

## Implementation of an Educational Program for Operating Room Nurses to Improve Perception and Attitudes towards Integrating Artificial Intelligence in Nursing Practice

Ekram Mohammed Gomaa Geneedy <sup>(1)</sup>, Waleed El-Sayed Mohammed Hemaïda <sup>(2)</sup> & Enas Ebrahiem Elsayed Aboelfetoh <sup>(3)</sup>

Lecturer of Adult Health Nursing Department (Critical Care Nursing), Faculty of Nursing, Helwan University, Egypt<sup>1</sup>.

Assistant Professor of Critical Care Nursing, College of Applied Medical Sciences Prince Sattam Bin Abdulaziz University, Kingdom of Saudi Arabia<sup>2</sup>.

Assistant Professor of Adult Health Nursing Department, Faculty of Nursing, Helwan University, Egypt<sup>3</sup>.

### Abstract

**Background:** In the fast-changing field of healthcare, incorporating artificial intelligence has tremendous potential to transform nursing practice, especially within the operating room setting. **Aim:** The present research aimed to evaluate the effect of the implementation of an educational program for operating room nurses to improve perception and attitudes toward integrating artificial intelligence in nursing practice. **Research design:** This study employed a quasi-experimental design with a single group assessed before and after the intervention. **Setting:** The study was conducted in the operating department of El-Araby Hospital, affiliated with Menoufia Governorate in Egypt. **Subject:** A convenience sample of all available nurses (n=50) working in the operating room at the previously mentioned facility was selected. **Tools:** The study employed two data collection tools: **Tool I**, a Structured Self-Administered Questionnaire for Nurses, and **Tool II**, the Nurses' Attitude Toward Artificial Intelligence Scale. **Results:** The findings indicate that over two-thirds of the nurses had a poor perception prior to the program's implementation. However, following the program, about three-quarters of the nurses showed a good perception, reflecting a highly significant improvement. Additionally, most nurses initially displayed a negative attitude toward artificial intelligence, but the majority exhibited a positive attitude after the program, highlighting a highly significant change. **Conclusion:** This study provides valuable insights into the critical role of education in influencing nurses' perceptions and attitudes toward integrating artificial intelligence in the operating room. The results reveal a strong, statistically significant correlation between nurses' attitudes and perceptions before and after the program, indicating a highly significant difference. **Recommendation:** Create evidence-based practice guidelines and protocols that define the appropriate use of artificial intelligence technologies in the operating room. Establish multidisciplinary teams that include nurses, technologists, and AI experts to foster cross-disciplinary knowledge exchange and encourage innovative approaches to enhance patient care.

**Key words:** Artificial Intelligence, Attitude, Operating Room Nurses, Perception

### Introduction

The development of computer systems that can carry out activities that normally require human intelligence, such as speech recognition, visual perception, decision-making, and language translation, is known as artificial intelligence (AI). Robotics is the most well-known and beneficial

use of AI. (Buchanan et al., 2020; O'Connor et al., 2022; Von Gerich et al., 2022).

Artificial intelligence application in nursing practice implicates the use of AI technologies to renovate nurses' roles and enhance patient care. AI refers to computers' ability to autonomously process data into knowledge to guide decisions or actions, AI algorithms and

robots are changing the nursing profession by shifting the nurse's role and healthcare delivery. AI applications in nursing include medical diagnostics, personalized treatment plans, patient monitoring, and predictive analytics. The ethical use of AI in nursing emphasizes algorithm transparency, patient privacy, and maintaining human oversight in critical decision-making processes (Brian et al., 2022).

The advancement of AI as a tool for enhancing healthcare offers opportunities to improve the quality of healthcare services, create new possibilities for better patient outcomes, reduce costs, and positively impact human health. This progress supports the development of a sustainable healthcare system. (Smith, Johnson & Lee, 2022). AI is expected to advance robotics and offer valuable information synthesis and recommendations to patients, families, and healthcare teams. It can be defined as a computer's ability to perform tasks typically associated with intelligent beings (Chen, Rodriguez & Williams, 2023).

The swift progression of artificial intelligence technologies is transforming the healthcare landscape, creating groundbreaking opportunities to enhance patient care, diagnosis, and treatment. In this evolving paradigm, the role of nurses as essential members of the healthcare team is increasingly vital (Johnson & White, 2023).

Operating room nurses play a vital role in ensuring patient safety, surgical accuracy, and postoperative care. As AI becomes more integrated into medical practice, it is essential for nurses to be skilled in these technologies and the preparatory processes involved in caring for patients undergoing AI-assisted procedures. Nurses are expected to continuously enhance and update their skills to keep pace with this evolving technology. Adapting to change and transformation is crucial for nurses to meet the demands of an evolving healthcare environment (Ergin et al., 2023).

Attitudes toward AI usage in healthcare are subject to debate. Unlike healthcare providers, patients and their families have received

comparatively less attention regarding their views on AI. Nurses' perceptions serve as a strong indicator of organizational readiness and consideration of requirements in this new era of technological advancement. Identified awareness acts as a key indicator of usage and acceptance, offering valuable insights for designers to refine technology features and purpose (Alami et al., 2020).

### The Significance of the Study:

Building a comprehensive understanding of AI's potential in nursing practice requires implementing a customized educational program for operating room nurses. The attitudes and opinions of healthcare workers, particularly nurses, play a significant role in the successful integration of AI in nursing. (Smith, Johnson & Lee, 2022).

A positive perception of AI among nurses can enhance patient outcomes, boost efficiency in healthcare processes, and elevate the quality of care. Conversely, skepticism or resistance may obstruct AI adoption, limiting the achievement of its potential benefits (Sabra et al., 2023). Egypt is actively integrating artificial intelligence and technology across multiple sectors, including healthcare, as part of its Vision 2030 initiative. The government is promoting AI growth through research and development, aiming for AI and robotics to contribute 7.7% of the country's Gross Domestic Product by 2030. This strategy seeks to foster a society driven by AI and robotics (Egypt's Artificial Intelligence Future, 2020). A comprehensive educational program acts as a catalyst to align nurses' knowledge, perceptions, and attitudes with the transformative potential of AI in the operating room.

