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Artificial Intelligence Enhancement Program: Its Effect on Nurse Managers' Professional Identity and Managerial Competencies

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Abstract: Background: The digital transformation of the healthcare sector demands a significant change to secure a competitive edge in the labor market. Recently, artificial intelligence has captured the attention of nurse managers, who are currently discussing whether to fully integrate it into their roles. **Purpose**: To investigate the effect of an artificial intelligence enhancement program on nurse managers' professional identity and managerial competencies. **Research Design**: Quasi-experimental research design with pre-test, post-test, and follow-up. **Setting**: The study was carried out at two distinct hospitals: Menoufia University Hospital and El-Shefa Private Hospital, Menoufia Governorate. **Sample**: All nurse managers at different managerial levels (n=100) in the previously mentioned setting. **Instruments**: First: Managers' knowledge about artificial intelligence questionnaire, (Second): Managers' perception of artificial intelligence questionnaire, (Third): The professional identity scale and (Fourth): the managerial competency assessment scale. **Results**: There was a statistically significant improvement in nurse managers' knowledge level (6.33+1.74 pretest Vs. 11.3 +1.68 posttest), perceptions regarding AI (49.8% pretest Vs. 85.8 posttest), professional identity (58.5+9.81 pretest Vs. 225.4±34.5posttest), and managerial competencies (70.8+18.3 pretest Vs. 143.2+7.80 posttest) **Conclusion**: It was concluded that the artificial intelligence enhancement program has a positive effect on improving nurse managers' knowledge level, perception towards artificial intelligence, professional identity, and managerial competencies. **Recommendations**: Hospital administration should organize workshops and training sessions to advance the culture concerning the implementation of artificial intelligence in healthcare settings.

Keywords: *artificial intelligence program, nurse managers, professional identity, and managerial competencies.*

Introduction:

Over the last few decades, the integration of technology into healthcare systems around the world has grown significantly. As a result, nursing research has increasingly focused on determining the implications of technology for the nursing profession. To effectively use artificial intelligence health technologies (AIHTs), nurse managers must gain a thorough understanding of the interconnected relationships between humans, technology, and the environment. This understanding is critical for meeting the challenges of healthcare in the twenty-first century (Buchanan et al., 2021).

Artificial intelligence refers to techniques for teaching robots to emulate human cognitive functions such as reasoning, learning, communication, and decision-making. According to AI's definition, it encompasses "software and possibly hardware systems designed by humans that, given a complex goal, act in the physical or digital dimension by perceiving their environment through data acquisition, interpreting the collected structured or unstructured data, reasoning on the knowledge derived from this data, and deciding the best action(s) to take" (Von Gerich et al., 2202).

Professional identity (PI) is a nurse's overall professional perception of who she/he is and what she/he can do as a nurse (Toropova et al., 2021). The three main dimensions of professional identity (PI) are professional image, self-responsibility, and assertiveness. The experience of successfully and ethically practicing nursing is known as one's professional image. To build positive self-esteem, a nurse must be self-responsible, which means that in order to improve her or his self-care skills, the nurse must identify their own self-care pattern and make decisions regarding health-promoting techniques (Elkenany et al., 2021).

The third component, assertiveness, encompasses the belief nurses hold in themselves and their abilities. It is considered that this empowers nurses on both a personal and professional level. (Bannur, 2023). Professional identity is a vital element in delivering high-quality care, which ultimately improves patient outcomes. Additionally, it is thought to protect against the damaging effects of a high-stress workplace, boost career satisfaction for nurses, and enhance clinical effectiveness and employment retention (Wei et al., 2021).

The nurse manager is in charge of planning and managing resources, organizing nursing care, encouraging teamwork, evaluating services offered, and contributing to the best possible outcomes for the organization and patients (Scoble et al., 2020). To perform their duties effectively, nurse managers must have managerial skills. These abilities include a combination of knowledge, skills, conduct, and attitude, all of which are required for effectiveness across a wide range of work functions and organizational kinds. Furthermore, these competencies can help to sustain organizational success (Gonzalez Garcia et al., 2020).

Theorists have divided managerial competencies into various categories, including creativity, motivation, influence, accomplishment orientation, teamwork, quality focus, customer focus, problem-solving and decision-making, innovation, and financial management. These categories include talents such as leadership, communication, staff management, analysis, and judgment (Fanelli et al. 2020).

