a range of experience: 0–5 years (n = 183, 33%), 6–10 years (n = 127, 23%), 11–20

Table 1 Participants' demographic information

		n	%
Gender	Female	490	89
	Male	63	11
Age groups (years)	20–29	167	30
	30–39	211	38
	40–49	126	23
	50–59	41	7
	60+	8	1
Education	Diploma	66	12
	BSc	482	87
	MSc	5	1
Country of graduation	UAE	68	12
	India	131	24
	Philippines	218	39
	Western Education	36	7
	Arab Universities	99	18
Experience (years)	0–5	183	33
	6–10	127	23
	11–20	169	31
	20+	72	13
Work	Hospital	409	74
	Clinic	144	26

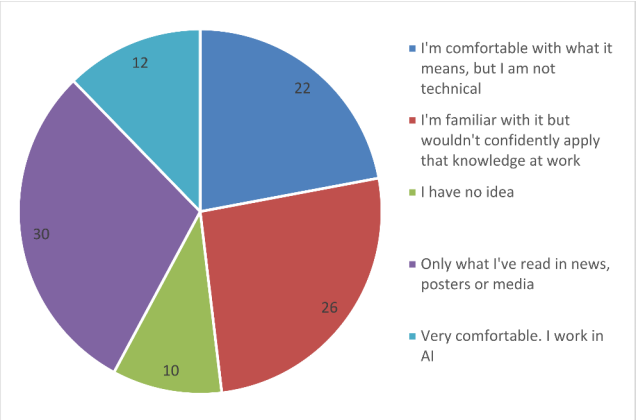

Fig. 1 Knowledge Assessment

years (n = 169, 31%), and more than 20 years (n = 72, 13%), Table 1.

3.2 Nurses' knowledge

When asked how well they understood what AI means, 165 respondents (30%) stated that their knowledge is only what they have read in news, posters, or media. In contrast (26%, n = 144) stated they are familiar with AI but would not be confident applying that knowledge at work. On the other hand, other respondents (22%, n = 122) stated that they are comfortable with what it means (n = 68, 12%) declared they are very comfortable with working with AI applications.

Table 2 Knowledge Assessment

	Strongly Disagree (SD) (%)	Dis-agree (D) (%)	Neutral (N) (%)	Agree (N) (%)	Strongly Agree (SA) (%)
The curriculum should include at least some basic knowledge of AI	10(2)	31(5)	98(18)	261(47)	153(28)
AI should be taught in the undergraduate programme	8(1)	37(7)	78(14)	265(48)	165(30)
AI should be taught in the postgraduate programme	8(1)	20(4)	66(12)	246(44)	213(39)
I have a basic understanding of AI	8(1)	16(3)	151(27)	291(53)	87(16)
I have a working knowledge of AI	19(3)	126(23)	188(34)	153(28)	67(12)
I have been trained and educated about the AI	53(10)	131(24)	166(30)	130(23)	73(13)

In contrast, the rest of the respondents (n = 54, 10%) stated they did not understand it (Fig. 1).

Participants were asked about AI learning in the nursing curriculum and practice. Data were gathered in a 5 point Likert scale scored from 1 to 5 for Strongly Disagree to Strongly Agree, Tables 2 and 3. Most respondents (n = 414, 75%) agreed that the nursing curriculum should include at least some basic knowledge of AI (μ = 3.93, SD = 0.915). 75% of them agreed that AI should be included in the undergraduate programme (n = 430, 78%) (μ = 3.98, SD = 0.916) and postgraduate programme (n = 459, 83%) (μ = 4.15, SD = 0.865). Although most respondents (n = 378, 69%) were affirmative when they were asked if they have a basic understanding of AI (μ = 3.79, SD = 0.783), less than half of the participants (n = 220, 40%) stated they have a working knowledge of AI (μ = 3.22, SD = 1.039). Respondents were asked if they had been trained and educated on AI; almost equal distribution of responses was received for agreed (n = 203, 36%), disagreed (n = 184, 34%), and neutral (n = 166, 30%) (μ = 3.07, SD = 1.175).