### The Aim of the Study

This study aimed to evaluate the effect of implementing an educational program for operating room nurses to improve their perceptions and attitudes toward integrating artificial intelligence in nursing practice, through the following objectives:

1. Assessing operating room nurses' perceptions and attitudes toward the

integration of artificial intelligence in nursing practice.

2. Designing an educational program for operating room nurses to support the integration of artificial intelligence in nursing practice.
3. Implementing the educational program for operating room nurses to facilitate the integration of artificial intelligence in nursing practice.
4. Evaluating the program's effect on improving operating room nurses' perceptions and attitudes toward integrating artificial intelligence in nursing practice.

#### Research Hypothesis:

The hypothesis proposed that implementing an educational program for operating room nurses on integrating artificial intelligence in nursing practice would lead to a significant positive improvement in nurses' perceptions and attitudes, as measured by **Tool I and Tool II**.

#### Subjects and methods

##### Research design:

A quasi-experimental design with a one-group pre/post assessment was used for this study.

##### Study Setting:

This study was conducted in the operating department of El-Araby Hospital, which is affiliated with Menoufia Governorate in Egypt. The operating department is located on the second floor and consists of six rooms: the first room is designated for cardiac surgery, the second for orthopedic surgery, and the remaining rooms are used for other types of surgeries. The department typically handles an average of 25 surgeries per day.

##### Sample:

A convenience sample was used, including all available nurses (n=50) of both genders who were present at the start of the study and working in the operating room at the aforementioned facility. The nurses held various qualifications, including diploma nursing, technical institution certificates, and bachelor's degrees, and had diverse ages and levels of experience.

##### Tools applied:

The following two tools were used to collect data for the study:

**Tool 1: Nurses' Structured Self-Administered Questionnaire:** Developed by the researchers, this tool consists of two parts:

**Part I: Nurses' personal and professional data:** This section assessed demographic characteristics and included ten items: age, gender, qualification, marital status, years of experience as an operating room nurse, current role in the operating room, and any training courses related to artificial intelligence.

#### Part II: Nurses' Perception of Artificial Intelligence scale

It was adapted from **Abdullah & Fakieh, (2020)** it was used to assess the nurses' perception of using AI in the operating room. This scale includes 14 questions classified under three subscales; Subscale one: knowledge of nurses about AI. It contains 4 questions. Subscale two: Advantages of using AI. It contains 5 questions. Subscale three: The application of AI in health care. It includes 5 questions. The scoring of perception of AI scale was as follows; 1 = strongly disagree 5 = strongly agree". The sums of the scores according to the three subscale; were as follows 0 - ≤ 50 was considered as low perception, a score of 51 - ≤ 70 was considered as moderate perception level and a score of ≥ 70 was considered as high perception

#### Tool II: Nurses' Attitude of Artificial Intelligence scale

It was adapted from **Sindermann et al., (2021)**. It assessed the operating room nurses' attitude towards integrating AI in Health care. It included 20 items, and each item was scored on a 5-point Likert scale, with 1 indicating strongly disagree, 2 indicating agree, 3 indicating neutral, 4 indicating agree, and 5 indicating strongly agree. The item scores were totaled and divided by the number of items to yield a mean score. A low score of ≤ 60% reveals a negative attitude towards AI, whereas a high score of ≥ 61% reveals a positive attitude towards artificial intelligence (**Elsayed and Sleem, 2021**).

### Validity and Reliability:

The validity of the instruments was evaluated by a panel of five specialists from the Medical-Surgical Nursing faculty staff to ensure their clarity, relevance, comprehensiveness, simplicity, and applicability. Minor adjustments were made based on their feedback. The reliability of the instruments was assessed statistically using Cronbach's alpha test, which yielded a score of 0.847 for the nurses' perception scale and 0.860 for the nurses' attitude scale, indicating that the tools were highly reliable.

### Field work of research implementation

#### Administrative design

The necessary official approvals were obtained from the director of El-Araby Hospital for conducting the study.

### Ethical considerations

On March 10, 2023, the Helwan University Faculty of Nursing's research ethics committee gave ethical permission for the study's conduct under code number 36. The investigated nurses received thorough information about the study and their involvement before providing their informed consent, and participation in the study is completely voluntary. Clarifying the purpose and nature of the study, emphasizing the option to withdraw at any time, and guaranteeing the confidentiality of the data—which would not be available to third parties without the participant's consent—were among the ethical issues. Beliefs, culture, ethics, and values will all be taken into account.

### Pilot study:

In order to assess the study's feasibility and the instruments' application, as well as to gauge the amount of time required to complete the study tools, a pilot study was conducted on 10%

of the participants. After the pilot study, no changes to the study instruments were required. The results of the pilot study did not lead to any changes in the data collection methods. Thus, nurses who took part in the pilot trial were part of the research.

### The educational program phases

Data collection took about 6 months starting from November 2023 till April 2024. The educational intervention for artificial intelligence was implemented according to the following phases:

#### 1-Assessment and planning phase:

The tools were developed by the researchers based on reviewing the recent and related literature. Two tools questionnaires were used to assess nurses' perceptions and attitudes toward integrating artificial intelligence into nursing practice. Once the approval was taken to carry out the study the researchers, started to collect data and implement the educational program.

#### 2-The implementing phase of the AI

At the beginning of the educational program, the researchers assessed the needs of the studied nurses regarding their perception and attitudes towards integrating artificial intelligence in nursing practice. Then, the studied nurses receive a booklet about an educational program regarding integrating artificial intelligence in nursing practice, which is illustrated and applicable by the three researchers using (handout & PowerPoint....etc.).The methods of teaching used were lecturing followed by focus group discussion in addition to audiovisual materials. Educational program sessions were conducted by the researchers which included 3 sessions. The sessions were conducted in the day and night shifts. The total number of the studied nurses was 50 nurses; it was difficult to gather all the nurses at one time, so nurses were divided into five groups, each group with about 10 nurses, and the educational program was

implemented on two days for each group separately in the same suitable time for each one of them. Nurses' structured self-administered questionnaire was filled by the nurses themselves during their free time before educational program implementation to assess their demographic characteristics and their level of perception and attitudes towards integrating artificial intelligence in nursing practice, it took about 15 - 20 minutes to be fulfilled. The study tools were filled two times before the educational program implementation; and immediately after the educational program implementation. The educational program; is a booklet in Arabic language, based on recent related literature derived from **Simon, G.&Aliferis, C. (2024)** it gives insight for integrating artificial intelligence in nursing practice. Nurses handled the educational program booklet, with some explanations from the researchers regarding its importance.

