

Effect of Educational Program on Nurses' Perception Regarding Green Hospital and Attitude towards Patient Safety Guidelines

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Abstract:

Background: Green hospital facility aims to improve patient wellbeing, help in the healing process, and make efficient use of natural resources without harming the environment. Patient safety is the avoidance and prevention of patients' injuries or adverse events resulting from the processes of health care delivery. **Aim:** To evaluate the effect of educational program on perception of nurses regarding green hospital and their attitude towards patient safety guidelines. **Research design:** A quasi experimental pre-post-test design was utilized to achieve the aim. **Setting:** The study was conducted at Nasser Institute, affiliated to the secretariat of specialized medical centers, Ministry of health, Cairo, Egypt. **Sampling:** A purposive sample of 107 nurses. **Tools:** (I) A) Structured sociodemographic and work data. B) Pre-post perception questionnaire regarding smart hospitals initiative green hospitals. (II), Pre-post attitude scale towards patient safety guidelines. **Results:** The total positive green hospital perception of nurses was improved from 6.5% to 90.7% after the intervention. Also the total positive attitude towards patient safety guidelines by nurses was improved from 8.4% in pre-test to 86.9% in post-test. In addition to a positive significant correlation between nurses' total green hospital perception and attitude towards patient safety guidelines. **Conclusion:** The educational program detected improvement in the positive nurses' perception regarding green hospital and their positive attitude towards patient safety guidelines, with a strong positive correlation. **Recommendation:** Green hospital and patient safety guidelines should be implemented nationally to be in line with the sustainable development goals.

Keywords: Attitude, Educational program, Green hospital, Guidelines, Patient safety & Perception.

Introduction:

People's health and well-being are increasingly impacted by climate change, both directly through extreme weather events and indirectly by endangering the ability of health systems to safeguard the health of their communities (Abdallah & Farag, 2022). These detrimental effects are especially evident when it comes to healthcare institutions, which are frequently not constructed to handle growing climate-related threats such as extreme weather events like storms, floods, and droughts (NOAA, 2022). Health care facilities in underdeveloped nations are particularly vulnerable because they frequently lack suitable infrastructure, a sufficient number of health professionals, and access to adequate energy and water supplies (World Health Organization, 2019).

American Nurses Association (ANA) stated an important part in its code of ethics related to the

Environmental Health principles for nursing. It always directs nurses through collaboration to meet the health needs of population and treat these needs equally. It requires each health care provider to consider and determine the environmental hazards (physical, chemical, radiological, and biological) that would affect themselves, patients, and the community (Joseph et al., 2019).

The concept of green building or green hospital is defined as, "the direct practices of creating structures as well as using processes which are responsible for the continuity of buildings' life-cycle starting from siting to construction, design, operation, renovation, maintenance, and deconstruction. The Green Hospital principles have started to play an important role in healthcare organization, its aim is to save and improve lives and thus they place the highest priority on health (Ngatindriatun et al., 2023).

Results of many recent studies stated that there are factors considered as complexities and barriers in

changing hospitals to Green ones. Those factors are starting with the importance of easy back up for emergencies and no shutdown at any time. Also sustainability of infection control protocols is a barrier. In addition to the factors related to high standards of air changes to prevent contamination. Requirements of water and energy comparing to other ideal buildings are essential and also high waste system for all beds. Constant maintenance and renovations to upgrade the building machinery is an effective factor facing hospitals to be green. All of factors would affect the achieving of green hospital main components such as energy saving & green source of energy, reducing waste management, saving water, lighting, and air quality (**Jamshidi et al., 2020**).

Health and sustainability are given top priority for green hospitals; therefore these facilities must reduce their use of some resources as electricity, water, and materials. Green construction practices are being implemented in hospitals to improve structure siting, planning, development, service, maintenance, and disposal, which has a positive influence on both human health and the environment (**Intraruangri & Mateekul, 2018**).

Green building stand for whole-systems-approach that includes siting, design, construction, operation, maintenance, renovation, and deconstruction (**Khairunnisa et al., 2022**). A sustainable or high-performance building is another name for a green building. According to the Green Facility Council, 2022, a green hospital facility is one that improves patient wellbeing, helps in the healing process, and makes efficient use of natural resources without harming the environment. Several hospitals have tried to put the "green hospital" concept into practice to address some environmental problems. Green design principles must be prioritized for the benefit of hospital patients and staff (**Daniel, 2018**).

To attain the objective of a safe healthcare system for patients, a thorough understanding of the system's strengths and weaknesses as well as its internal dynamics are required. Patients' safety is in its mean is the avoidance of unnecessary injury and harm for patients. According to **Al-Lawati et al. (2019)**, the definition of patient safety is "the avoidance and prevention of patients' injuries or adverse events resulting from the processes of health care delivery." In view of the current situation of growing healthcare needs and the complexity of health services, patients' safety should be taken into consideration to be on top of healthcare delivery as a requirement for help in various areas of health services (**Garcia et al., 2019**).