The study also assessed how participants developed their knowledge and skills in AI. Most participants obtained knowledge of AI through self-taught measures (n = 283, 51%), while some (n = 113, 20%) gained it through various courses. Only a few (n = 43, 8%) stated they learned through postgraduate courses, while others (n = 51, 9%) stated that they lack knowledge of AI, Fig. 2.

Table 3 Descriptive Statistics of Knowledge

	Minimum	Maximum	Mean	Std. Deviation
The nursing curriculum includes at least some basic knowledge of AI.	1	5	3.93	0.915
AI should be taught in the undergraduate program	1	5	3.98	0.916
AI should be taught in the postgraduate program	1	5	4.15	0.865
I have a basic understanding of AI	1	5	3.79	0.783
I have a working knowledge of AI	1	5	3.22	1.039
I have been trained and educated about the AI	1	5	3.07	1.175

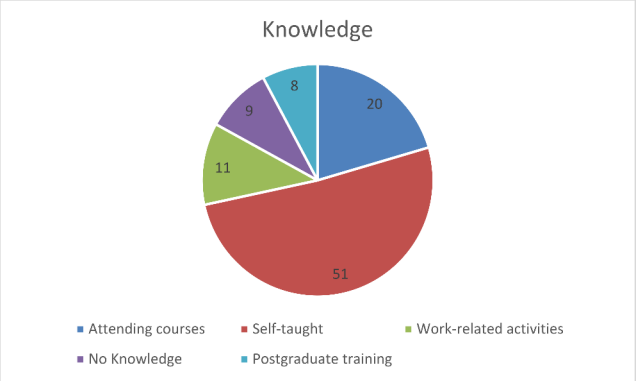

Fig. 2 Knowledge Gain

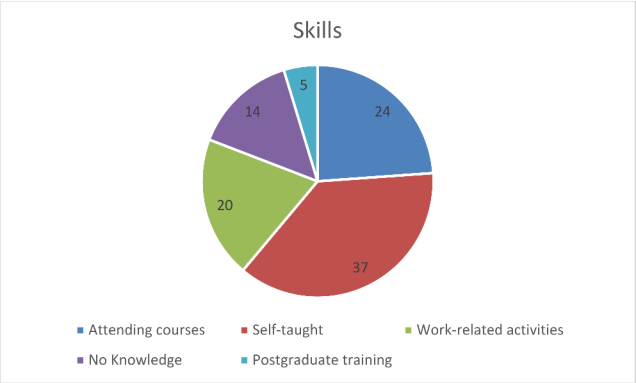

Fig. 3 Skills Gain

Table 4 Perception of AI

	SD (%)	D (%)	N (%)	A (%)	SA (%)
AI play an important role in Nursing	8(1)	11(2)	62(11)	215(39)	257(47)
AI will take place in many nursing applications and practice	8(1)	11(2)	48(9)	243(44)	245(44)
AI will threaten/ disrupt the nursing practice	32(5)	82(15)	203(37)	138(25)	98(18)
AI will threaten/ disrupt some nursing careers.	34(6)	74(14)	128(23)	205(37)	112(20)
AI has no limitations in my work	25(5)	107(19)	145(26)	174(32)	102(18)

Table 5 Descriptive Statistics on Perception

	Minimum	Maximum	Mean	Std. Deviation
AI play an important role in Nursing	1	5	4.27	0.846
AI will take place in many nursing applications and practice	1	5	4.29	0.779
AI will threaten/ disrupt the Nursing practice	1	5	3.34	1.107
AI will threaten/ disrupt some nursing careers.	1	5	3.52	1.137
AI has no limitations in my work	1	5	3.40	1.127

In terms of the skills on AI developed, distribution of responses was self-taught (n = 206, 37%), developed through attending courses (n = 132, 24%), through work-related activities (n = 109, 20%), through post-graduate training (n = 26, 5%), and they lack the knowledge (n = 80, 14%). See Fig. 3.

