Efficacy of Guidance Program about Informatics Competencies for Staff Nurses and its Effect on Patients Safety

Manar Kamel Abdel-Razik[1], Reda Abd El-Fatah Abo Gad[2], Fawzia Farouk Kamel[3] and Hoda Abd Alla Saleh[4]

(1) Ph.D. student of Nursing Administration, Faculty of Nursing -Benha University, Egypt (2) Professor of Nursing Administration, Faculty of Nursing - Tanta University, Egypt (3) Professor of Nursing Administration, Faculty of Nursing - Benha University, Egypt and (4) Lecturer of Nursing Administration. Faculty of Nursing - Benha University, Egypt

Abstract:

Background: Nursing Informatics along with growth and development of Health Information Technology (HIT) become a fundamental part of nursing practice. Nurses must to equip with NI competency for providing patients' safety. The study aimed**:** this study aimed to assess the efficacy of guidance program about staff nurses informatics competencies and its effect on patients' safety**.** Research design: A quasi-experimental design was utilized. **Setting:** The study was conducted at El Nasr Specialized Hospital – Universal Health   Insurance (UHI) at Port Said Governorate, Egypt. **Subjects:** consisted of 50 staff nurses. **Tools:** Three tools were used in the present study for data collection, I) Nursing Staff Informatics Knowledge Questionnaire, II) Nursing Informatics Competency Assessment Questionnaire (NICAT), III)   Patients' Safety Questionnaire**. Results:** 24.0% of staff nurses had good knowledge level at pre-program phase regard nursing informatics while it improved to be 82.0% at post program and slightly declined to 78.0% at follow up program. about one third (32%) of staff nurses were competent regard nursing informatics competency at preprogram phase while it increased to be the majority (80% & 84%) at post program and follow up program phases, respectively. Also, 26.0% of staff nurses reported that patients' safety was moderate level at preprogram phase, while it increased to be 82.0% & 86.0 % high level of patients' safety at post program and follow up program phases, respectively. **conclusion:** There was a highly positive statistically significant correlation between staff nurses' informatics knowledge, competency and their patients' safety levels as preserved by staff nurses at follow up program phases. **Recommendations:** Conduct competency-based nursing informatics training programs for nursing personnel according to their needs and up to date with new competencies. Develop curricular based competencies about nursing informatics and patient safety.

Keywords: Guidance program, Nurse Informatics competency, Patient safety, Staff nurse.

Introduction:

Since the beginning of the third millennium, health information technology (HIT) has dramatically influenced all aspects of healthcare. HIT plays an important role in nursing practice, and nurses have participated in the conception, design and implementation of HIT. Following the development of information technology initiatives in nursing, the nursing informatics (NI) discipline has been emerged due to the expansion of the knowledge required in this field **(Jouparinejad et al., 2020).**

Nursing informatics is the specialty that integrates nursing science, computer science, and information science in identifying, collecting, processing, and managing data and information to support nursing practice, administration, education, research, and expansion of nursing

knowledge. It supports the practice of all nursing specialties, in all sites and settings, whether at the basic or advanced level. The practice includes the development of applications, tools, processes, and structures that assist nurses with the management of data in taking care of patients or in supporting their practice of nursing **(Elizabeth et al., 2020)**.

Nursing informatics (NI) competency is an acceptable level of knowledge, skill and ability to complete specific informatics tasks, and it is important capability of nurses **(Khezri et al., 2019)**. NI competency is a compulsory set of skills that enable nurses to effectively use the health information technology in healthcare-delivery system **(Forman et al., 2020)**.

Nursing informatics competence is key to minimize medical errors, improve documentation of clinical information (e.g., patients' diagnoses, treatments, and outcomes), and promote evidence-based practice worldwide **(Harerimana et al., 2021).** These competencies assist nursing in acquiring computer utilization skills and information literacy, and being able to apply them to information management and clinical practice to achieve optimum safety and provide high-quality health services **(Kleib et al., 2021).**

competency domains and provided a set of indicators under each domain, domains include: (i) computer literacy, the ability to utilize relevant information and knowledge to support the delivery of evidence-informed practice, such as performing searches and critical appraisal of online literature, and documenting nursing and patient data using standardized languages; (ii) information literacy, the ability to use Information and Communication Technology (ICTs) in accordance with professional and regulatory standards and workplace policies, such as

maintaining patient safety and exercising clinical judgment in the presence of ICTs; and (iii) information management, the ability to use ICTs in the delivery of patient/ client care, such as using ICTs for point-of-care systems and electronic health records **(Kleib et al., 2018)**.

Training courses are necessary to increase NI competency and to better meet the competency requirements of nursing profession **(Vehko et al., 2019)**. Furthermore, low NI competency of nurses were associated with negative impacts of HIT in patient care. Poor NI competency of both newly graduated and experienced nurses not only puts patients at risk for suboptimal care, but also places additional stresses on nurses who are expected to demonstrate improved patient outcomes by using HIT **(Belchez, 2019)**. Therefore, nurses' NI competency in the delivery of patient care should be improved with continuous learning. Without educational interventions, nurses are not able to effectively use HIT in practice **(Kleib et al., 2018 &Vehko et al., 2019)**.