#### Guidelines sessions:

1. The instructional guidelines sessions focused on theoretical knowledge, as follows:  
During the first session, nurses completed a standardized self-administered questionnaire and received an overview of AI and integration. Artificial intelligence in operating rooms takes several forms. It took roughly 30 minutes.
2. The second session focused on presenting graphics and instances of AI integration, surgical robots, and their benefits. It took around 30 minutes.
3. The final session covered AI approaches for assisting operating room nurses. It took around 30 minutes.
4. Researchers conducted the study both day and night shifts three days a week for four weeks

#### Methods of Teaching:

(1) Presentation: This strategy increases the likelihood of job completion on time and lesson execution as planned.

(2) Group discussion: This approach of instruction has the greatest potential for increasing learners' self-esteem and thus improving their performance.

**Media used for teaching:** illustrated booklet, computer, and banner.

#### Evaluation phase of the AI program

After the educational program, its efficacy was evaluated by analyzing nurses' perceptions and attitudes regarding incorporating artificial intelligence into nursing practice and comparing pre- and post-implementation.

#### Statistical design:

A personal computer (PC) was used to enter, code, and revise the data that was gathered from the analyzed sample. The Statistical Package for Social Sciences (SPSS) version 22 was used to do statistical analysis and computerized data entry. Descriptive statistics were used to display the data as Mean SD, percentages, and frequencies. A statistical relationship between two variables is indicated by a correlation coefficient, sometimes known as the "Pearson correlation." A statistical method for figuring out the link between categorical variables is the chi-square ( $\chi^2$ ) test. A non-parametric method for comparing the observed frequencies of categorical data is the chi-squared test. The value of one variable is predicted by linear regression analysis based on the value of another.

#### Results

**Table (1):** reveals that 48% of the studied nurses were between 25 - <30 years with a mean age of 27.04 (SD = 2.54). As well as 82% of the participants were female. Regarding educational background, 58% of the nurses held a bachelor's degree in nursing. Concerning professional experience, the mean years of overall nursing experience were 5.24 years (SD = 1.87), while the mean years of experience as an operating room

nurse specifically were 4.06 years (SD = 1.63). A significant portion of the nurses, 74%, reported working in rotating day/night shifts, and 72% held the staff nurse position. Examining the current roles in the operating room, 44% of the nurses work as scrub nurses. Concerning training in artificial intelligence related to nursing practice, only 10% of the participants reported attending training courses on this subject.

**Table (2):** shows that 78% of the studied nurses had a poor perception related to the concept of AI, whereas 68% demonstrated a good perception post- program implementation, indicating a highly significant difference at  $p < 0.01$ . Concerning the advantages of using AI, 74% of the studied nurses had a poor perception pre- program implementation, while 76% of them showed a good perception post- program implementation with a highly significant difference at  $p < 0.01$ . Additionally, in terms of the application of AI in healthcare, 70% of studied nurses had a poor perception pre- program implementation, but 70% of them exhibited a good perception post- program implementation, showing a highly significant difference at  $p < 0.01$ .

**Figure (1):** illustrates that 72% of the studied nurses had a poor perception before the program implementation, whereas more than three-quarters 78% of them demonstrated a good perception post- program implementation, indicating a highly significant difference at  $p < 0.01$ .

**Table (3)** clarifies that 76% of the studied nurses had a negative attitude related to the perceived benefits and opportunities of artificial intelligence integration in the operating room pre- program implementation, while the majority 86% exhibited a positive attitude with a highly significant difference at  $p < 0.01$ . In the concerns and challenges domain, 82% of nurses had a negative attitude pre- program implementation, whereas 90% showed a positive attitude post- program implementation with a highly significant difference at  $p < 0.01$ . Similarly, in the ethical and

moral considerations domain, 80% of nurses had a negative attitude pre- program implementation, while 84% displayed a positive attitude post- program implementation, with a highly significant difference at  $p < 0.01$ . Additionally, in the future outlook domain, 78% of nurses had a negative attitude pre- program implementation, but post- implementation, 86% exhibited a positive attitude, demonstrating a highly significant difference at  $p < 0.01$ .

**Figure (1):** depicts that 80% of the studied nurses exhibited a negative attitude before the program implementation, while the majority of 88% demonstrated a positive attitude post- implementation, showing a highly significant difference at  $p < 0.01$ .

**Table (4):** reveals a highly significant correlation between nurses' attitudes and nurses' perceptions pre- program implementation, with a significant difference at  $p < 0.01$ . As well there was a highly significant correlation between nurses' attitude and nurses' perception post- implementation, with a significant difference at  $p < 0.01$ .

**Table (5):** stated that there is high significant model related Nurses' Perceptions with 41% detected through R2 .41. Also, high education level, increased years of experience as an operating room nurse, and attended training courses had positive significant predictor effects on Nurses' Perceptions with B score .326, .299 and .314, respectively. Also, age and years of experience in nursing had positive predictors with B scores of .198 and .210.

**Table (6)** stated that there is high significant model related to Nurses' attitudes with 44% detected through R2 .44. Also, high education level, and attended training courses had a positive significant predictor effect on Nurses' attitudes with a B score of .416 and .341, respectively. Also, years of experience in nursing and years of experience as an operating room nurse had positive predictors with B scores of .203 and .240.