3.3 Nurses perceptions

The participant's perception of AI was assessed through a series of questions that had responses on 5 points Likert scale. Scores were assigned for responses, 1 = 'Strongly Disagree' (SD), 2 = 'disagree' (D), 3 = 'Neutral' (N), 4 = 'Agree' (A), and 5 = 'Strongly Agree' (SA), for which frequencies, percentages, mean and standard deviation were calculated and displayed in Tables 4 and 5.

Participants strongly agreed that AI plays an important role in nursing practice (n = 257, 47%), (μ = 4.27, SD = 0.846). Most participants (n = 488, 88%) agreed that AI would have a place in many nursing applications and practices (μ = 4.29, SD = 0.779). A neutral opinion was common

Fig. 4 Perceptions toward AI

(n = 203, 37%) when the respondents were asked if AI would threaten/disrupt nursing practice (μ = 3.34, SD = 1.107). Further, the participants were asked if AI would threaten/disrupt nursing careers (n = 317, 57%) of them agreed (μ = 3.52, SD = 1.137). Affirmative responses were received from the participants (n = 276, 50%), stating that AI has no limitations in their work (μ = 3.40, SD = 1.127).

When asked how they feel about AI, the respondents stated that they are aware of the challenges (n = 191, 35%), (n = 176, 32%) were excited, (n = 70, 13%) were neutral, and (n = 69, 12%) did not know enough. However, a small fraction (n = 47, 8%) of the respondents were worried about the impact of AI in nursing g practice, Fig. 4.

3.4 Organizational readiness regarding integrating AI into practice

When asked if someone was in charge of AI at their institutes (n = 213, 39%) said they were unsure. In contrast (n = 186,34%) said no. 220(40%) stated that AI is a big part of what they do, some (n = 183, 33%) mentioned it was in their organization's plan, other respondents (n = 57, 10%) stated it was a small part. The rest (n = 93, 17%) stated that they have no idea regarding AI integration in their current work. When the respondents were asked if their organization has any strategy for AI integration, the responses indicated their lack of knowledge of it (n = 219, 40%), yes (n = 153, 28%) and no (n = 181, 32%).

3.5 Comparison of demographics and responses

The association between the demographics and the participants' responses was analyzed through Chi-Square. Neutral responses were excluded from the analysis, and the two 'extreme' responses on either side of the neutral column were combined to form two data groups. The new data columns were labelled 'Disagreement' and 'Agreement'.

The study concluded that there is an association between the respondents' workplace and their perception of AI. The workplace plays an important role (p = 0.02) where the respondents from hospitals (n = 358, 98%) tend to agree more with it compared to the respondents from the clinics (n = 114, 91%).

An association was found between the opinion of participants on whether AI will have a place in many nursing applications and practices and the age of participants (p = 0.014), country of education (p = 0.0001), and experience (p = 0.0001). Participants between 50 and 59 years (n = 33, 00%) were more inclined to agree. Participants who obtained education from UAE (n = 56, 10%), Philippines (n = 200, 10%) and Western Education (n = 30, 100%) were in more agreement compared to those who graduated from India (n = 119, 94%) and Arab countries. Nurses with experience between 0 and 5 years (n = 170, 100%) were inclined to agree that AI is integrated into nursing applications and practices.

There was an association between the age of participants and their perception of whether AI will threaten/disrupt Nursing practice (p = 0.037), where participants were within age 30–39 years (n = 100, 74%) and those between 50 and 59 years (n = 24, 77%) were inclined to agree to it compared to other age categories. Further, an association was found between the experience of the participants and their idea whether AI will threaten/disrupt the Nursing practice (p = 0.006), where participants in the 6–10 years age group (n = 61, 75%) and those between 11 and 20 years (n = 77, 76%) tend to agree to the idea compared to the others.

The study revealed an association between the years of experience of the participants and their opinion regarding the threat/disruption AI brings to nursing jobs (p = 0.024), where participants between 6 and 10 years of experience (n = 81, 81%) and those between 11 and 20 years experience (n = 98, 80%) were more likely to feel threatened.