Significance of the study

AI in nursing seeks to support and enhance patient outcomes. Professionals' frustration with the organizational burden can be lessened by technology, which can address issues like inadequate experience or lack of expertise, streamline documentation, and give access to current evidence-based practices to ensure high-quality patient care. Because of their critical role in patient care, nurses are under pressure to stay current with technological innovations in order to meet the growing demand for high-quality, evidence-based procedures. Thus, artificial intelligence (AI) has the potential to improve nursing practices by enabling the effective management of patient data and care, cutting down on administrative job time, and offering real-time decision support (Connor et al., 2023). So, the present study was conducted to investigate the impact of an artificial intelligence enhancement program on nurse managers' professional identity and managerial competencies.

Purpose:

To investigate the effect of an artificial intelligence enhancement program on nurse managers' professional identity and managerial competencies.

- Nurse managers who receive artificial intelligence enhancement program are expected to have higher professional identity after the program than before.
- Nurse managers who receive artificial intelligence enhancement program are expected to have higher professional identity after the program than before .
- Nurse managers who receive artificial intelligence enhancement program are expected to have higher Managerial competencies after the program than before.

Conceptual Framework:

ADDIE, which stands for Analysis, Design, Development, Implementation, and Evaluation, serves as an instructional model to guide the phases of the current study (Reiser & Dempsey, 2018). This model serves as a strategic approach for instructional designers, content developers, and nursing educators to devise an efficient and effective teaching framework. It achieves this by integrating the processes of the ADDIE model into the development of any instructional product.

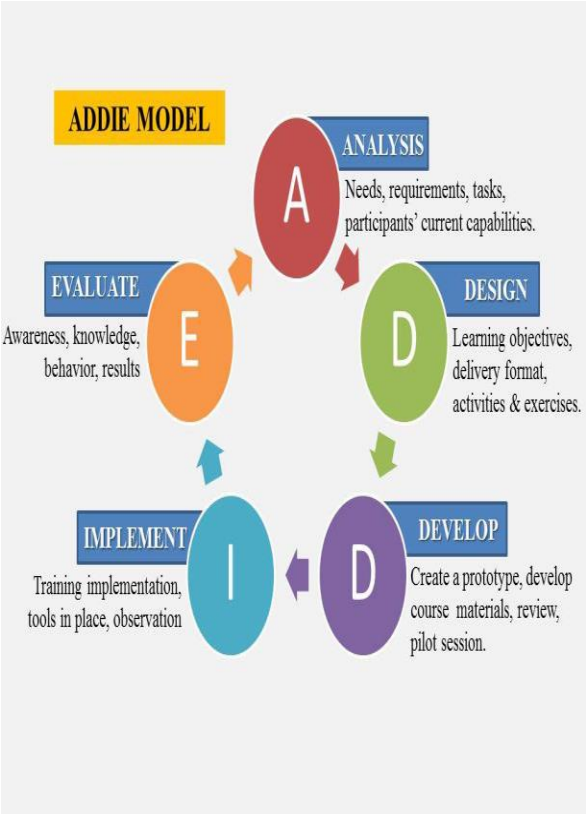

Figure 1: ADDIE model
Source: Reiser and Dempsey (2018).

Methods

Design:

The current study utilized a quasi-experimental research design, incorporating pre-test, post-test, and follow-up.

Setting:

The study was carried out at two distinct hospitals. The first one is Menoufia University Hospital which is governmental. The second is El-Sheafa Hospital, a private hospital, both situated in the Menoufia Governorate, Egypt.

Sample:

All nurse managers at different levels from the previously mentioned settings (n=100) were recruited with a response rate of 100%.

Instruments:

The study utilized four standardized instruments for data collection, originally developed in English. Since the study took place in Egypt, these instruments were translated into Arabic through a method involving both translation and back-translation.

Instrument one: Managers' knowledge about artificial intelligence questionnaire:

it was developed by the researchers after reviewing the relevant literature (Ongena et al., 2020; Shinners et al., 2021; Shimon et al., 2021; Lennartz et al., 2021) to assess the nurse managers' knowledge regarding artificial intelligence.

It consisted of two parts as follows:

- **Part 1** included nurse managers' personal data such as age, gender, educational qualifications, marital status, years of experience in the nursing field, hospital, etc.
- **Part 2** contains 15 multiple-choice questions with 3 multiple-choice answers. The respondents were encouraged to answer all the questions and select the correct answer. It contains questions like the definition of artificial intelligence, kinds or types of AI in healthcare, its benefits, etc.

Scoring system of each item:

each multiple-choice question received a "1" if the participants' answer was correct and a "zero" if it was incorrect. The total score was 15. Total scoring system: Level of knowledge was satisfactory if it was ≥ 60% and

unsatisfactory if knowledge level was < 60 %.