Nowadays, patient safety is a new healthcare issue in the healthcare organizations that includes reducing and preventing medical fault that often leads to harmful health consequences. Health care has become more efficient and also become more complex, with greater application of new technologies and therapies, which needs adopting with the international patient safety goals to improve the patient safety environment to simulate international competition and to increase the competitive advantages of the healthcare organizations at the national and international grades **(Abousallah, 2018 & Saaid et al., 2020)**.

patient safety is the absence of preventable harm to a patient during the process of health care and reduction of risk of unnecessary harm associated with health care

to an acceptable minimum **(WHO, 2020).** Patient safety is the prevention of errors and adverse effects to the patient associated with health care and to not harm patients **(Kuriakose et al., 2020).**

International Patient safety goals are a set of requirements that are crucial for foundation of a patient Safety approach at hospital level **(WHO, 2016)**. The Joint Commission International (JCI, 2011), published international patient safety goals that can be used to assess head nurses' management, aims to decrease errors resulting from healthcare in care environments. Its six goals are: (a) identifying patients correctly; (b) improving effective communication; (c) maintaining the safety of high alert medications; (d) ensuring correct procedure; (e) reducing the risk of healthcare-associated infections; (f) reducing the risk of patient harm resulting from falls **(Aguiar et al., 2017 & Saaid et al., 2020).**

When nurses have an expected level of informatics practice, they will utilizing patient data in way that grantees increase quality maximize outcome, enhance patient safety and promoting evidence-based practice **(Liston, 2019).** Nurse informatics competency is an essential aspect of high quality, safe, and cost-effective healthcare, which in clinical practice reflects the reality of patient care and the complex nature of professional practice **(Ansari et al., 2022)**.

Significant of the study:

At 2018 the nursing workforce is 3.4 million strong and makes up the largest group of users of Health Informatics Technology (HIT). The lack of NI knowledge contributes to the lack of understanding of downstream effects and continues to be a problem for patients, healthcare systems, and populations. Nurses use workarounds when technology becomes a barrier to providing care to

patients**, (Rathert et. al., 2017)**. Nursing education, training and informatics competency development have not kept pace with the rate of Health Informatics Technology (HIT) ascension and implementation, leading to safety concerns **(Meeks et al., 2014)**. The issue is standardizing, validating, and implementing these competencies to create an information-literate, highly-skilled nursing workforce that drives developing technology to enhance usability and ensure patients' safety **(Hubner et al., 2016)**.

Nurses are expected to provide safe, competent, and compassionate care in an increasingly technical and digital environment. A major theme in this new healthcare environment is the use of information systems and technologies to improve the quality and safety of patient care. Nurses are directly engaged with information systems and technologies as the foundation for the electronic health record (EHR). So, his study was conducted to assess the efficacy of guidance program about staff nurses' informatics competencies and its effect on patients' safety.

Aim of the study:

This study was to assess the efficacy of guidance program about nursing staff informatics competencies and its effect on patients' safety through:

1- Assessing staff nurses informatics knowledge through the program,

2- Assessing staff nurses informatics competency levels through the program.

3- Identifying patients' safety level as perceived by staff nurses.

4- Designing and implementing guidance program about informatics competency on staff

5- Investigating the effect of informatics competencies' guidance program on patients' safety.

Research Hypotheses

Staff nurses' informatics knowledge and competencies expected to be improved after implementing a guidance program and it will have a positive effect on patients' safety.

Subjects and Methods

Research Design

A quasi-experimental design was utilized to conduct this study.

Setting

This study was carried out at El Nasr Specialized Hospital –Universal Health Insurance (UHI) at Port Said Governorate, Egypt. These hospital use electronic medical record at all departments, emergency, operation room, intensive care unit, newborn Intensive care Unit, inpatient Department for communication between all medical staff, which consisted of two separated buildings and 70 beds.

Subjects

The subjects consisted of all available staff nurses 50 out of 65 nursing. Of the total staff nurses population in the setting, 50 staff nurses accepted to share in the program. 15 nurses refused to participate in the study so that the actual study sample consisted of 50 staff nurses.

Tools of data collection:

Three tools were used for data collection.

I- Informatics Knowledge Questionnaire:

It was developed by the investigator based on review of related literature (**Practice Guide for Healthcare, 2014, Nursing Informatics, 2015, Quintana et al., 2016, Ruth et al., 2021 and Rashed et al., 2022**) to assess the staff nurses' knowledge regarding nursing informatics. It contained two parts:

Part (1) Nursing staff demographic data: It consisted of personal data of staff nurses (age, department, gender, marital status, education, qualifications, years of experience, and attending course about nursing informatics).

Part (2) it included 61 questions to assess nursing staff knowledge regarding nursing informatics and patient safety, in the form of multiple choice, true or false and matching questions.

Scoring system:

Each question was assigned a score one for a correct answer and zero for wrong answer. Total score was calculated by summing up the grades of the questionnaire. Total score was 61 degree; the total scores were converted into percentages: as follows: Poor knowledge level<60% that equals ≤36 degree. Average knowledge level 60% - <75% that equals ≤36- < 46. Good knowledge level ≥ 75% that equals ≥46 degree.

Table (A): Tools reliability

- Informatics knowledge questionnaire=0.97
- Nursing informatics competency=0.94 observational checklist
- patient safety questionnaire=0.96.

II- Nursing Informatics Competency Assessment Questionnaire (NICAT) (Observation checklist)

It was developed by the investigator based on review of related literature (**Staggers et al., 2002, Hill et al., 2014, Technology Informatics Guiding Education Reform TIGER, 2014 and Rahman, 2015**) to assess staff nurses' competency regarding nursing informatics. It consisted of 40 Items divided into four dimensions.