Furthermore, the participants' age was associated with the perception that AI has no limitations on their work (p = 0.043). Participants, those between 30 and 39 years, 50–59 years, and those above 60 + were in a greater agreement than the other age groups that AI positively impacts nursing practice. There also was an association between the perceptions and participant's experience (p = 0.028) and workplace (p = 0.019). Participants with 6–10 years of nursing experience and those with more than 20 years of nursing experience agreed with the above perception, and those from clinics were similarly affirmative.

4 Discussion

This study reports significant results from the nursing workforce in the UAE regarding the integration of AI into nursing practice.

Many work sectors are affected by the integration of AI in their work practice; for example, fewer labourers are currently employed in agriculture, ticketing and tourism as jobs become more automated. In healthcare AI application is applied in robotics and radiology image interpretation [9]. Integration of AI in health and medicine has become a reality, and every healthcare professional will experience some sort of impact of work automation and integration of AI applications [7]. Woolery et al. published the first report about utilizing artificial intelligence and machine learning in nursing literature for the first time in 1991 [12]. With the increased digitization in healthcare and the usage of electronic health data, nursing practice will be greatly impacted.

The nursing profession is critical in healthcare delivery as it works directly with the patients and ensures the diagnostic and treatment plans work efficiently. The daily nursing tasks are wide and varied and include maintaining the patient charting, recording, taking vital signs, assisting in physical exams, and communication between patients, physicians, other healthcare professionals, and administrator's sectors [13]. Therefore, there is no question that the impact of AI in nursing practice will be transformational. An example of AI application in nursing practice is the utilization of robotics in medication dispensing, special needs robotics and decision-making applications for health management and coordination [1, 14]. Nurses are important in healthcare delivery, so they must be aware and knowledgeable about AI. However, most current studies concentrated on AI application development and compared the work performed before and after AI integration; few studies tried to understand the knowledge and readiness to integrate AI in their daily practice [6].

Swan investigated the knowledge, attitude, application of AI, and implications among (n = 675) nurses and students in the United States. 72% considered themselves well-oriented, 70% heard about AI applications, and 24% reported well knowledge about AI. Our study's knowledge is less than Swan's results as 40% agreed they have AI knowledge while almost similar in the basic understanding (Table 1) [5, 13]. Interim of attitude, perceptions and implications both studies showed the excitement of the nurses towards integrating AI application in daily work practice. In both studies, more than 70% agreed that AI application would help nurses in work practice with a great understanding of the importance of AI in nurse work [5, 14].

The participants in this study were enthusiastic about incorporating AI into nursing and were aware of the challenges that would have to be overcome; yet, the majority agreed on the role of AI in nursing practice. AI would threaten or disrupt their professional careers, according to 57% of respondents. There could be two reasons for this. First, it's unclear whether this is related to how AI is used in the local nursing context, where the workforce sees no use for it. The second explanation could be a lack of sufficient and in-depth understanding of how AI can be deployed and what it can achieve beyond the widely held perception of x-ray cases being classified as normal or abnormal [4, 9, 15].

Implementing AI applications in nursing could help nurses make clinical decisions; nevertheless, there are a few things to keep in mind. First, AI education is not enough in undergraduate nursing programs and continuous education. Important educational elements should be added, such as clinical information systems, data quality, data standardization, data mining, and data analytics. In the nursing management system, AI technologies can support responsive and evidence-based nursing practice, for example, through visualization of patient trends that can provide insights for both immediate patient care and long-term planning and management. Moreover, nurses should engage with the current research and encourage up-to-date knowledge of the evidence to support practice.

Limitation: A focus group research is also suggested to facilitate a deeper understanding and is anticipated to complement the growing awareness of AI's role in nursing practice.

5 Conclusion

The integration of artificial intelligence into nursing practice will continue to arouse interest; however, there is a lack of understanding of its technical potential. We strongly recommend universities and professional organizations implement appropriate educational and training programs. Nurses need to increase their knowledge of basic AI and understand how it is integrated into nursing practice.

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Data availability Not applicable.

Declarations

Conflict of interest All authors declare that they have no conflicts of interest.

Study approval The University of Sharjah research ethics committee approved the study. All methods and protocols were performed in accordance with the research ethics committee's guidelines and regulations (reference number REC-20-05-06-01).

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