Instrument two: Managers' perception of artificial intelligence scale:

It was developed by Taie (2020) and adopted by the researchers to assess the perception of nurse managers regarding the application of artificial intelligence in nursing. It consisted of 16 items.

Scoring system of each item:

"Agree" (3), "Sometimes" (2) and "Disagree" (1). The total score ranged from 16 to 48. Total scoring system was classified as follows: high level ≥75%, moderate level 60 % - < 75% and low level < 60 %.

Instrument three: The professional identity scale:

It was developed by Ali (2004) and adopted by researchers to assess the professional identity of nurses. It consisted of 56 items under three dimensions, which are assertiveness (25 items), professional image (27 items), and self-responsibility (4 items).

Scoring system:

Items were scored on a 5-point Likert scale ranging from "zero" (strongly disagree) to "4" (strongly agree). The total score was 224. Nurses' professional identity was rated on three levels: high professional identity (≥75%), moderate professional identity (60% - < 75%), and low professional identity (<60%).

Instrument four Managerial competency assessment scale:

It was developed by Tongmuangtunyatep et al. (2015) to assess the level of managerial competencies as perceived by nurse managers. It consisted of 52 items categorized under 5 factors as the following: Leadership (15 items), healthcare environment management (7 items), policy implementation and communication (13 items), management (8 items), and professional ethics (9 items).

Scoring system:

Responses were measured on a 5-point Likert scale as follows: never done (1), seldom done (2), occasionally done (3), almost always done (4), and always done (5). The total score ranged from 52 to 260. Scores were calculated and converted into percentages that reveal the level of managerial competencies as perceived by nurse managers, which are classified as the following: High level of managerial competencies (≥75%), moderate level (60% - < 75%) and low level (< 60%).

Validity:

A panel of two experts from the nursing administration department, two experts from the medical-surgical nursing department, and one expert from the community health nursing department (Faculty of Nursing, Menoufia University) evaluated the tools' face and content validity to make sure that all the items were understandable, pertinent, and covered the material that was typically measured. The necessary adjustments were made as a result. Additionally, the researchers translated

the original instruments into Arabic and then, using back translation, translated the Arabic tools into English and compared them with the original English tools to make sure the translated items were consistent and to find any tool ambiguities or confusion. According to the experts, the instruments were valid.

Reliability:

The reliability of the instruments was assessed using Cronbach's alpha coefficient which was (α = 0.95) for the Managers' nurses Knowledge about Artificial Intelligence questionnaire, (α = 0.94) for the Managers' nurses Perception of Artificial Intelligence questionnaire, (α = 0.95) for the Professional Identity Scale, and (α = 0.97) for the Managerial Competency Assessment Scale.

Pilot Study

A pilot study was carried out to evaluate the questionnaires' feasibility and applicability.

Procedures

An official letter was submitted from the dean of the Faculty of Nursing, Menoufia University to the directors of Menoufia University Hospitals including purpose of the study and methods of data collection. Data collection was lasted from January 2023 to June 2023.

- **Analysis:**

This phase involved gathering pre-test data on nurse managers' knowledge and perception of artificial intelligence, as well as their professional identity and managerial competencies. This was accomplished using AI questionnaires, a professional identity questionnaire, and a managerial competencies assessment scale.

- **Implementation:**

1) The researchers conducted educational program sessions with nurse managers using a variety of teaching methods, including lectures, group discussions, and brainstorming, as well as audiovisual materials such as PowerPoint, flip charts, and whiteboard, and educational activities presented as scenarios. All participating nurse supervisors received presentations on a tablet device, as well as handout booklets.

2) 2.The researchers employed evaluation methods such as participation and discussion during instructional sessions, as well as post-session comments. Three educational sessions (Session 1: Introduction, Concept of Artificial intelligence, Features of Artificial intelligence, Benefits of Artificial intelligence; session 2: Types of Artificial intelligence, Tools of Artificial intelligence, Uses and Implementation of Artificial intelligence in nursing, session 3: Challenges of Artificial intelligence, Shaping the future of care with Artificial intelligence) were held two days per week for four weeks. Participants were separated into small groups (25 nurse managers per session) to maximize learning efficacy and participation while not interfering with everyday job operations. As a result, each day is

divided into four sessions with the same title, each lasting two hours.

- **Evaluation:**

This phase took place using the same pretest instruments to track the desired changes, with a post-test evaluation conducted immediately following program implementation and a follow-up test conducted three months later.