Patients' safety practice attempts to prevent and minimize the risks, mistakes, and harm for patients

when receiving medical care. Patient safety investments are required to improve patient outcomes and to save money that might be spent on problems resulting from adverse events in healthcare (**Garcia et al., 2019**). Prevention expenditures add significant value to the country's healthcare systems and costs less than spending on treatment. Additionally, for patient safety initiatives to be implemented successfully, it is necessary to have clear policies, leadership capability and data to drive safety improvements, skilled healthcare personnel, and effective patient involvement in their care (**WHO, 2019**).

The largest workforce ever seen in healthcare facilities is made up of nurses. The nursing profession bears some responsibility for environmental protection. Nurses and other healthcare providers face significant challenges during the delivery of care from the impact of climate change (**USDA Climate Hubs, 2021**). They are responsible for making the hospital as a healthy place to work. As a part of the green team, nurses can also support and educate other employees on environmentally friendly institutional practices in a variety of areas, such as recycling, wise product choice, and disposal in accordance with hospital policy (**Jang et al., 2017**).

Providing a sustainable environment and reducing the effects of climate change are the abilities that nurse has. Create a green team at healthcare organization promote environmental sustainability and concentrate on raising awareness through education and initiatives. In order to investigate the knowledge of health care personnel, it should enlighten the minds of the healthcare providers to take a step forward by taking initiative in formulating the policies to reduce pollution to our mother earth by adopting green practices (**Law & Joanna, 2021**). The researchers' focused aspect is to investigate the perception of nurses regarding green hospital and provided them with enough informational materials. This will encourage nurses to take effective steps adopting green practices. Applying of these green practices in hospitals would affect positively in secure patients by changing the nurses' attitude towards patient safety guidelines. So that, conducting of periodically educational programs for nurses regarding green hospital and patient safety guidelines is essential to reach satisfied standards of them in hospital systems (**Joseph et al., 2019**).

Significance of study:

The greatest threat to world health in the twenty-first century is climate change. The effects of climate change on health have a significant impact on human health both directly and indirectly. One of these

effects is increase hospitalizations which are frequently the outcome of harm resulted from climate change. According to **Southerland et al., (2022)** nearly nine out of ten (86%) people who live in urban areas worldwide are exposed to harmful particulate matter amounts, which contribute to the 1.8 million excess deaths globally in 2019. Based on research carried out by **Bein et al., (2021)**, research investigated urban air pollution and related mortality trends in over 13,000 cities worldwide. Also the number of respiratory-related illnesses and deaths is rising as a result of rising greenhouse gas concentrations, air pollution, prolonged heat waves, forest fires, droughts, and floods.

This study evaluates the effect of educational program among nurses' on perception and attitude after adopting green hospitals concept in order to reduce the negative effect on the environment and patients' safety guidelines.

Aim of study:

To evaluate the effect of educational program on perception of nurses regarding green hospital and their attitude towards patient safety guidelines.

Research hypothesis:

H1: Educational program will lead to positive improvement in nurses' perception regarding green hospital.

H2: Educational program will lead to positive attitude of nurses towards patient safety guidelines.

H3: There will be a positive correlation between green hospital and patient safety guidelines.

Research design: A Quasi-Experimental design was utilized to achieve the aim of the study.

Setting: The study was conducted in Adult Intensive Care Unit , Adult Intermediate Care Unit , Open Heart Intensive Care Unit (ICUs) , Pediatric Intensive Care Unit (PICU) and Neonatal Intensive Care Unit (NICU) at Nasser Institute. It is affiliated to the secretariat of specialized medical centers, Ministry of health, Cairo, Egypt. It is one of the largest specialized medical centers and one of the most important providers of health care services in Egypt.

Subject: A purposive sample of 107 nurses constituted the subjects of the study. The sample size was estimated based on the following equation:

$$N \times p (1-p)$$

$$N = \frac{N-1 \times (d^2 \div z^2)}{p (1-P)}$$

N x p(1-p)	=[172*(0.5*(1-0.5))]
N-1	=(172-1)
d ² /z ²	=0.0025 / 2.8561
p(1-p)	=0.5*(1-0.5)
N	= 107.6 = 107

N = Nurses number per ICUs

Z = Class standard corresponding to the level of significance equal to 0.95 and 1.96

d = The error rate is equal to 0.05

p = Ratio provides a neutral property = 0.50

Based on the equation, the sample size was 107 nurses, who were all the available nurses in intensive care units as following:

Intensive Care Units	No. of nurses
Adult Intensive Care Unit	54
Adult Intermediate Care Unit	16
Open Heart Intensive Care Unit	21
Pediatric Intensive Care Unit	8
Neonatal Intensive Care Unit	8
Total	107