**Table (1) Distribution of studied nurses related to their personal and professional data (n=50).**

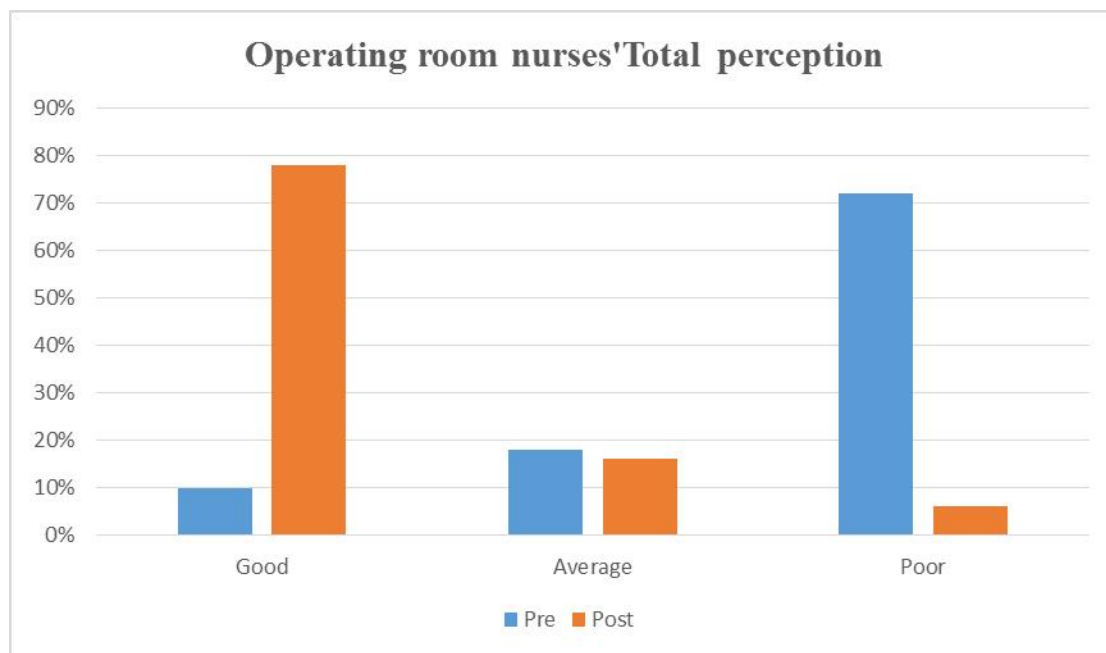
Items	No	%
<b>Age:</b>		
20 -<25	16	32
25 - <30	24	48
30 - 35	7	14
>35	3	6
<b>Mean (SD)</b>	<b>27.04 (2.54)</b>	
<b>Gender:</b>		
Male	9	18
Female	41	82
<b>Marital status:</b>		
Married	24	48
Unmarried	26	52
<b>Education level:</b>		
Diploma Nursing	16	32
Bachelor degree	29	58
Master degree	5	10
<b>Experience in nursing:</b>		
1 – 5	28	56
6 – 10	18	36
11- 15	4	8
<b>Mean (SD)</b>	<b>5.24 (1.87)</b>	
<b>Years of experience as an operating room nurse:</b>		
1 – 5	38	76
6 – 10	9	18
11- 15	3	6
<b>Mean (SD)</b>	<b>4.06 (1.63)</b>	
<b>Working shifts:</b>		
Day shifts	7	14
Night shifts	6	12
Rotating day/night shifts	37	74
<b>Job title:</b>		
Staff nurse	36	72
Charge nurse	9	18
Head nurse	4	8
Supervisor	1	2
<b>Current role in the operating room:</b>		
Scrub nurse	22	44
Circulating nurse	13	26
Anesthesia nurse	15	30
<b>Formal training or education related to AI in nursing practice:</b>		
Yes		
No	5	10
	45	90
<b>Benefit from attending the training:</b>		
Yes	11	100
No	0	0

**Table (2): Comparison of the studied Nurses' Perceptions toward utilization of AI in operating room Subscales pre and post- implementation (n=50)**

Items	Pre		Post		Chi-square	
	No	%	No	%	X2	p. value
<b>Knowledge of AI:</b>						
Good	4	8	34	68	12.660	<b>0.001**</b>
Average	7	14	11	22		
Poor	39	78	5	10		
<b>The advantages of using AI:</b>						
Good	5	10	38	76	10.731	<b>0.003**</b>
Average	8	16	8	16		
Poor	37	74	4	8		
<b>The application of AI in health care:</b>						
Good	4	8	35	70	13.096	<b>0.000**</b>
Average	11	22	11	22		
Poor	35	70	4	8		
<b>Total perception:</b>						
Good	5	10	39	78	14.067	<b>0.000**</b>
Average	9	18	8	16		
Poor	36	72	3	6		