Scoring system:

Each item was assigned a score of (one) degree for "done" and zero for "not done". The total score of informatics competency was 40 degree. A total score was calculated by summing up the grades of items. The score were converted into percent score. The level of skills was determined as the following: Competent if the percent score ≥75% that

equals ≥30 degree. Incompetent if the percent score <75% that equals <30 degree.

Tool III: Patients' Safety Questionnaire:

It was developed by the investigator based on review of related literature **(WHO, 2016 & General Authority for Healthcare Accreditation and Regulation standards, 2018 and Abousallah, 2018)** To assess staff nurses' perception regard patients' safety**.**

Scoring system:

- The response to each statement was a 3-point Likert scale ranging from never (1) sometimes (2) and always (3). The total scores 108 are summed up and graded according to the following scores;

- Low staff nurses' perception level <60% that equals 64≤ degree, moderate staff nurses perception level >60%- <75% that equals 64≥ <81degree and high staff nurses' perception level ≥75% that equals ≥ 81degree.

Validity of the tools:

Validity of the different tools of data collection was measured by panel of five experts from different Nursing Administration &informatics system: one assistant professor of Nursing Administration at Faculty of Nursing Tanta University and two professors of Nursing Administration, Faculty of Nursing El Menoufia University and one professor of Nursing Administration, Faculty of Nursing, Cairo University and one specialist of information system at Benha University. Modifications were done in the light of their valuable comments such as modify some words to give the right meaning for the phrase which were not clear.

Ethical considerations:

Prior the study conduction, ethical approval was obtained from the Scientific Research Committee at Faculty of Nursing Benha University. The respondent rights was protected by ensuring voluntary participation, so the informed consent was obtained by explaining purpose, nature time of conducting the study, potential benefits of the study, how data was collected, any invasive procedure, expected outcomes and the respondent rights to withdraw from the research study at any time without any reasons. The respondent was assured that the data was treated as strictly confidential; furthermore, the respondent anonymity was maintained as they were not requiring mentioning their names. To ensure scientific honesty, the researcher uses backeting and intuiting to avoid bias.

Pilot study

Pilot study was done on 10% of (n=50) staff nurses to assess tools clarity and applicability, it also served in estimating the time needed for filling the different data collection tool for nursing informatics knowledge questionnaire 20-30 minute, for informatics competency observational checklist 40-50 minutes, and for patient safety questionnaire 60-70 minutes. No modifications were required to the pilot study, so the subjects were included in the main study subject.

Administrative design:

Formal approval was obtained through official letter from the dean of the Benha Faculty of Nursing that sent to the director of El Nasr specialized Hospital for taking their permission to collect data and seek their support. The investigator met with staff nurses of each unit to explain the aim of data collection and program implementation were also determined based on their views to gain their approval and cooperation.

Preparatory phase

- This phase took six months that started from (October 2021 to March 2022) included the following:-

- Reviewing the national and international related literature, using journals, textbooks, internet and theoretical knowledge of the various aspects concerning the topic of the

study. The investigator began to construct content of educational program to be appropriate for application.

- Developing different tools of data collection.
- Determining general and specific objectives of the educational program.

Field Work

The field work for this study includes four phases; assessment, planning, implementation, and evaluation phase. It took nine months started from April to December 2022.

Phase I (Assessment): This phase took one month (April 2022). The data was collected to assess staff nurses' knowledge, before implementation of the guidance program through using of the different tools of data collection in the available hospitals' classroom and during their work hours every shift. The questionnaire sheets were distributed to staff nurses, the investigator was available all the time during filling the questionnaire sheets for any clarification as needed then the investigator checked each one to ensure its completeness.

Phase II (Program planning)

This phase took two months that took place from May to June 2022. A guidance program was developed based on determined needs and relevant review of literature. The teaching sessions were achieved by using available resources, relevant content and instructional strategies for each session. Different methods of teaching were used such as on job training area using computers, group discussion, brain storming and hand out prepared by the investigator and distributed to all staff nurses.

Phases III (Program implementation)

It was aiming to prepare and develop a guidance program. The subjects were divided to five groups according to their departments, each group was nearly 10 staff nurses. The program took about 2 days / week. The

duration of each session was two hours depending on workload and including periods of discussion according to the achievement, progress and feedback. It started at (11) AM to (13.30) Pm. At the beginning of the each session an orientation to the training and its aims took place. Feedback was given at the beginning of each session about the previous one and at the end of each session about the current session.

Phase IV (evaluation phase):

During the period of September till December 2022, the impact of the guidance program was evaluated. Immediate evaluation included, immediate post program was implemented for all the subjects using the same tools which were used before the program. Follow up after three months of program implementation, all the study tools were applied for staff nurses to test the follow up gain in the nurse's knowledge, competency and its effect on patients' safety.

Statistical analysis:

Data were verified prior to computerized entry. The statistical package for social sciences (SPSS version 25-0) was used for the purpose, followed by data analysis and tabulation, for numerical values, the Mean and Standard deviations were calculated. Descriptive statics were applied (e.g., Mean, Standard deviation, Frequency and Percentage, chi-square (^{X2}), test of significance (paired (t)test, pearson correlation cofficients were used investigation of relationships among scores. The P-value is the probability of error that indicate significance of results through observed difference. A significant level value was considered when (P value <0, 05) and A highly significant level value was considered when (p value<0,001).