Tools:

Two tools were used in the present study as follow:

Tool I: Smart hospitals initiative green hospitals.

a) Structured sociodemographic data to assess nurses sociodemographic characteristics as age, sex, income, residence, educational level, work experience & position.

b) Pre-post perception questionnaire regarding smart hospitals initiative green hospitals, adapted from The Centre for Environmental Sciences (Kaney 2022), for assessing the nurses' perception regarding green hospital. It translated into Arabic. It consisted of (9) domains for green hospital (84 items) as follows: water (7 items), energy and atmosphere (11 items), materials and resources (6 items), indoor environmental quality (19 items), chemical management (11 items), solid waste management (13 items), environmental services (4 items), food services (8 items) and environmentally preferable purchasing (5 items).

Scoring system:

Each item will be measure using five point Likert scale ranged as "strongly disagree = 1 to strongly agree = 5". The total scoring system of this part were distributed as postive perception if nurses had score more than 60% (101); and negative perception about green hospital if nurses had score less than 60% (100).

Tool II: Nurses attitude toward Patient Safety

Pre-post attitude scale, adapted from **the Agency for Healthcare Research and Quality (AHRQ) in the USA (2023)** for assessing the nurses' attitude regarding patient safety guidelines. It was a five points Likert scale, translated into Arabic. It consisted of (44 items) that divided into six main dimensions as follows: work area (18 items), nursing supervisor (4 items), nursing patient communication (6 items), event report (4 items), patient safety grade (1 items), and hospital managerial system (11 items).

Scoring system:

All statements Responses were (strongly agree=5, agree=4, neither=3, disagree=2, strongly disagree=1), the percentage of positive attitude is more than 60% (133) and less than 60% (132) should be considered negative attitude toward patient safety.

Validity and Reliability:

The perception questionnaire and attitude scale were revised by a group of five professors in nursing administration and community health nursing to assess the validity of content. Also, reliability of tools were tested by Cronbach's Alpha test and proved the homogeneity of items and total score of perception questionnaire and attitude scale as follows:

Green hospital perception (Domains)	Cronbach's Alpha
Water	.877
Energy and Atmosphere	.808
Materials and Resources	.869
Indoor Environmental Quality	.510
Chemical Management	.782
Solid Waste Management	.795
Environmental Services	.312
Food Services	.736
Environmentally Preferable Purchasing	.510
Total green hospital perception	.835

Attitude towards Patient Safety Guidelines (Domains)	Cronbach's Alpha
Safety regarding work area	.925
Nursing supervisor	.912
Nursing patient communication	.410
Event reports	.771
Patient safety grade	.586
Hospital managerial system	.896
Total attitude towards patient safety guidelines	.954

Field Work:

Data were collected through six months from April 2023 to September 2023. Pre-test data were collected over one month. The educational program regarding green hospital and patient safety was implemented through one month. As well as three months were following the program end to the post-test data collection over one month.

Program Construction:

The educational program, aimed to improve the perception and attitude of nurses concerning the green hospital and patient safety guidelines, program was planned and designed in several phases as following:

Preparatory phase:

A pilot study was carried out on 11 nurses before starting the actual data collection to test the applicability and clarity of the items included in the

adapted part of the data collection tool. Also to estimate the time needed to complete the questionnaire, and to add or omit items. Accordingly, no modification was needed and the time to answer the sheet was estimated to be from 30 - 50 minutes.

Assessment phase:

Based on the pre-test results, the educational program was constructed. The program main objective was to improve nurses' understanding of elements and benefits of green hospital, and the International Patient Safety Goals (IPSG). Different teaching methods were employed, including lectures, brainstorming, and group discussions. Audiovisual materials such as screen shows, PowerPoint presentations, posters, videos, and handouts additionally were utilized.

Implementation phase:

Nurses divided into small groups each group consisted of about twenty nurses according to work needs and nature in ICUs. Each group was attending two sessions in the morning shift. Each session lasted for about one hour in Arabic language. Continuous and different communication channels were used for additional questions and feedback. Sessions were conducted at the hospital conference hall as follows:

Session 1: Green Hospital: introduction to green management and its goals and importance in healthcare organizations, key stakeholders and related Practices guidance.

Session 2: Patient Safety: introduction to Patient Safety, related guidelines, developing an implementation timeline, and role of nurse in ideal implementation.

Evaluation phase:

After the program implementation by three months, the post-test evaluation was carried out to assess the effect of the educational program on nurses' perception regarding green hospital, and their attitude towards patient safety guidelines.

Ethical Considerations:

Study proposal and data collection tools were reviewed and approved by Research Ethics Committee - Faculty of Nursing - Modern University for Technology and Information (MTI), Cairo, Egypt, with Formal Approval Number (FAN/68/2023).