\*significant <0.05, \*\* high significant <0.01



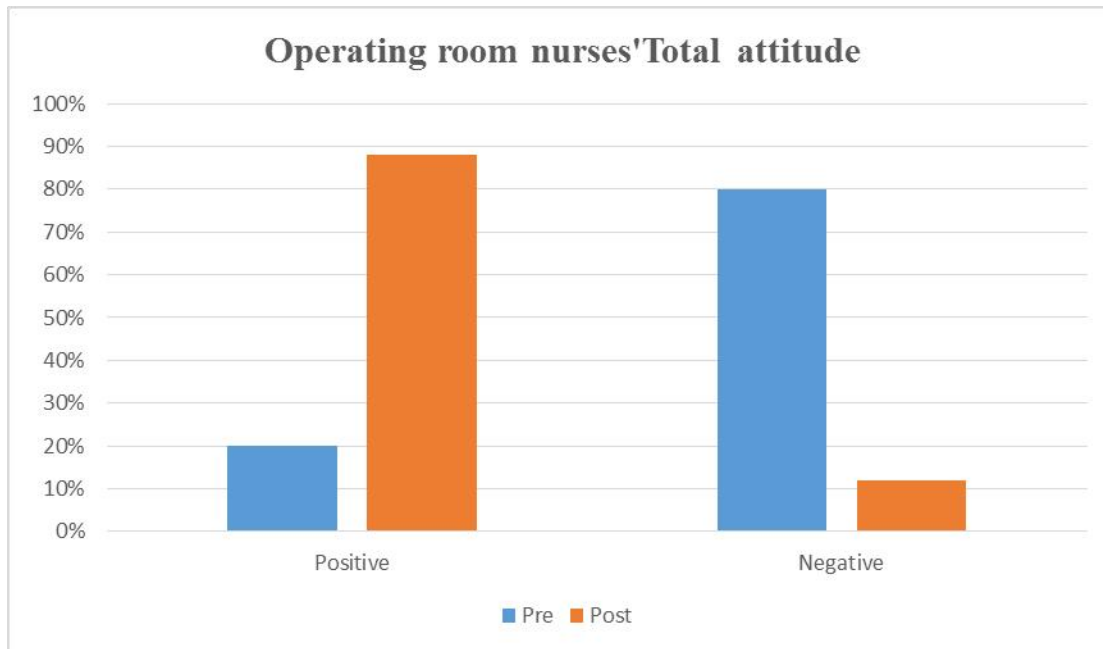


**Figure (1):** Percentage distribution of the studied nurses' total perception regarding the integration of artificial intelligence in the operating room

**Table (3): Comparison of Operating Nurses' attitude toward utilization of AI in health care Subscales pre and post -intervention (n=50)**

Items	Pre		Post		Chi-square	
	No	%	No	%	X <sup>2</sup>	p. value
<b>Perceived Benefits and Opportunities:</b>						
Positive attitude	12	24	43	86	11.724	<b>0.001**</b>
Negative attitude	38	76	7	14		
<b>Concerns and Challenges:</b>						
Positive attitude	9	18	45	90	12.906	<b>0.000**</b>
Negative attitude	41	82	5	10		
<b>Ethical and Moral Considerations:</b>						
Positive attitude	10	20	42	84	10.401	<b>0.003**</b>
Negative attitude	40	80	8	16		
<b>Future Outlook:</b>						
Positive attitude	11	22	43	86	13.355	<b>0.000**</b>
Negative attitude	39	78	7	14		
<b>Total attitude:</b>						
Positive attitude	10	20	44	88	16.293	<b>0.000**</b>
Negative attitude	40	80	6	12		

\*significant <0.05, \*\* high significant <0.01



**Figure (2):** Percentage distribution of the studied nurses' total attitude regarding the integration of artificial intelligence in the health care

**Table (4):** Correlation between the studied Nurses' Attitudes and Nurses' Perceptions pre-&post program implementation

Pre intervention			Post intervention		
Nurses' Perceptions	Nurses' Attitude		Nurses' Attitude		
	r	P	Nurses' Perceptions	r	p
	0.521	0.001**		0.714	0.000**

\*significant <0.05, \*\* high significant <0.01

**Table (5): Multiple Linear regression model for the studied Nurses' Total Perceptions post-intervention (n=50).**

Items		Unstandardized Coefficients	standardized Coefficients		
		<i>B</i>	<i>B</i>	<i>T</i>	<i>P. value</i>
Age		0.198	.127	2.113	<0.05*
Educational level (High)		0.326	.273	4.026	<0.01**
Years of experience in nursing		0.210	.148	2.879	<0.05*
Years of experience as an operating room nurse		0.299	.246	4.229	<0.01**
Attended training courses (Yes)		0.314	.259	5.067	<0.01**
Model	R <sup>2</sup>	Df.	F	P. value	
Regression	0.41	4	7.890	<0.01**	

**a. Dependent Variable:** total Nurses' Perceptions

**b. Predictors:** (constant): Age, Educational level (High), Years of experience in nursing, Years of experience as an operating room nurse, Attended training courses (Yes)

**Table (6): Multiple Linear regression model for the studied Nurses' Total Attitude post-intervention (n=50).**

Items	Unstandardized Coefficients	standardized Coefficients		
	<i>B</i>	<i>B</i>	<i>T</i>	<i>P. value</i>
Age	-0.199	0.136	2.472	<0.05*
Educational level (High)	0.416	0.383	5.590	<0.01**
Years of experience in nursing	0.203	0.165	2.956	<0.05*
Years of experience as an operating room nurse	0.240	0.197	3.015	<0.05*
Attended training courses (Yes)	0.341	0.299	4.102	<0.01**
Job title (Staff nurse)	-0.186	0.143	2.650	<0.05*
Model	R <sup>2</sup>	Df.	F	P. value
Regression	0.44	5	9.018	<0.01**

**a. Dependent Variable:** total Nurses' attitude

**b. Predictors:** Age, Educational level (High), Years of experience in nursing, Years of experience as an operating room nurse, Attended training courses (Yes), Job title (Staff nurse)

## Discussion

Artificial intelligence (AI) has the potential to enhance nursing practice by increasing efficiency, precision, and the overall quality of care, especially in operating room settings. It helps alleviate workloads, allowing nurses to focus more on patient care and critical decision-making. Recognizing the importance of AI integration, nurses have expressed the need for appropriate training, actively pursuing opportunities to deepen their understanding and exhibiting a forward-thinking approach to embracing technological advancements (Khan

Rony et al., 2024). The nursing profession faces growing challenges driven by demographic changes and a shortage of skilled staff. Artificial intelligence (AI) offers promising solutions to alleviate these pressures and reduce stress levels among nurses. However, the initial attitudes and perceptions of nurses toward AI play a crucial role in ensuring its successful implementation and acceptance within the healthcare environment (Sommer et al., 2024). Perceptions and attitudes toward technology are critical factors that can influence its adoption and overall success. Despite their importance, there is a notable gap in research exploring whether measurable differences exist in

how nursing staff perceive and approach the integration of artificial intelligence (AI). This study aimed to address this gap by assessing the impact of an educational program on operating room nurses' perceptions and attitudes regarding the integration of AI into nursing practice.