Results

Table (1) shows that, 62% of nurses aged from 35< 45 years, Also, 60.0% of them were

female. Concerning to nurses' job, more than two-fifth (46.0%) of nurses were working at Intensive Care Unit. In relation to their marital status, majority of nurses (92.0%) were married and more than three-quarters of them (76.0%) had diploma in nursing and more than half of nurses (54.0%) had 10-< 15 years of experience. Regarding to training course about nursing informatics, more than three-quarters of them (76%) attended courses about nursing informatics.

Figure (1) indicates that, less than one-quarter of staff nurses (24.0%) had good knowledge level at preprogram phase while it improved to be 82.0% of nurses had good knowledge at post program and slightly declined to 78.0% at follow up program.

Table (2) reveals that, there was a highly statistically significant difference between mean scores of staff nurses' knowledge regarding nursing informatics through the program phases (p<0.001). The highest mean percent of staff nurses' knowledge at post and follow up program was (91.7)% with mean score 12.84±2.41&12.14±2.93 was related to patients' safety dimension compared with preprogram phase was (31.0%) with mean score 4.46±3.66. While, the lowest mean percent of staff nurses' knowledge at post and at follow up phase was (76.0%) with mean score 13.02±3.26 12.22±2.99 was related to computer skills dimension compared with preprogram phase was (28.0%) with mean score 4.86±3.91.

Figure (2) summarize that, about one third (32%) of staff nurses were competent regard nursing informatics competency at preprogram phase while it increased to be the majority (80% & 84%) at post program and follow up program, respectively.

Table (3) clarifies that, there was a highly statistically significant improvement between mean scores of total staff nurses'

competency regarding nursing informatics through the program phases (p<0.001). Also, the lowest total mean percent of staff nurses' competency at post program was 78.7% with mean score 14.18± 1.46 and at follow up program was 86.0% with mean score 15.52±1.40 related to computer competency compared with preprogram phase was 24.0% with mean score 4.34± 2.88. In addition to, the table reveals that, the highest total mean score of staff nurses competency was related to informatics management competency at preprogram was more than one third (37.8 %) with mean score 3.40±2.14 and it increased to 85.8 % at post program with mean score 7.72±1.64 and 88.4 % at follow up program phases with mean score7.96±1.48.

Figure (3) obvious that, patient safety was a moderate level 26.0% as reported by staff nurses at preprogram phase, while it increased to be the majority (82.0% & 86.0 %) high level of patient safety as reported by them at post program and follow up program phases, respectively.

Table (4) indicates that, there was a highly statistically significant difference between mean scores of staff nurses' patients' safety dimensions through program phases (p<0.001). Also, the lowest total mean percent of staff nurses reported regarding patient safety at post program was 86.0% with mean score 34.74± 2.75 and at follow up program phases slightly declined to 85.0% with mean score 34.36 ±3.21 was related to correctly identify patients compared to preprogram phase was 59.0% with mean score 23.80 ±4.56. While the highest total mean percent of staff nurses' patients' safety at post program was 89.7% with mean score13.46 ±.64 and at follow up program phases slightly declined to 89.1% with mean score 13.36±.89 was related to lowering healthcare-associated infection compared to preprogram phase was 66.0% with mean score9.96±2.60.

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Table (5) clarifies that, there was a positive highly statistically significant correlation between staff nurses' total knowledge, total informatics competency and staff nurses' total patients' safety level at post program phase. In addition, there was a positive statistically significant correlation between staff nurses' total knowledge and total patient safety level at follow up program phase, while there was a positive statistically significant correlation between staff nurses' total Competency and total patient safety level at follow up program phase. Also, there was a positive statistically significant correlation between staff nurses' patient safety level and total knowledge, total informatics knowledge at follow up program phase.

Table (1): Frequency distribution of staff nurses according to their personal characteristics (n=50)

| Personal characteristics	No	%
Department		
Emergency	16	32.0
Operation room	4	8.0
Intensive Care Unit	23	46.0
Newborn Intensive Care Unit	4	8.0
Inpatient Department	3	6.0
Age		
25 > 35 years	8	16.0
35 >45 years	31	62.0
45 > 55 years	7	14.0
<55 years	4	8.0
Mean ±SD	40.21 ±4.71	
Gender		
Male	20	40.0
Female	30	60.0
Marital Status		
Married	46	92.0
Unmarried	4	8.0
Education qualification		
Diploma in nursing	38	76.0
Associated degree in nursing	4	8.0
Bachelor in Nursing	8	16.0
Years of experience		
5 < 10 years	8	16.0
10-< 15 years	27	54.0
15 < 20 years	7	14.0
>20 years	8	8.0
Mean ±SD	12.69 ±3.54	
Training Course About Nursing informatics		
Yes	38	76.0
No	12	24.0
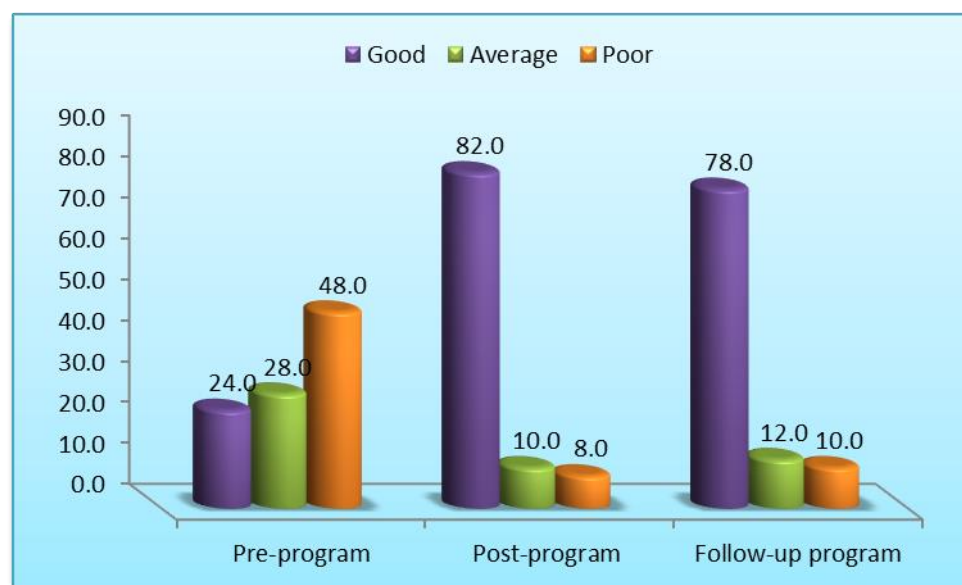
Figure (1): Staff nurses' knowledge regarding nursing informatics through the program phases.