The agreement letter for carrying out the study was obtained from the general director of Nasser Institute. Purpose and benefits of the study were clarified for participated nurses by authors. Verbal and written consents were obtained from nurses. Nurses participated in the study were assured by keeping confidentiality of their data. They were also informed their own right in withdrawing at any phase from the study.

Statistical Analysis:

SPSS version 24.0 was used in data entry and statistical analysis. Presenting of qualitative variables were in frequency & percentage. Quantitative variables were presented in mean & standard deviation. The normality of study variables was assessed by using Kolmogrov Smironov test. Wilcoxon signed ranks test was used in testing the differences of non-parametric variables for green

hospital perception and attitude towards patient safety guidelines and also for all related domains. Correlation among qualitative variables were tested by Spearman correlation coefficient for nurses' perception and attitude. The correlation between nurses' sociodemographic data and perception & attitude that could assess the predictors was tested by linear regression fitting model.

Results:

Table (1): Distribution of nurses regarding socio-demographic and work data (n=107):

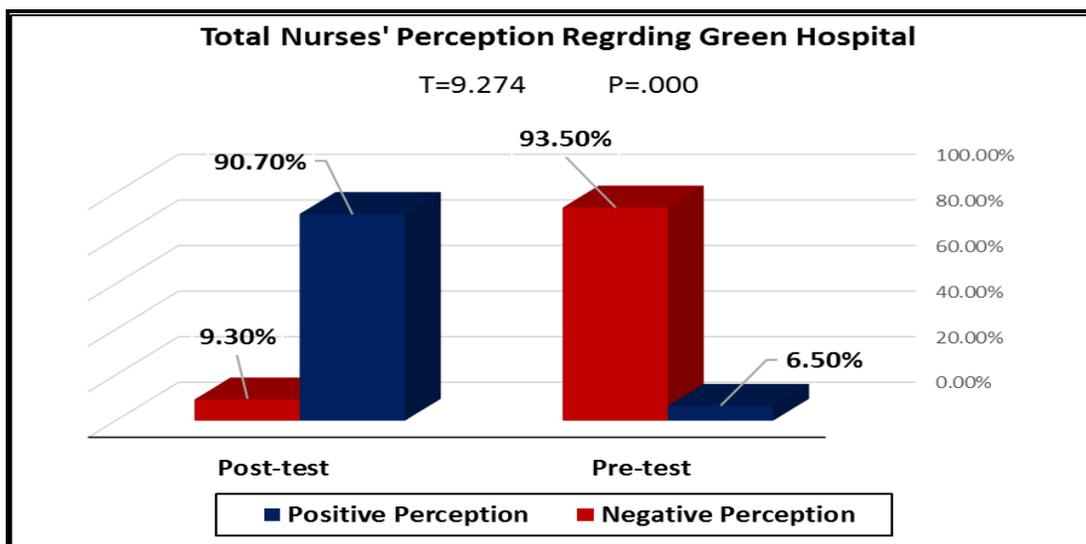
Socio-demographic & work data	N	%
Age (years):		
Mean±SD	37.37±8.36	
Median	36.0	
Sex:		
- Male	43	40.2
- Female	64	59.8
Income:		
- Enough and save	12	11.2
- Just enough	33	30.8
- Not enough	62	57.9
Residence:		
- Urban	40	37.4
- Rural	67	62.6
Educational level:		
- Diploma/technical nursing	20	18.7
- BSc of nursing	44	41.1
- MSc of nursing	21	19.6
- PhD in nursing	22	20.6
Work experience (years):		
Mean±SD	13.28±8.21	
Median	12.0	
Nursing position at hospital:		
- Nursing Director/Supervisor/Head nurse	33	30.8
- Nursing Specialist	30	28.0
- Quality Assurance/Infection Control Nursing	11	10.3
- Nursing Research/Informatics	11	10.3
- Nursing Education	12	11.2
- Staff nurse	10	9.3

Table (2): Pre-test and post-test comparison of nurses' perception regarding green hospital:

Domains of Green Hospital Perception	Pre-test		Post-test		T	p
	N	%	N	%		
Water:						
- Positive Perception	22	20.6	87	81.3	8.062	.000
- Negative Perception	85	79.4	20	18.7		
Energy and Atmosphere:						
- Positive Perception	11	10.3	65	60.7	7.348	.000
- Negative Perception	96	89.7	42	39.3		
Materials and Resources:						
- Positive Perception	6	5.6	90	84.1	9.539	.000
- Negative Perception	101	94.4	17	15.9		
Indoor Environmental Quality:						
- Positive Perception	32	29.9	43	40.2	3.317	.001
- Negative Perception	75	70.1	94	59.8		
Chemical Management:						
- Positive Perception	6	5.6	65	60.7	7.681	.000
- Negative Perception	101	94.4	42	39.3		