The present study examined the personal and professional characteristics of the participating nurses and found that slightly less than half were aged between 25 and 30 years, with a mean age of 27.04 years (SD = 2.54). Additionally, slightly more than three-quarters of the participants were female. Regarding educational qualifications, over half of the nurses held a bachelor's degree in nursing. The average total nursing experience was 5.24 years (SD = 1.87), while the mean experience as operating room nurses was 4.06 years (SD = 1.63). A significant proportion of the nurses, approximately three-quarters, reported working rotational day and night shifts. Regarding their current roles in the operating room, less than half were serving as anesthesia nurses, and only a small number had attended training courses related to the integration of AI. The findings also suggested a decline in the number of nurses with increasing age and years of experience, indicating higher turnover or role transitions among older, more experienced staff. Furthermore, the prevalence of rotational shifts was a notable factor influencing their work patterns.

These findings align with the research conducted by **Eminoğlu and Çelikkanat (2024)**, titled "Assessment of the Relationship between Executive Nurses' Leadership Self-Efficacy and Medical Artificial Intelligence Readiness." Their study revealed that the majority of participants were female, held a bachelor's or higher degree in nursing, had six or more years of professional experience, and around three-quarters worked primarily during the day shift. Similarly, these results are consistent with the quasi-experimental study by **Ergin et al. (2023)**, "Can Artificial Intelligence and Robotic Nurses Replace Operating Room Nurses?" This study found that most operating room nurses in their sample were women, over three-quarters held an undergraduate degree, and slightly less than half had between 1 and 10 years of operating room experience. Both studies highlight similar demographic and

professional trends, underscoring the shared characteristics of nursing populations across different research contexts.

These findings are further supported by the study conducted by **Abd-Elmonem et al. (2023)**, titled "Artificial Intelligence Technology and its Relation to Staff Nurses' Professional Identity and Problem-Solving Abilities." Their research revealed that over two-fifths of the staff nurses were aged between 25 and 30 years, with the majority being female and married. Additionally, more than one-third of the participants held an associate degree in nursing. In terms of professional experience, slightly less than half of the nurses had 5 to 10 years of experience. Interestingly, the study also highlighted that most participants did not work in private hospitals utilizing artificial intelligence technology, indicating a potential gap in exposure to advanced technological environments within certain healthcare sectors. These findings align closely with the demographic and professional characteristics observed in the present study.

In contrast, this finding differs from the results of **Mohamed et al. (2023)** in their study, "Effect of Artificial Intelligence Enhancement Program on Managerial Competencies and Workplace Flourishing for Head Nurses." Their analysis showed that all participants were aged between 40 and 50 years, with a mean age of  $40.53 \pm 4.918$ . Additionally, the majority of the nurses held a bachelor's degree in nursing and had an average of 15 years of professional experience.

These discrepancies highlight the variations in demographic and professional characteristics among nursing populations, which may be influenced by differences in study settings, the specific nursing roles targeted, and the focus on head nurses in Mohamed et al.'s research. In the context of operating room nurses' perceptions towards the integration of Artificial Intelligence (AI) into nursing practice, the current study found that slightly more than three-quarters of the nurses initially held a poor perception of AI before the program implementation. However, following the program, more than half of the nurses demonstrated a positive shift, showing a good perception of AI. This improvement can likely be

attributed to the fact that most of the nurses in the study had not previously participated in AI training, and their nursing curriculum did not cover the fundamentals of AI. Prior to the educational program, these nurses had limited exposure to AI in their practice. Post-program, however, their understanding and awareness of AI applications relevant to operating room nursing increased significantly. They became more receptive to incorporating AI tools into their daily tasks and recognized the potential for AI to enhance or even substitute certain aspects of their work, improving their readiness to embrace technological advancements in their practice.

The findings of this study align with those of **Abuzaid et al. (2022)** in their research, "Artificial Intelligence Integration in Nursing Practice," which highlighted an insufficient understanding and perception of AI principles and its technical potential within the nursing profession. The study concluded that there is a critical need for higher education institutions and healthcare organizations to develop and implement comprehensive AI education and training programs for nursing staff. This would enhance nurses' competencies and promote the safe and effective integration of AI into nursing practice.

Similarly, **Al-Sabawy (2023)** in "Artificial Intelligence in Nursing: A Study on Nurses' Perceptions and Readiness" reported that nurses' understanding of AI varied significantly. A substantial portion, nearly a quarter of the nurses, had no knowledge of AI, while less than one-fifth were familiar with AI but lacked confidence in applying it practically. Interestingly, around one-fifth of nurses not only felt comfortable with the concept of AI but were also optimistic about its integration across all areas of nursing practice. These studies reinforce the importance of targeted education and training to address gaps in AI knowledge and improve readiness for its integration into nursing workflows.

In terms of professional perceptions, AI was viewed positively in a survey conducted by **Shinners et al. (2021)**, titled "Exploring Healthcare Professionals' Opinions of Artificial Intelligence," where the concept of AI was rated 3.66 out of 5. The survey indicated that the agreement was particularly higher among healthcare professionals who had prior knowledge of and interest in AI. Affirmative responses suggested that these professionals not only understood the concept of AI but also expressed a desire for further training or indicated that they had already received AI education. These findings suggest that training plays a significant role in increasing healthcare professionals' awareness and sensitivity to how AI can be beneficial in clinical practice, highlighting the importance of education in fostering acceptance and integration of AI technologies.

The results of this study contrast with the findings of **Catalina et al. (2023)** in their research "Knowledge and Perceptions of Primary Healthcare Practitioners on The Usage of Artificial Intelligence as a Healthcare Tool." Their study revealed that most healthcare professionals believed they understood the concept of AI and were already using it in their practice. However, it also highlighted that despite this general understanding, the Catalan Institute of Health, which serves 5.8 million people in Catalonia, is still in the early stages of validating AI models used in imaging and integrating them into consultations. This suggests that while professionals may have a theoretical understanding of AI, its practical and widespread application is still in the developmental phase within certain healthcare settings, pointing to ongoing efforts to refine and adopt AI technologies in clinical environments.

Furthermore, this finding contradicts the results of **Elsayed and Sleem (2021)** in their study, "Attitudes and Perceptions of Nurse Managers about The Use of AI in Healthcare Settings," which revealed that more than three-quarters of the sample had a moderate perception of using AI in nursing settings. In contrast, only a minority of nurses had a high perception of AI's potential. Similarly, **Abdullah and Fakieh (2020)** conducted a study titled "Perceptions of Artificial

Intelligence Applications by Healthcare Workers: A Survey Study," which found that healthcare workers generally had a moderate perception of AI. These studies suggest that, while some healthcare professionals are open to AI, their perceptions remain cautious, with many expressing a balanced view of its benefits and limitations in practice.