Table (2): Standard deviation, mean score and mean percent of staff nurses' knowledge regarding nursing informatics dimensions through the program phases (n=50)

Total knowledge items	Max score	Pre program $\overline{X}\pm SD$	Mean %	Post program $\overline{X}\pm SD$	Mean %	Follow program $\overline{X}\pm SD$	Mean %	t 1	p-value	t2	p-value	t3	p-value
Nursing informatics concepts	12	4.50±2.69	37.5	10.38±2.75	86.5	9.78±2.54	86.5	-11.584	.000 **	1.592	.118	10.581	.000 **
Computer skills	17	4.86±3.91	28.6	13.02±3.26	76.6	12.22±2.99	76.6	-14.168	.000 **	1.609	.114	10.067	.000 **
Electronic health record	18	5.34±3.75	29.7	14.28±3.03	79.3	13.44±3.19	79.3	-17.214	.000 **	1.677	.100	11.293	.000 **
Patient safety	14	4.46±3.66	31.9	12.84±2.41	91.7	12.14±2.93	91.7	-15.591	.000 **	1.504	.139	10.613	.000 **
Total	61	19.16±11.81	31.4	50.52±10.62	82.8	47.58±10.14	82.8	-17.498	.000 **	1.782	.081	12.244	.000 **

t_1 paired t test between pre and post *t_2 paired t test between post and follow-up the program

*t_3 paired t test between pre and follow-up the program

Statistically significance p<0.05 ** highly statistically significance p<0.001
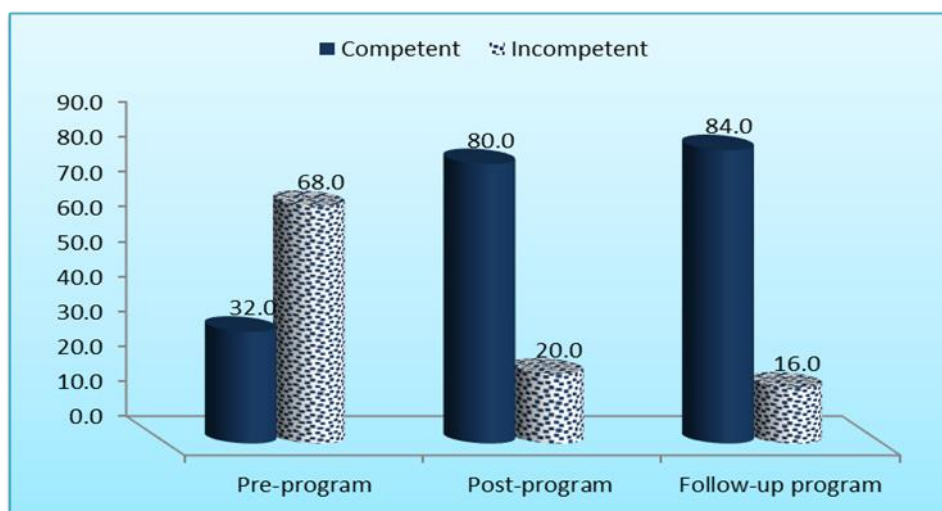
Figure (2): Staff nurses' competency regarding nursing informatics through the program phases

Table (3):   Standard deviation, mean scores and mean percent of staff nurses informatics competency dimensions through program phases