Domains of Green Hospital Perception	Pre-test		Post-test		T	p
	N	%	N	%		
Solid Waste Management:						
- Positive Perception	22	20.6	44	44.1	4.690	.000
- Negative Perception	85	79.4	63	58.9		
Environmental Services:						
- Positive Perception	31	29.0	96	89.7	8.062	.000
- Negative Perception	76	71.0	11	10.3		
Food Services:						
- Positive Perception	21	19.6	65	60.7	6.633	.000
- Negative Perception	86	80.4	42	39.3		
Environmentally Preferable Purchasing:						
- Positive Perception	31	29.0	96	89.7	8.062	.000
- Negative Perception	76	71.0	11	10.3		

Wilcoxon Signed Ranks Test



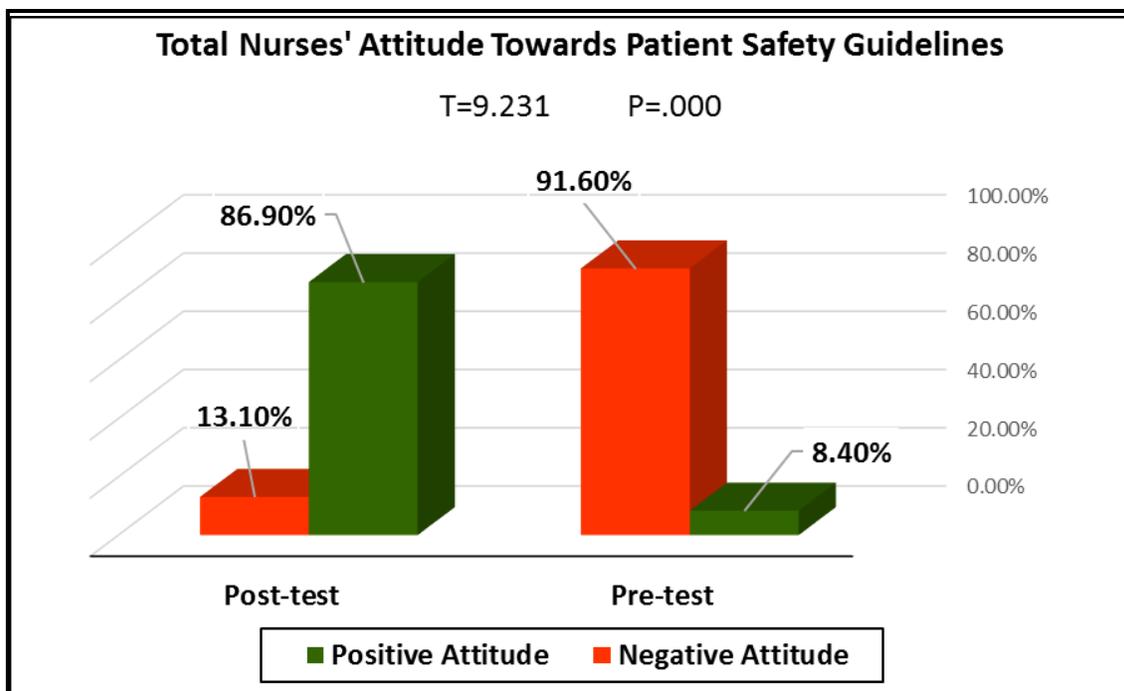
Wilcoxon Signed Ranks Test

Figure (1): Pre-test and post-test comparison of total nurses' perception regarding green hospital:

Table (3): Pre-test and post-test comparison of nurses' attitude towards patient safety guidelines:

Attitude Towards Patient Safety Guidelines	Pre-test		Post-test		T	p
	N	%	N	%		
Safety regarding work area:						
- Positive Attitude	33	30.8	105	98.1	8.602	.000
- Negative Attitude	74	69.2	2	1.9		
Nursing supervisor:						
- Positive Attitude	11	10.3	54	50.5	4.583	.000
- Negative Attitude	96	89.7	53	49.5		
Nursing patient communication:						
- Positive Attitude	2	1.9	76	71.0	7.672	.000
- Negative Attitude	105	98.1	31	29.0		
Event reports:						
- Positive Attitude	20	18.7	74	69.2	7.351	.001
- Negative Attitude	87	81.3	33	30.8		
Patient safety grade:						
- Positive Attitude	11	10.3	86	80.4	8.718	.000
- Negative Attitude	96	89.7	21	19.6		
Hospital managerial system:						
- Positive Attitude	21	19.6	103	96.3	8.598	.000
- Negative Attitude	86	80.4	4	3.7		

Wilcoxon Signed Ranks Test



Wilcoxon Signed Ranks Test

Figure (2): Pre-test and post-test comparison of total nurses' attitude towards patient safety guidelines:

Table (4): Correlation between the nurses' socio-demographic data and their post-test total perception of green hospital & attitude towards patient safety guidelines: (Linear regression model)