Statistical analysis

An IBM personal computer running the Statistical Package of Social Science (SPSS) version 20 (SPSS, Inc., Chicago, Illinois, USA) was used to gather, tabulate, and statistically analyze the data. Qualitative data were displayed as numbers and percentages, while quantitative data were displayed as mean, standard deviation (SD), and range. The Shapiro-wilk test was used. The paired t test was used for comparison and McNemar tests were used for comparison between related groups having quantitative data. Spearman's correlation (r) was used for correlating quantitative variables. A P-value of <0.05 was considered statistically significant and <0.01 was considered highly statistically significant.

Table 1 showed that the highest percent of the studied sample's age was ≥40 years (53%), were female (63%), and working at inpatient departments (52%). In addition, the highest percentage of the sample studied had bachelor's degrees in nursing (80%), while the highest percentage of the sample studied had experience of more than or equal to 15 years (58%). Furthermore, all the sample studied do not attend training courses related to AI.

Table 2 showed that the majority of nurse managers had satisfactory knowledge regarding AI after implementing the program and at the follow-up phase compared to before implementing the program. In addition, there were high statistically significant differences in the mean scores of nurse managers' knowledge about artificial intelligence before and after implementing the program and between the intervention and the follow-up phase.

Table 3 showed that the total mean scores of nurse managers' perceptions toward using artificial intelligence improved after implementing the program (41.2±3.90) and at the follow-up (36.4±2.32) compared to the pretest phase (23.9±4.42). Additionally, there were high statistically significant differences in the mean scores of nurse managers' perceptions toward using artificial intelligence before and after implementing the program ($p < 0.001$) and between the intervention and the follow-up ($p < 0.001$).

Figure 2 presented that the highest percentage of the study sample (82%) has a low perception level toward professional identity at the pre-test phase. However, the professional identity perception level has been improved to a high level at the post-test phase and becomes moderate at the follow-up phase (76% and 56%, respectively).

Table 4 Illustrated that there were high statistically significant differences in the mean scores of nurse managers' professional identity before and after

implementing the program ($p < 0.001$), and between the intervention and the follow-up phase ($p < 0.001$).

Figure 3 presented that the total level of nurse managers' perceptions toward managerial competencies was low at the pretest phase (78%), and more than half of the sample studied had a high perception level about managerial competencies at the posttest and follow-up phases (51% & 65%).

Table 5 showed that there was a statistically significant improvement in the mean scores of nurse managers' managerial competencies after implementing the enhancement program and after three months at the follow-up phase compared to before the program ($p < 0.001$).

Table 6 showed that there was a statistically significant positive correlation between nurse managers' knowledge regarding artificial intelligence and their professional identity after implementing the program ($r = 0.249$ & $p = 0.012$). Moreover, there was a statistically significant positive correlation between nurse managers' perception regarding artificial intelligence and their professional identity on one side and managerial competencies on the other side ($r = 0.207$, $p = 0.039$ & $r = 0.439$, $p = 0.001$, respectively). Additionally, there was a statistically significant positive correlation between nurse managers' perception regarding AI and their managerial competencies ($r = 0.434$, $p = 0.001$).

Table 7 revealed that following the implementation of the enhancement program, Elsheafa Hospital had a higher overall mean score for nurse managers' knowledge and perception regarding artificial intelligence, professional identity, and managerial competencies than Menoufia University Hospital. These differences between the two hospitals were statistically significant ($p = 0.002$, $p < 0.001$, $p < 0.001$, and $p < 0.001$, respectively).

Table 1: Percentage distribution of sample studied according to personal characteristics (N=100)

Studied variables	No.	%
Age / years		
<30	21	21.0
30 - < 40 years	26	26.0
≥40 years	**53**	**53.0**
Gender		
Male	37	37.0
Female	**63**	**63.0**
Unit		
Critical units	48	48.0
In patient departments	**52**	**52.0**
Qualification		
Bachelor	**80**	**80.0**
Master	20	20.0
Experience		
5 - < 10	23	23.0
10 - < 15	19	19.0
≥ 15	**58**	**58.0**
Are you attending training courses related to AI		
Yes	0	0.00
No	**100**	**100.0**
Hospital		
Menoufia Governmental Hospital	50	50.0
Sheafa Private Hospital	50	50.0

Table 2: Mean scores of nurse managers' knowledge about artificial intelligence throughout the study phases. (N=100):