Nursing informatics competency dimensions	Max score	Pre program $\overline{X}\pm SD$	Mean %	Post program $\overline{X}\pm SD$	Mean %	Follow program $\overline{X}\pm SD$	Mean %	t_1 p-value	t_2	t_3
Computer competency	18	4.34± 2.88	24.6	14.18± 1.46	78.8	15.52±1.40	86.2	-11.309 .000**	2.621 .012	12.149 .000**
Informatics competency	11	4.08±2.81	37.1	8.82±2.00	80.2	9.12±1.84	82.9	-10.373 .000**	2.278 .027	11.459 .000**
Informatics management competency	9	3.40±2.14	37.8	7.72±1.64	85.8	7.96±1.48	88.4	-12.669 .000**	1.950 .057	13.529 .000**
Wireless device competency	2	0.70±.73	35.0	1.74±.56	87.0	1.78±.50	89.0	-9.111 .000**	1.000 .322	9.498 .000**
Total competency	40	12.52±7.36	31.3	31.46± 5.00	78.7	34± 5	86.0	-14.427 .000**	2.563 .013	13.579 .000**
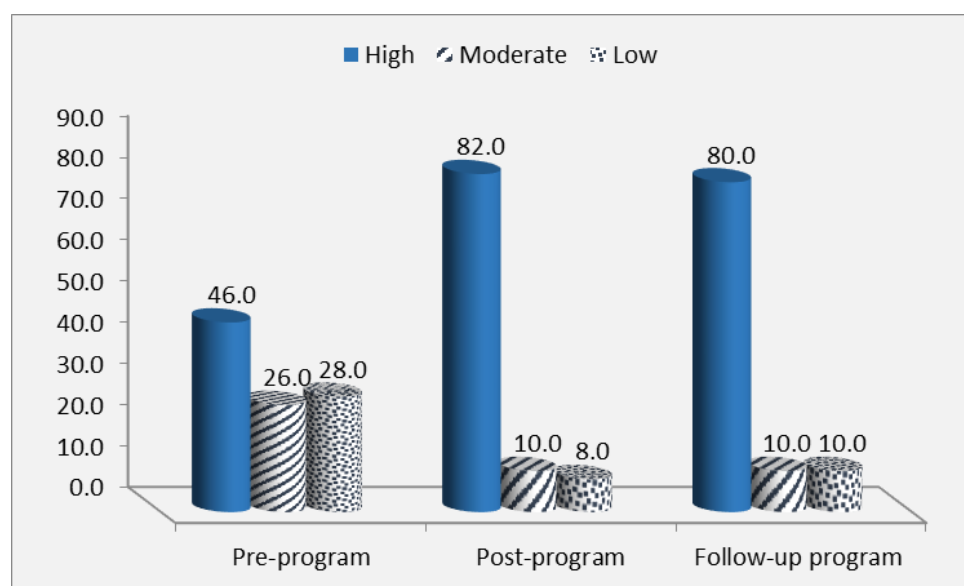
Figure (3): Patients' safety levels as reported by staff nurses through the program phases.

Table (4): Standard deviation, mean and mean percent scores of staff nurses regarding patients' safety through program (n=50).

Patient safety items	score	Pre Program		Post Program		Follow-up Program		t_1 p-value	t_2 p-value	t_3 p-value
		$\overline{X}\pm SD$	Mean %	$\overline{X}\pm SD$	Mean %	$\overline{X}\pm SD$	mean %			
Correctly identify patients	24	23.80 ±4.56	59.5	34.74± 2.75	86.9	34.36 ±3.21	85.9	12.407 .000	1.677 .100	12.374 .000
Effective communication	24	24.38 ±4.47	61.0	35.20 ±2.36	88.0	34.92 ±2.66	87.3	15.852 .000	1.155 .254	16.237 .000
High alert medication	27	27.98± 4.95	62.2	39.82 ±2.36	88.5	39.42 ±2.56	87.6	15.429 .000	2.046 .051	16.710 .000
Correct procedures and surgery	15	15.62± 2.92	62.5	21.68 ± 1.18	86.7	21.52 ±1.32	86.1	13.973 .000	1.385 .172	13.492 .000
Lowering healthcare-associated infection	9	9.96 ±2.60	66.4	13.46 ±.64	89.7	13.36 ±.89	89.1	9.334 .000	1.000 .322	9.350 .000
Reducing the harm caused by falls	9	9.20 ±2.49	61.3	13.38 ±1.24	89.2	13.28 ±1.34	88.5	11.435 .000	1.400 .168	11.295 .000
Total patient safety	108	110.94 ±18.72	61.6	158.28±5.29	87.9	156.86±6.33	87.1	16.821 .000	2.065 .068	17.498 .000

*t1 paired t test between pre and post

*t2 paired t test between post and follow-up the program

*t3 paired t test between pre and follow-up the program

* Statistically significance p<0.05 ** highly statistically significance p<0.001

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Table (5): Correlation matrix among staff nurses' knowledge, competency and patients' safety through the program phases

Program phase	Studied variables		Total Knowledge	Total Competency	Total patient safety
Preprogram	Total knowledge	r	1	.736	.189
		p-value		.000**	.188
	Total informatics competency	r	.736	1	.030
		p-value	.000**		.836
	Total patient safety	r	.189	.030	1
		p-value	.188	.836	
Post program	Total knowledge	r	1	.844	.546
		p-value		.000**	.000**
	Total informatics competency	r	.844	1	.634
		p-value	.000**		.000**
	Total patient safety	r	.546	.634	1
		p-value	.000**	.000**	
Follow-up program	Total knowledge	r	1	.185	.282
		p-value		.199	.047*
	Total informatics competency	r	.185	1	.354
		p-value	.199		.012*
	Total patient safety	r	.282	.354	1
		p-value	.047*	.012*	

* Statistically significance p<0.05 ** highly statistically significance p<0.001

Discussion:

Regarding staff nurses' knowledge regarding nursing informatics through the program phases, the study finding indicated that less than one-quarter of staff nurses had good knowledge level at preprogram phase while it improved to be the majority of nurses had good knowledge at post program phase and slightly declined at follow up program phase. That indicated the program had a greater effect on improving staff nurses' informatics knowledge. May be due to all nurses facing time pressure to attend hospital workshops due to various deadlines and work priorities which may find that the investment of time necessary for nursing informatics is not possible. In relation to, the nurses were

also worried that they would spend more time with computers and less time with patients.