Dependent variables	Predictors	Unstandardized coefficients		Standardized coefficients	F	T	Sig.	R-square
		B	Std. Error	Beta				
Total green hospital perception	(Constant)	-.305-	.767		17.444	-.397-	.692	55.2
	Age	.026	.026	.740		.979	.330	
	Sex	-.038-	.061	-.064-		-.622-	.535	
	Income	-.205-	.055	-.428-		-3.699-	.000	
	Residence	.031	.069	.052		.449	.654	
	Education	.300	.103	.409		2.905	.005	
	Experience	.012	.026	.338		.463	.644	
	Position	.672	.139	1.067		4.842	.000	
Total attitude towards patient safety guidelines	(Constant)	2.026	.871		10.357	2.326	.022	42.3
	Age	.001	.030	.027		.032	.975	
	Sex	-.005-	.069	-.009-		-.076-	.939	
	Income	.010	.063	.020		.153	.879	
	Residence	.486	.078	.815		6.193	.000	
	Education	-.489-	.117	-.668-		-4.175-	.000	
	Experience	-.002-	.029	-.045-		-.054-	.957	
	Position	-.030-	.158	-.047-		-1.188-	.851	

Table 5: Correlation between pre-test post-test total nurses' green hospital perception and their attitude towards patient safety guidelines:

Spearman correlation coefficient				
Total green hospital perception	Pre-test		Post-test	
	r	p	r	p
Total attitude towards patient safety attitude	.256**	.008	.399**	.000

(**) Correlation is significant at the 0.01 level

Table (1): Clarifies that the mean age of nurses was 37.37 ± 8.36 with 36 years of their median age and 59.8% of them were female. Also 62.6% of nurses were living in rural areas with not enough monthly income for 57.9% of them. The nursing bachelor degree was for 41.1% of them and nursing PhD was for 20.6%. In addition to 30.8% of them were occupied the nursing positions of head nurses, supervisors and directors. The mean years of experiences for them in the same hospital was 13.28 ± 8.21 with 12 years of median experience.

Table (2): Illustrates an improving in the nurses' perception regarding all green hospital domains. The most improvement in the post-test positive perception was in the environmental services and environmental preferable purchasing domains by 89.7% for both of them. Also the positive perception in materials, resources and water domains were improved through the post-test by 84.1% & 81.3%. There were statistical rank differences between all pre-test and post-test domains of green hospital perception.

Figure (1): Shows improvement in the total positive green hospital perception among nurses from 6.5% to 90.7% after the educational program, with a statistical rank difference between total pre and post nurses' perception.

Table (3): Detects an improving in nurses' attitude towards patient safety guidelines. The major post-test improvement was in their post-test attitude towards safety regarding work area and hospital managerial system (98.1% & 96.3%). Also the post-test attitude towards patient safety grade and nursing patient communication were improved by 80.4% & 71.0%. There were a statistical rank differences between all pre-test and post-test patient safety guidelines domains.

Figure (2): Reveals improvement in the total nurses' positive attitude towards patient safety guidelines from 8.4% in pre-test to 86.9% in post-test. Also there was a statistical rank difference between total pre-test and post-test attitude of nurses towards patient safety guidelines.

Table (4): The linear regression model clarifies a post-test significant correlation between nurses' sociodemographic data and their total green hospital perception (income, position and educational level). This regression model reports 55.2% of the predictors which affect the post-test of nurses' total green hospital perception. This model also detects another post-test significant correlation between nurses' sociodemographic data and total attitude towards patient safety guidelines (residence and educational level). The model reveals 42.3% of the predictors which affect the nurses' total attitude towards patient safety guidelines.

Table (5): Reported a significant positive correlation between nurses' total green hospital perception and their attitude towards patient safety guidelines through the pre-test and post-test phases ($r = .256$ & $r = .399$).

Discussion:

Green hospitals are considered one of the solutions facing the challenges of urbanization which appeared with the advent of technology. Green buildings, in general, are those that are friendly to the environment and have the potential to both reduce their passive impact and have positive effects on the environment throughout their life cycle (Wang et al., 2022). Creating a green hospital environment help patient quick recovery, using renewable energy sources, and developing green buildings to save energy usage, those are a few examples of green healthcare initiatives. According to Darnall, et al., (2018) in order to achieve patient safety, management must set green goals, to evaluate the number of green incidents, the use of environmental responsibility, and the successful communication of environmental policy should be within their operational scope.

It was observed from the current study that there was an improvement in the nurses' perception regarding all green hospital domains. In the domains of environmental services and environmentally preferred purchases, three fourth of the study sample showed improvement in their positive post-test perceptions (Table, 2).

Concerning environmental services, such as procure cleaning materials which help environment to be less toxic. Also using recycle for disposable paper products which prohibit products that are manufactured with carcinogens and asthma-causing agents. The researchers depicted that more than two third of the study sample had negative perception before program and increased to more than three fourths which revealed that nurses acquire a more profound comprehension of the function of environmental services in hospital environments.