Studied variables	Pre-	Post-	Follow-up	Test of sig.	P-value
Knowledge Mean±SD	6.33±1.74	**11.3±1.68**	9.89±0.89	F 176.5	**P1:<0.001**** **P2:<0.001**** **P3:<0.001****
Mean percentage	42.2%	**75.3%**	65.9%		
Knowledge	**N (%)**	**N (%)**	**N (%)**	Cochrans Q test	
Unsatisfactory	88(88.0)	2(2.00)	36(36.0)	119.7	<0.001**
Satisfactory	12(12.0)	**98(98.0)**	64(64.0)		

** High significance F: Repeated measures ANOVA

P1: Comparison between pre- and post-

P2: comparison between pre- and follow-up

P3: comparison between post- and follow-up

Table 3: comparison between mean scores and percentage distribution of nurse managers' perceptions of using artificial intelligence throughout the study phases (N=100):

Studied variables	Pre-	Post-	Follow-up	Test of sig.	P-value
AI				F	
Mean±SD	23.9±4.42	**41.2±3.90**	36.4±2.32	192.7	**P1:<0.001** **P2:<0.001** **P3:<0.001**
Mean percentage	49.8%	**85.8%**	75.8%		
Total AI				MH	
Low	88(88.0)	0(0.00)	0(0.00)	9.26	**P1:<0.001**
Moderate	12(12.0)	38(38.0)	69(69.0)	4.34	**P2:<0.001**
High	0(0.00)	**62(62.0)**	31(31.0)	17.6#	**P3:<0.001**

** High significance

F: Repeated measures ANOVA

Bonferroni adjustment for multiple comparisons:

P1: Comparison between pre- and post-

P2: comparison between pre- and follow-up

P3: comparison between post- and follow-up

Figure 2: Total Percentage Levels of Professional Identity Among Nurse Managers Throughout the Study Phases

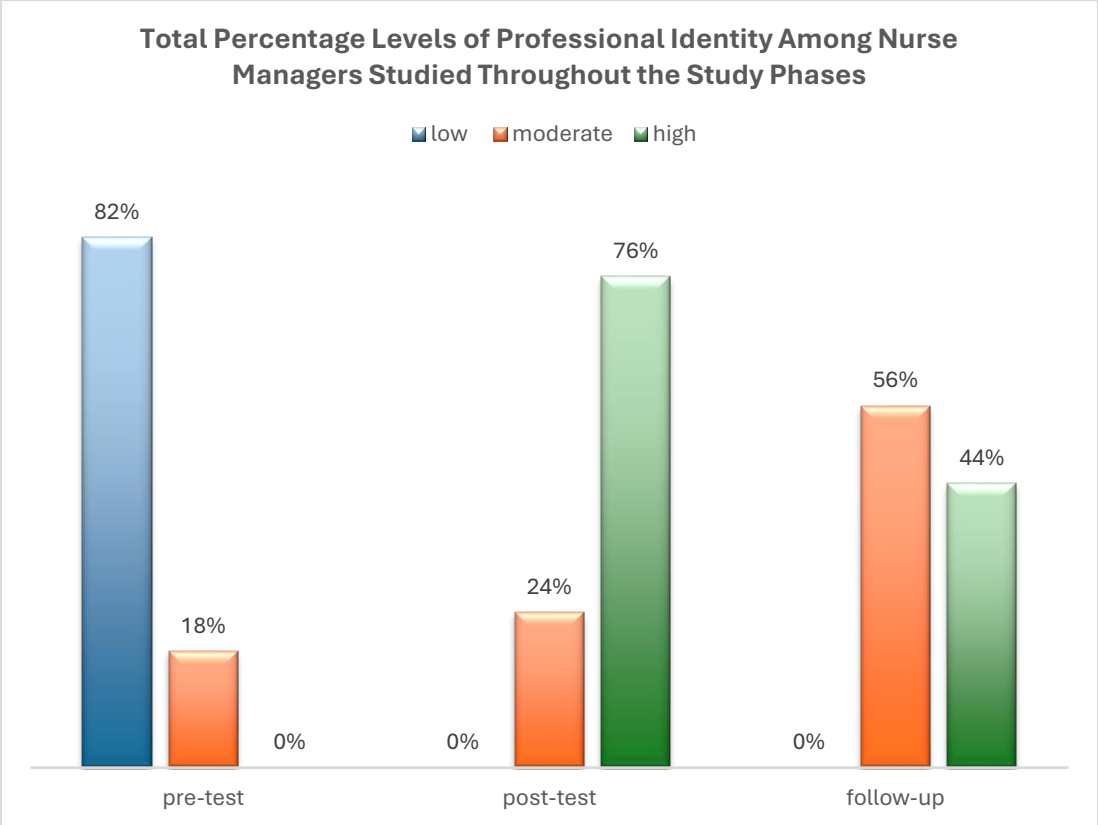

Table 4: Mean scores of nurse managers' perceptions of professional identity throughout the study phases in the selected hospitals (N=100):