This result is confirmed by **Asonye et al., (2021)** who indicated that the respondents had an above-average level of nursing informatics knowledge and utilization after education program. Also, **Jouparinejad et al., (2020)** concluded that the improved scores of NI and its dimensions after using the training program. The application of the training program in diverse domains of nursing practice shows its high efficiency and there was significant improvement in nurses' knowledge levels regarding informatics. And, **Raee & Haseli, (2018)** who reported that the knowledge level regarding nursing informatics has improved after program implementation.

On the other hand, **Ademuyiwa et al., (2020)** they concluded that the respondents had a good knowledge of nursing informatics and good use of nursing informatics. In the same line, **Liston and McKinnon (2017)** explained that as a result of training of nursing informatics has been below the expectation in nursing programs and post graduate education.

Regarding sub-dimension of nursing informatics knowledge, the current study revealed that, the highest mean percent of staff nurses' knowledge at post and follow up program was related to patients; safety compared with preprogram phase, implied the effectiveness of training program in enhancing the NI of nurses working in the hospital. This study also is in agreement with **Kinnunen et al., (2022)** who concluded that the importance to increase different educational programs for nurses using digital tools and software programs to produce high-quality patient data which also affects patient safety. This result agreed with **Chand and Sarin, (2014) and Kohlhof et al., (2015)** as they mentioned that

informatics improves quality of patient care, improve nursing care practice and support the appropriate and effective use of resources to improve the patients' safety.

Concerning staff nurses' total competency regarding nursing informatics, the current study summarized that, about one third of staff nurses were competent regarding nursing informatics as a total at preprogram phase while it increased to be the majority at post program and follow up program phases. From researcher point of view this improvement may be due to staff nurses had the chance to use the application of EHRs by using computer devices and teaching how to use basic component of computer, use operating systems, use search engine and accessing the internet and enter complete and accurate data quickly all of this making the nurses deal more with computers and technological issues. In addition, this improvement in nurses' skills could be resulted from their desire to learn new skills to facilitate the work and increase the efficacy of patient care.

This result is supported by **Chipps et al., (2022),** who highlighted that computer literacy skills, informatics literacy skills and information management skills were relevant to nursing practice, despite varying levels of competence in these skills among nurses. Also, **Lee et al., (2021),** indicated that there was a highly significant improvement in nursing students' performance competency after program implementation.

Also in line with this study **Gosa, (2022)** who study improving EMR competency in first year nursing students and revealed that there was significant improvement in nursing students' competency levels after program implementation. In addition, **Kleib & Nagle (2018)** they revealed that there was significant improvement of all dimensions regarding nursing informatics

after program implementation. Similarly, this result was incompatible with **Abd El Fattah (2017),** who reported that nurses' NI competency skills was at the competent level after attending the educational intervention.

Regarding patient safety level as reported by staff nurses the current study clarified that, more than one-quarter of staff nurses reported moderate level of patient safety at preprogram phase, while it increased to be the majority of them reported high level of patient safety at post program and follow up program phases, that indicted there was a highly statistical significant difference improvement of staff nurses perceived patients' safety level through post and follow up program phases compared with preprogram phase. This may be due to the current information system help staff nurses to correctly identify patients, know high alert medication list well and effective communication these makes them able to overcome problems related to patient safety.

This finding is in the same line with **Dinesh et al., (2022)** who found out that the awareness level of doctors, nurses and technicians towards patient safety goals is good. Further quality improvement in this field can be achieved by conducting on the job training, workshops, lectures and seminars. And this study result agreed with **Opoku-Agyemang et al. (2021)** who mentioned that HIT can be utilized to promote patients' safety and the deployment of the appropriate technology leads to increased efficiency, improved quality and safety, and at a reduced cost. If done correctly, using technology results in facilitation of communication between clinicians, improving medication and medical device safety, reducing potential medical errors, increasing access to medical information, and encouraging patients' safety.

Also, this result is agree with **Yu et al., (2019)** who revealed that health information technology can help build an evidence-based patients' safety improvement system. And, **Jang et al., (2017)** supported the result and concluded that it is necessary to enhance nursing educators' patient safety skills and knowledge by developing and providing an integrated program of patient safety, with various teaching methods to meet their educational needs.

Regarding correlation matrix among staff nurses' knowledge, competency and patient safety, the current study clarified that, there was a positive highly statistically significant correlation between staff nurses' total knowledge, total informatics competency and staff nurses' total patient safety level at post program phase. In addition, there was a positive statistically significant correlation between staff nurses' total knowledge and total patient safety level at follow up program phase. This may be due to the comprehensiveness, efficacy, efficiency and effectiveness of the training program.

This result was in the same line with **Jouparinejad et al., (2020)** they reported that there was statistical significant difference regarding nurses' informatics knowledge and competency between pre, post and follow up phases. This result accordance with **Ohno-Machado, (2017)** who focused on informatics applications to enhance patient safety, they reported that there was statistical significant difference regarding nurses' informatics knowledge and competency. In contrary with **Ademuyiwa et al., (2020)** they concluded there was no statistically significant relationship between knowledge and the use of nursing informatics among the respondents.