This is in the same line with a study conducted by Ibrahim, et al., (2023) to enhance nurses' performance through developing a risk management training strategy. Their findings indicated that prior to training, one third of nurses' overall knowledge was deemed satisfactory in relation to risk management dimensions. The knowledge score increased to be more than three fourth of nurses with satisfactory practice following training.

Also a study which was conducted at Ministry of Health, Kuwait City by Abdo, et al., (2019) to evaluate the teaching program offered for improving the knowledge, attitudes, and practices of environmental service workers with regard to the

handling of sharps waste. After conducting the interventional educational program, found an improvement in all areas of the knowledge, related to sharps and waste management by less than two third of the study sample.

This finding also is in congruence with a study which is carried out by **Letho et al. (2021)** who applied an observational cross-sectional study to assess the awareness and practice of medical waste management among health care providers in Bhutan one of Indian hospitals, they showed that about less than two thirds of study sample appropriately separated the general garbage according to national regulations. But unfortunately, more than half of hospital garbage is not separated into general and infectious waste, meaning that half of the waste is not being carried properly based on the proper segregation process.

As for environmental preferable purchasing it was found that more than two thirds of study sample had negative perception before program and a remarkable improvement was found in three-quarters of the sample after program implementation, the researchers concluded the importance of educational program which equipping nurses with wide background they need to understand how different products and services affect the environment. These principles helps them to perceive how significant it is to choose the best environmentally friendly products and services that are ecologically friendly.

On the other hand emphasize on nurse managers' role to participate in the purchasing stage to ensure that the purchases are in line with the overarching goal to reduce solid waste generation and disposal. In Egypt, nurse managers as a member of the board of directors have the rights and lead to suggest purchases of equipment after knowing what has a better impact on the environment, and this also appeared higher in the post-test.

Based on the findings of **Dubey et al., (2015)**, who recommended that hospitals should identify, utilize, and disseminate standards that reduce destructive effects without compromising performance or cost-effectiveness. This recommendation came out from the exposure of environment which affected by severely harmed through the procurement of supplies. The total green hospital perception of nurses demonstrated positive perception ranged from less than third of the sample to a majority in all domains. There were statistical differences between all pre-test and post-test domains and total green hospital perception (Figure, 1). This is due to nurses participation in green initiatives is frequently encouraged by educational program. Engagement in these activities increases staff members' commitment to the program's success and fosters a more favorable concepts of the hospital's green initiatives.

For instance, **Yanamandra & Alzoubi (2022)**, stated in their research that when low-value garbage is converted by recycling into secondary building materials as a method of material and resource domain, companies can encourages reuse, cuts waste, and conserves natural resources, all of which benefit the materials and resource sectors. One effective approach to managing medical waste seems to be management and healthcare professional education.

In fact, one of the biggest obstacles to implementing ecologically sustainable practices was found to be a lack of information. Further research conducted by **Wu & Cerceo (2021)**, supports this data by stating that change-promoting and change-maintaining the healthcare system need continueing education at all levels.

It was observed from the current study results that there was an improvement in the nurses' attitude regarding domains of patient safety guidelines after conducting the educational program. The majority of study sample illustrated a positive attitude in the items of safety regarding work area and hospital managerial system after program conduction which was indicated in the post-test. There is also a noticeable improvement and enormous difference in patient safety grade and nursing patient communication which lead to work environment to be safer for patient life by more than three fourths and more than two thirds of nurses. There were statistical differences between all pre-test and post-test patient safety domains and total attitude. From the researchers' point of view, there were a numbers of reasons shown by the majority of the research participants exhibiting a positive shift in attitude toward safety following the program's implementation, including enhanced program, better communication, and the introduction of safety guidelines may have had a more positive mood as a result of working in a more safe and orderly workplace (Table, 3) (Figure, 2).

Also despite the fact that the largest numbers in the research sample were nursing director, supervisor and head nurse respectively, safety concerns were effectively addressed and participants' perceptions of safety were improved after program implementation which causes the favorable shift in nurses attitudes.

In this context **Ibrahim, et al., (2023)** clarifies in a study which conducted at Elaraby Hospitals in Egypt that, about two thirds of the studied patients have high total level of safety post educational program, more than one third of them have moderate level. Beside that researchers concluded that there is a statistically significant difference between total patient safety pre and post the educational program. Another study conducted in France by **Bentahar, et al., (2022)**, who concluded that there is a statistically significant

difference between total patient safety post educational programs compared to pre-educational program. Work in green supply chain taxonomy in healthcare considers critical factors for a proactive approach, when an intra-case and a cross-case analysis were implemented.