Studied variables	Pre-	Post-	Follow-up	F	P-value
Total Professional identity Mean±SD	58.5±9.81	**225.4±34.5**	191.6±30.5	196.0	**P1:<0.001**** **P2:<0.001**** **P3:<0.001****

** High significance F: Repeated measures ANOVA

Bonferroni adjustment for multiple comparisons:

P1: Comparison between pre- and post-

P2: comparison between pre- and follow-up

P3: comparison between post- and follow-up

Figure 3: Total Percentage Level of Managerial Competencies as Perceived by Nurse Managers throughout the Study Phases

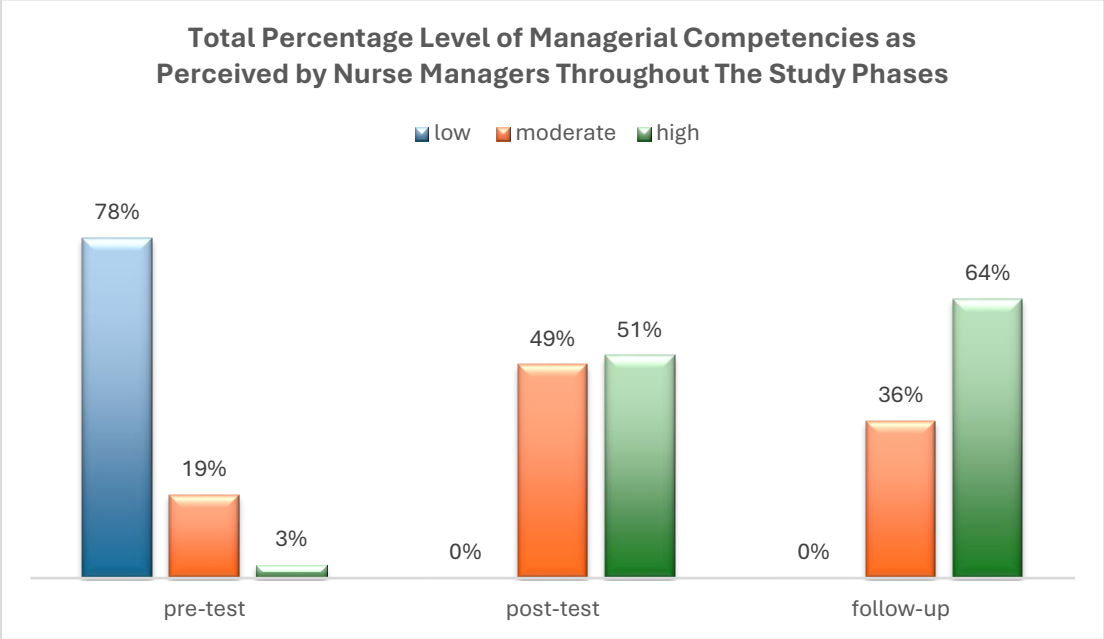

Table 5: Mean scores of nurse managers' perceptions of managerial competencies throughout the study phases in the selected hospitals (N=100):

Studied variables	Pre-	Post-	Follow-up	Paired t-test	P-value
	Mean±SD	Mean±SD	Mean±SD		
Total Managerial Competencies	70.8±18.3	**143.2±7.80**	191.6±30.5	39.3 33.0 15.6	**P1:<0.001**** **P2:<0.001**** **P3:<0.001****

** High significance

P1: Comparison between pre- and post-

P2: comparison between pre- and follow-up P3: comparison between post- and follow-up

Table 6: Correlation between nurse managers' knowledge and perceptions of artificial intelligence, professional identity, and managerial competencies after implementing the program in the selected hospitals (N=100)

Studied variables	Knowledge		AI perception		professional identity		managerial competencies	
	R	P-value	R	P-value	R	P-value	R	P-value
Knowledge	-	-	0.122	0.228	0.249	**0.012***	0.038	0.708
AI perception	0.122	0.228	-	-	0.207	**0.039***	0.439	**0.001****
Professional identity	0.249	**0.012***	0.207	**0.039***	-	-	0.434	**0.001****
Managerial competencies	0.038	0.708	0.439	**0.001****	0.434	**0.001****	-	-