In the context of the advantages of using AI, approximately three a quarter of the studied nurses had a poor perception pre- program implementation, while the same present showed a good perception post-program implementation with a highly significant difference, this may be due to the studied nurses' viewing after receiving the training that the implementation of AI can improve nursing practice in the operation department, AI technologies can enhance the precision and accuracy of surgical procedures, AI-assisted imaging, and diagnostics can help identify and locate critical structures more accurately during surgery, can provide real-time data analysis and decision support to assist surgeons during complex procedures, as well as AI algorithms can help predict potential complications and suggest optimal courses of action during surgery, AI can minimize risks associated with surgeon fatigue and stress, improving overall patient safety, utilizing AI can lead to faster and more accurate post-operative data analysis for research and quality improvement and the use of AI in the operating room can lead to a reduction in human errors during surgery.

The findings of this study are supported by the research of **Porto & Catal. (2021)**, who found that the majority of operating room nurses had positive perceptions of robotic surgery in their study "A Comparative Study of the Opinions, Experiences, and Individual Innovativeness Characteristics of Operating Room Nurses on Robotic Surgery." Almost all of the operating room nurses involved in robotic surgery valued the technology and expressed excitement about being part of it. Similarly, **Kang et al. (2016)** gathered data that aligns with these findings, showing that, despite the demanding nature of their work, operating room nurses were enthusiastic about being part of a team that utilized advanced surgical technology. This

highlights a shared optimism among operating room nurses about the potential of new technologies, including AI and robotic systems, to improve patient outcomes and the overall surgical process.

This result is consistent with the findings of **Mohammed et al. (2023)** in their study, "The Effect of Educational Programs on Nurses' Knowledge and Attitude Regarding Artificial Intelligence," which showed that nurses' general knowledge significantly improved shortly after the introduction of the educational program. The increased satisfaction and positive attitudes toward AI could be attributed to nurses' enhanced understanding of AI's benefits and applications. Through the AI educational intervention, nurses gained insight into how AI could assist in various aspects of their practice, such as observing their environment, recognizing objects, supporting decision-making, resolving conflicts, planning actions, learning new things, and solving complex problems. This suggests that structured educational programs can play a vital role in transforming nurses' perceptions and boosting their confidence in integrating AI into their professional practice.

This result is supported by **Oh et al. (2019)**, who found that nurses believed AI could not be applied to debatable or complex subjects and would not be suitable for every patient. Their study highlighted concerns about the limitations of AI, especially in situations where human judgment and flexibility are required. Similarly, **Sabra et al. (2023)** discovered that less than half of the nurses agreed with the notion that AI is inflexible and challenging to apply due to contentious issues. These findings indicate that while nurses recognize the potential of AI, there are reservations about its adaptability in certain clinical contexts, particularly when dealing with complex or nuanced patient care scenarios.

These findings align with those of **Abdullah and Fakieh (2020)**, who reported that the majority of respondents feared AI might replace human workers and had a general lack of knowledge about AI prior to any educational intervention. Additionally, most respondents were not aware of the common benefits and challenges



of AI applications in the healthcare sector. Their study also revealed that technicians were the most affected by AI applications, as their roles often involve tasks that require minimal direct human interaction.

Similarly, **Elsayed and Sleem (2021)** found that nurse managers had the highest perception of the advantages of using AI, followed by concerns about the challenges related to AI application in healthcare. These results underscore the mixed feelings healthcare professionals have regarding AI, with some recognizing its benefits while others express concern about its potential impact on jobs and the challenges of integrating AI into existing healthcare systems.

Additionally, in terms of the application of AI in healthcare, two-thirds of the studied nurses had a poor perception pre-program implementation, but the same exhibited a good perception post-program implementation, showing a highly significant difference at  $p < 0.01$ . This result may be due to the nurses thought that AI cannot be used to offer ideas in unexpected Conditions, AI is not flexible to be useful for every patient, AI is difficult to apply to arguable subjects and finally AI was established by a specialist with slight clinical experience in medical practice.

The results of this study align with those of **Lambert et al. (2023)**, whose study "The Integrative Review on The Acceptance of Artificial Intelligence among Healthcare Professionals in Hospitals" identified safety as a key factor influencing the acceptance of AI in healthcare. They pointed out that different AI systems pose varying risks of errors, which can significantly affect their acceptance among healthcare professionals. While AI-based prediction systems have been shown to result in fewer errors compared to traditional methods, simpler AI tasks are often perceived as more reliable and trustworthy. In contrast, AI systems performing more complex tasks, such as surgical robotics, may face greater skepticism and resistance.

Additionally, **Elderiny et al. (2024)** discussed in their study "Intensive Care Nurses' Knowledge and Perception Regarding Artificial Intelligence Applications" that one-third of nurses disagreed with the notion that AI applications could replace them in their roles. However, about one-quarter of nurses expressed high hopes for AI applications in healthcare and reported having adequate knowledge of AI. This further emphasizes the varying perceptions among healthcare professionals, where some embrace the potential of AI, while others remain cautious about its ability to fully replace human expertise in complex clinical settings.

This finding is supported by **Swan (2021)**, who explored nursing staff knowledge and attitudes toward artificial intelligence in healthcare settings in the United States. Swan discovered that the majority of nurses lacked understanding or were unfamiliar with the concept of AI in clinical practice. This lack of awareness and knowledge reflects a significant gap in the integration of AI in nursing practice. Similarly, **Castagno and Khalifa (2020)** in their survey "Perceptions of Artificial Intelligence among Healthcare Staff: A Qualitative Survey" found a widespread lack of knowledge about AI and its applications in healthcare. Nearly two-thirds of the participants reported never having encountered AI in their workplace, highlighting the need for more exposure and education about AI in healthcare settings. These studies underscore the importance of educational initiatives to bridge the knowledge gap and increase awareness of AI among healthcare professionals.