Also, the current study clarified that, there was a positive statistically significant correlation between staff nurses' total Competency and total patient safety level at follow up program phase. Also, there was a positive statistically significant correlation between staff nurses' patient safety level and total knowledge, total informatics knowledge at follow up program phase. This result is in the same line with **Abd-Elrahman et al., (2022)** concluded that there was highly statistically significant correlation between nurses' knowledge, performance and competence related to high alert medication at pre, immediate post and follow up phases of program. Also, the study findings congruent with **Alotaibi & Federico., (2017)** they studied that there was statistical significant positive correlation between the qualified nurses' total nursing informatics competency scores and their total attitude score toward patient safety.

In the same line **Zareshahi et al., (2022)** who mentioned that nurses need to have some skills such as computer skills, management of existing software, familiarity with nursing information systems, databases related to nursing and web search methods for obtaining nursing informatics competence to provide patient safety. Moreover, **Harerimana et al., (2020**) concluded that the importance attached to the integration of NI in undergraduate nursing education, developing the ICT skills of nursing students should go beyond teaching basic computer skills and focus on the application of ICT skills in clinical practice. And, **Verma and Gupta (2019)** also referred to these informatics competencies related to the nursing information system.

Conclusion:

The present study concluded that less than one-quarter of staff nurses had good knowledge level at preprogram phase regard nursing informatics while it improved to majority good knowledge at post program and slightly declined at follow up program phase. About one third of staff nurses had competent level regard nursing informatics competency at preprogram phase while it increased to be the majority at post program and follow up program. One-quarter of staff nurses reported moderate level of patient safety at preprogram phase, while it increased to high level of patients' safety at post program and follow up program phases. In addition to, there was a highly positive statistically significant correlation between staff nurses' informatics knowledge, competency regard informatics and patients' safety levels as reported by staff nurses at post and follow up program phases.

Recommendations:

At hospital administration level:

- Periodically assess NI competency to improve staff nurses knowledge and skills about health information technology.
- Organize appropriate interventions and training programs to improve NI competency particularly in the field of information management skills.
- Provide the necessary resources needed to develop ICT infrastructure required for EHRs to promote nurses' competence in nursing informatics and new technologies.
- Continues monitoring for unaccepted practice with patient safety goal.
- Provide all capabilities and consumables to facilitate application of technology to achieve patient safety goal.

For staff nurses:

- Attending training course and education program for refreshing and increasing knowledge and skills about NI concept.
- Emphasizing on attending training courses about the importance of using technology to achieve patient safety goal.

- Use electronic communication with colleagues or other department for patient data documentation.

For educational level:

- Provide opportunities for learning and developing nursing informatics skills to prepare them to integrate this course into the faculty curriculum and courses they teach.

Opportunities for further research:

- Repetition of the same study wide health care sector is highly recommended to achieve generalizable results.
- Investigate factors that affect staff nurses' informatics skills at the clinical setting.

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فاعلية برنامج ارشادي عن الكفاءات المعلوماتية لهيئة التمريض وأثره على سلامة المرضى

منار كامل عبدالرازق – رضا عبدالفتاح ابوجاد – فوزية فاروق كامل- هدى عبدالله صالح

ازدادت أهمية وفائدة المعلوماتية التمريضية تدريجياً.لذلك من المهم التأكد من البنية المعرفية لمعلوماتية التمريض وفهم اتجاهات البحث التي تربط البيانات بمعلومات ذات مغزى؛ لأن هذا يطور المعرفة في ممارسة التمريض. علاوة على ذلك ، فإن كفاءة المعلوماتية للممرضين لها تأثير كبير على سلامة المرضى والجودة في مراكز الرعاية الصحية. لذا هدفت هذة الدراسة الي تقييم فاعلية برنامج ارشادي عن الكفاءات المعلوماتية لهيئة التمريض وأثره على سلامة المرضى. تم استخدام التصميم الشبه تجريبي. حيث أجريت الدراسة في جميع الوحدات بمستشفى النصر التخصصي التابعة لهيئة التأمين الشامل بمحافظة بورسعيد جمهورية مصر العربية. حيث اشتملت عينة الدراسة على كل العدد المتاح ٥٠ من الهيئة التمريضية , الذين يعملون في مكان الدراسة المذكورة. و خلصت الدراسة إلى وجود ارتباط إيجابي ذو دلالة إحصائية عالية بين المعرفة الكلية لممرضات الموظفين، والكفاءة المعلوماتية الكلية، ومستوى سلامة المرضى الكلي للممرضات العاملين في مرحلة ما بعد البرنامج. بالإضافة إلى ذلك، كان هناك ارتباط إيجابي ذي دلالة إحصائية بين المعرفة الكلية للممرضات ومستوى سلامة المريض الكلي في مرحلة برنامج المتابعة، بينما كان هناك ارتباط إيجابي ذو دلالة إحصائية بين الكفاءة الكلية للممرضات ومستوى سلامة المريض الكلي في برنامج المتابعة. مرحلة. أيضًا، كان هناك ارتباط إيجابي ذي دلالة إحصائية بين مستوى سلامة المرضى لدى طاقم التمريض والمعرفة الكلية والمعرفة المعلوماتية الكلية في مرحلة برنامج المتابعة. كما اوصت الدراسة بزيادة التدريب لتحسين معرفة ومهارات الممرضات العاملين حول تكنولوجيا المعلومات الصحية وذلك لزيادة كفاءة معلوماتية التمريض بشكل دوري.