** High significance

Table 7 Comparison between the two hospitals regarding nurse managers' knowledge and perceptions of artificial intelligence, professional identity, and managerial competencies after implementing the program in the selected hospitals (N=100) :

Studied variables	Menoufia Hospital	Elshefa Hospital	t-test	P-value
	Mean±SD	Mean±SD		
Knowledge	10.8±1.70	**11.8±1.51**	3.22	**0.002****
AI perception	39.6±4.36	**42.8±2.52**	4.57	**< 0.001****
Professional identity	203.1±35.1	**247.8±12.7**	8.43	**< 0.001****
Managerial competencies	139.4±8.97	**147.1±3.58**	5.58	**< 0.001****

Discussion:

The digitalization of the healthcare sector requires a dramatic shift in order to gain a competitive advantage in the labor market. Since then, artificial intelligence has been able to catch the interest of important healthcare executives and nurse managers, who are now debating whether to include it in their jobs entirely (Elsayed & Sleem, 2021).

Regarding nurse managers' knowledge about artificial intelligence before the program implementation in the selected hospitals, the current study declared that more than two-thirds of the study participants had unsatisfactory knowledge regarding artificial intelligence pre-implementation of the enhancement program. From the researchers' point of view, this finding can be explained by the fact that most of the participants in the current study were 40 years old or more, and AI is a new topic for them, and it was not included in the curricula of undergraduate nursing programs at that time. Additionally, all nurse managers in the current study didn't attend any training courses related to AI.

The current study findings are in the same line as Elderiny et al. (2024), who revealed that the majority of nurses had an unsatisfactory level of knowledge about AI. Also, in accordance with these results, Abuzaid et al. (2022) discovered that the sample under study lacked sufficient knowledge and comprehension of AI's technological potential and principles in the nursing field. In contrast, the studies conducted by Sabra et al. (2023) and Abd El-Maksoud (2024) confirmed that participants had adequate knowledge regarding AI. Moreover, Sheela (2022) contradicted the present study, who showed that slightly half of the participants had prior knowledge about AI.

According to nurse managers' perceptions of the level of AI before implementing the enhancement program, the current study reveals that the majority of the study participants had a low perception level regarding AI before implementing the program. This may be explained by the fact that the lack of knowledge about the importance and value of AI in improving the healthcare sector may affect their perception regarding AI.

The present study findings are in the same line with Ahmed et al. (2024) and Farghaly et al. (2022), who confirmed that the majority of the participants have high levels of perception of artificial intelligence. Additionally, Habib et al. (2024) who explored that studied sample, held positive perceptions about AI's capabilities and benefits. Moreover, the current study matched with Swan (2021), who reported that the majority of the participants studied were well-oriented, knew, and had high perception regarding AI. In contrast, the current study findings contradicted Elkholy et al. (2024), who revealed that more than two-thirds of the studied sample had a moderate level of perception regarding artificial intelligence.

Regarding the effect of the educational program on nurse managers' knowledge and perceptions about artificial intelligence throughout the posttest and follow-up phases, the current findings affirmed that there were high statistically significant differences in the total mean scores of nurse managers' knowledge and perceptions toward using artificial intelligence before and after the program, also between the intervention and the follow-up. This indicates that the total knowledge and perception level of nurse managers toward AI improved immediately after educational program implementation and three months later at the follow-up phase.

From the researchers' point of view, those findings may be justified as the educational program empowered nurse managers to understand the benefits and advantages of AI when it is incorporated into the nursing practices and its application. Additionally, this preparedness helps them to enhance their background regarding AI, which in turn can improve their perception and encourage them to lead technological integration.

In the same way, Mohamed et al. (2023) concluded that the head nurses' knowledge regarding AI statistically significantly improved after

implementation of the education program about AI. Similarly, Mohamed et al. (2023) showed that all domain scores of nurses' artificial intelligence knowledge before and just after intervention and follow-up showed statistically significant differences.

Concerning the level of nurse managers' professional identity in the selected hospitals before program implementation, the present findings disclosed that the highest percentage of the study subjects had a low level of professional identity in the pre-test phase. This is understandable considering that all the participants possess a bachelor's degree in nursing. Along the same line, Wang et al. (2023) revealed that the studied sample's professional identity scores were the lowest, as the studied nurses' work autonomy is not strong and they have little respect from some patients and families in clinical work, leading to nurses not feeling the value of their work and low personal achievement.