Furthermore, time and staff resources may influence the adoption of AI systems in healthcare, according to **McBride et al.'s (2019)** study, "Knowledge and Attitudes of Theatre Staff prior to The Implementation of Robotic-Assisted Surgery in The Public Sector." varied disciplines had varied perspectives on these elements. Medical professionals anticipated that the diagnostic process and operating time would increase with robotic-assisted surgery.

These results opposed those of **Zhou (2022)**, who found that the study produced outstanding results and helped build successful application measures in conjunction with the actual work content. Zhou also stated that the study contributed to the employment of artificial intelligence technology in clinical nursing. These results were in line with those of **Sheela (2022)**, who found that over 50% of participants were already aware of the use of AI in nursing practice.

Regarding operating room nurses' attitudes toward incorporating AI into nursing practice, the current study's findings make clear that, prior to the program's implementation, over three-quarters of the nurses showed a negative attitude toward all aspects before program implementation, including perceived opportunities and benefits, concerns and challenges, ethical and moral considerations, and, finally, the future outlook domain of AI. In contrast, the majority of the nurses showed a positive attitude after the program was implemented, indicating a highly significant difference. This could be as a result of the program's ability to improve nurses' attitudes by demonstrating various areas in which artificial intelligence can be integrated. These results could suggest that training could increase awareness of the ways in which AI can support clinical practice. After implementation, nurses exhibit a negative attitude, most likely as a result of concerns about the change in their jobs and how it would affect patient care.

These results matched with a research paper by **Ghazy et al. (2023)** titled "Perception and Attitudes of Nurse Managers toward Artificial Intelligence Technology at Selected Hospitals," which found that over half of nurse managers had a negative attitude toward using AI. Additionally, they had some concerns and uncertainties about using AI in the healthcare industry due to the heavy workload, which made them more resistant to change.

**Karaarslan et al.'s (2024)** study, "How does Training Given to Pediatric Nurses about Artificial Intelligence and Robot Nurses Affect their Opinions and Attitude Levels?," supports the research's conclusions. According to a quasi-experimental study, the mean scores on the AI

general attitude scale's positive attitudes toward AI subscale were  $3.43 \pm 0.54$  and  $3.59 \pm 0.60$  before and after training, while the mean scores on the subscale measuring negative attitudes toward AI were  $2.68 \pm 0.67$  and  $2.77 \pm 0.75$ , respectively.

likewise, a quasi-experimental study titled "Can Artificial Intelligence and Robotic Nurses Replace Operating Room Nurses?" took place by **Ergin et al. in 2023**. discovered that almost 50% of the operating room nurses who took part thought that robots would lessen their workload. According to the findings of the study "Intelligence and Robot Nurses: from Nurse Managers' Perspective: A descriptive Cross-Sectional Study" by **Ergin et al. (2022)**, more than half of the participants thought that robotic nurses would advance the nursing field. In the study by **Alcan et al. (2021)** exploring nurses' perspectives on robotic surgery, slightly over two-thirds of the participants indicated they would opt for robotic surgery if they required surgery in the future. The findings suggest that incorporating robots to assist nurses can help meet patients' needs more efficiently while enhancing the nurse-patient relationship.

Conversely, this finding was challenged by **Sabra et al. (2023)** in their study titled "Artificial Intelligence Application in Healthcare: Nurses' Views and Attitudes", which demonstrated that participants possessed substantial knowledge about AI. This suggests a positive inclination toward change, which is often characteristic of healthcare environments. Similarly, the current findings were contradicted by **Sommer et al. (2024)** in their study titled "Nurses' Perceptions, Experience, and Knowledge Regarding Artificial Intelligence: Results from a Cross-Sectional Online Survey in Germany." This research revealed that nearly two-thirds of participants viewed AI as a positive potential for nursing, while a smaller portion perceived it as a threat or risk. Negative views were primarily tied to practical concerns, such as the risk of AI malfunctions leading to errors. Additionally, slightly more than one-fifth of respondents were undecided, unable to classify AI positively or negatively, reflecting a lack of sufficient information to form an opinion.

The current study results indicate a highly significant correlation between nurses' attitudes and perceptions before and after program implementation, with a statistically significant difference observed at  $p < 0.01$ . These findings highlight that enhanced knowledge of artificial intelligence directly influenced participants' perceptions after training. Additionally, the healthcare sector is increasingly adopting technology and exploring strategies for its implementation in alignment with Egypt's Vision 2030, also known as "Digital Egypt," which emphasizes digital transformation across all societal sectors. Moreover, educational intervention played a crucial role in positively shaping nurses' perspectives on AI technology.

The study's results align with the findings of **Seada, Etway, and El-Shafay (2022)**, who reported a statistically significant improvement in the total mean scores of managerial competencies. Additionally, the total scores showed a notable increase from the pre- to post-program phases. Moreover, three months after the program's implementation, a statistically significant positive correlation was observed between the immediate post-program phase and the overall knowledge levels.

In addition, this finding aligns with the results of **Abd-Elmonem et al. (2023)**, who reported a highly statistically significant correlation between staff nurses' perceptions of artificial intelligence technology, their professional identity, and their problem-solving abilities. Furthermore, a strong statistically significant relationship was observed between the dimensions of artificial intelligence technology and those of professional identity and problem-solving abilities among staff nurses.

### Conclusion:

In line with the study's findings, operating room nurses' perceptions and attitudes on the incorporation of artificial intelligence in nursing practice have been positively impacted by the educational program in a highly statistically significant way.

### Recommendation:

### The researchers made the following suggestions in light of the current study's findings:

- Develop evidence-based practice guidelines and protocols delineating the appropriate utilization of AI technologies in the operating room.
- Establishing interdisciplinary teams of nurses, technologists, and AI specialists may stimulate information exchange and creative approaches to improve patient care.
- To safely integrate AI into nursing practice, particularly in operating rooms, additional education and training are required.
- Continuing education for operating room nurses can improve patient outcomes by preparing them for the use of AI and robot nursing technologies.

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