This current finding is contrary to Ageiz et al. (2021), who showed that more than half of the participants had a high level of professional identity prior to the educational program. Additionally, in congruence with current findings, Zhang et al. (2021) reported that the nurses studied had high levels of professional identity at an early level of training. Additionally, this finding is congruent with Abd Elhamed & Elborai (2024), who displayed that more than three-quarters of participants studied had a high level of professional identity.

Regarding the effect of the educational program on nurse managers' professional identity throughout the study phases, the current findings affirmed that there were high statistically significant differences in the total mean scores of nurse managers' professional identity before and after the program, also between the intervention and the follow-up. This indicates that there was a statistically significant improvement in professional identity after educational program implementation and three months later at the follow-up phase compared to the pre-test phase.

From the researchers' point of view, this might be explained by the fact that the provided program helps to create opportunities for different professional groups to learn together and understand one another's abilities and roles better and stay continuously up to date to keep up with continuous health care changes. The present study findings are in the same line with Chen & Howes (2024), who showed that intentional education improves the studied nurse's positive professional identity level. In addition, this finding is consistent with Fitzgerald & Clukey (2022), who discovered that reflection and education improve the studied sample's professional identity level. This finding is also in agreement with the results of Alharbi et al. (2022), who explored that the studied sample had strong professional identities after entering the study program. Moreover, Ageiz et al. (2021) reported that there was an improvement in nurse managers' professional identity at the post-test and follow-up phases compared to the pre-test phase.

Concerning the level of managerial competencies among nurse managers in the selected hospitals throughout the study period, the current findings revealed that slightly more than two-thirds of the nurse managers studied had a low level of managerial competencies at the pre-test phase. Additionally, there were statistically significant differences in the total mean scores of managerial competencies before and after the program, and also between the intervention and the follow-up. This indicates that there was a statistically significant improvement in managerial competencies after educational program implementation and three months later at the follow-up phase compared to the pre-test phase.

From the researchers' point of view, this might be explained that the fact that the AI program enhances the managerial roles of nurse managers through improving their innovative abilities, strategic thinking, delegating administrative duties, supporting design thinking, work judgments, and building social skills and networks.

The present study findings are in the same line with Bilgin & Torun (2023), who displayed that the total mean score of managerial competence among the studied participants was close to the maximum values and the managerial competence level was high. In addition, this finding is consistent with Ahmed & Abd-ElGhani (2021), who reported that the total mean score of managerial competencies among the studied sample was high. This finding is also in agreement with the results of Abd-Elmoghith & Abd-Elhady (2021), who revealed that total scores of the studied sample's managerial competency are at a low level and the competency domains were compared and significantly different to mean scores.

Furthermore, the current findings indicate that all study variables showed greater improvement at Elsheafa Private Hospital compared to Menoufia University Hospital. These differences were statistically significant. From the researchers' point of view, this might be due to AI becoming integrated into nursing science and healthcare settings, especially in nursing care at specific hospitals as Elshefa Hospital, more than governorate hospitals (Menoufia University hospital) includes digital devices such as electronic medical records (EMRs), machine learning, administrative applications, and new applications in the health field especially after the coronavirus pandemic, while Menoufia University Hospital had huge numbers of nurse managers with large workloads that decreased nurse managers' opportunity to learn about new issues such as artificial intelligence and effectively understand it.

In the same line, Ghazy et al. (2023) revealed that there was a highly statistically significant difference between selected hospitals regarding total mean scores of studied nurses' perception towards artificial intelligence technology. Furthermore, this finding is consistent with Taie (2020), who displayed that there was a highly significant difference between managers' knowledge and perception about AI among three hospitals studied. Additionally, the present findings showed that there was a statistically

significant positive correlation between nurse managers' knowledge and perception regarding artificial intelligence and their professional identity after implementing the program. This can be justified by increasing the acknowledgement about AI empowers nurse leaders to have confidence and competence in a rapidly advancing healthcare environment. Moreover, knowledge of AI in turn increases their sense of purpose and meaning as a profession and develops a higher level of professional identity. This finding is consistent with Abd El-Monem et al (2023) who reported that there was a highly statistically significant correlation between participated nurses' perception toward artificial intelligence technology and professional identity.

Conclusion

It is concluded that the artificial intelligence enhancement program has a positive effect on improving nurse managers' knowledge level, perception towards artificial intelligence, professional identity, and managerial competencies.

Recommendations

- The concept of AI and its application should be incorporated in healthcare into both undergraduate and postgraduate nursing programs.
- Hospital administration should organize workshops and training sessions to advance the culture concerning the implementation of artificial intelligence in healthcare settings.
- It is advised that this study be replicated with a larger probability sample and in various settings.

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