Also, the current study was consistent with **Wahl, et al., (2022)**, who conducted a study in Sweden's Neonatal Care Unit. Researchers used an intervention program on nurses to measure the extent of their adherence to the guideline, and accordingly, the patient safety level was measured. They found that two thirds of patients have high total level of safety post intervention, more than one third of them have moderate level, but more than one third of them have low level.

Kim, et al., (2022), mentioned in a cross-sectional survey which was conducted in Korea, intended to investigate the canonical relationships between person-centered care characteristics such as professional patient safety culture, nurse patient safety activities. It was concluded that, participation in patient safety systems enhanced the level of patient safety activities in hospitals; therefore, the study reports an increase in the level of activities compared with prior studies.

As for the current study results of correlation between nurses' green hospital total perception and sociodemographic data, there were many significant associations. The post-test findings demonstrated a significant association between their overall perception of green hospitals and sociodemographic and employment variables (income, position, educational level), which was proved by the linear regression model. Regression analysis of model revealed that more than half of the factors influencing the overall total nurses' perceptions of green hospitals. There was no relationship between nurses' perception regarding green hospital and their age, sex, residence and experience. Researchers viewed that although most of the research sample had bachelor's degrees and least had master's and doctorate, however the nurses values, beliefs, and norms about what is important in a health care organization were marked by evidence of changing in nurses' perception (Table, 4).

This study findings is in accordance with a study conducted by **Wang, Guo, et al., (2022)** to explore factors contributing to the sustainability of nursing leadership and their correlation relatively to nurse managers in healthcare institutions. The data were analyzed using multiple linear regression, correlation, and descriptive models. There was a substantial correlation between the dependent variable (nurse leadership knowledge) and the linear combination of the independent variables (demographic data). The

dependent variable has significant regressions from both behavior and problem-solving skills.

Similarly to **Abd-Elrhaman, (2018)** whose discovered in their research that there was a positive statistically significant correlation between years of experience and educational level for head nurses' transformational leadership style post-test,

The linear regression model in the current study also finds a substantial association between sociodemographic characteristics and total nurses' attitude towards patient safety guidelines (residence, educational level). The model identifies 42.3% of the factors that influence the total nurses' attitude towards patient safety guidelines. From the researcher's point of view this result can be clarified that there is a significant correlation between total nurses' attitude towards patient safety guidelines and sociodemographic, and willingness of nurses' to improve the patient condition when applying safety guidelines in workplace (Table, 4).

Another reason which prompted nurses to search for modern research trends and contemporary problems that threaten human lives such impact of climate change on health. For this reason nurses were able to learn about the risks caused by the environment, thus increasing their passion for knowing the sources that affect environmental services. Sometimes emphasis on certain actions is important to achieve better results, such as safe disposal of waste.

Another multiple linear regression was done to assess the correlation between nurses' educational level and patient safety level in the study of **Rahman et al., (2015)** in medical surgical wards in private hospitals of Malaysia. Conversely study indicated that nurses' educational level did not significantly affect the patient safety. Moreover, registered nurses with a bachelor degree were not significantly affecting patient safety compared with diploma nurses.

On the other hand, there was a multiple linear regression used by **Akologo et al., 2019** in a cross-sectional survey in Ghana upper east hospitals to assess patient safety determinants among healthcare workers. This linear regression reported that no correlation between patient safety culture and age and gender. Also **Ayisa, et al., (2021)** cross-sectional study in Ethiopia used a multiple linear regression, which approved a correlation between patient safety culture and sex, age, educational level of care providers and years of experience. It revealed that female care providers had higher culture of patient safety.

According to the present study results, there was a significant positive correlation between nurses' total green hospital perception and their attitude towards patient safety guidelines through the pre-test and post-test (Table, 5). The current study results also

supported by Ibrahim, et al., (2023), who examine the effect of a green management teaching program for nursing management staff on patient safety. There was a high positive statistically significant correlation between overall knowledge and total patient safety before and after the educational program.

While, the study of Aly, EL-Shimy, & EL-Sayed (2021) in Egypt approved no statistical significant correlation between factors influencing patient safety in two educational hospitals through work environment, organizational & management and institutional context. Those factors were considered as parts of the green hospital dimensions.

Conclusion:

After the educational program conduction, researchers detected the improvement in the positive nurses' perception regarding green hospital and their positive attitude towards patient safety guidelines. Nurses' perception regarding green hospital and attitude towards patient safety guideline revealed a strong positive correlation.

Well-designed educational programs can play an effective role in empowering nurses adopt responsible practices, towards application of both green hospital and patient safety guideline.

To ensure the sustained effect of green hospital and patient safety guidelines, such educational programs are needed. In addition to, continuous monitoring and related evaluation are essential.

Recommendations

In light of the previous findings, the following recommendations should be followed:

1. Green hospital management should be implemented nationally to be in line with the sustainable development goal and Egypt vision 2030.
2. Conduct periodic educational program regarding patient safety guidelines to improve related nurses' attitude.
3. Purchase materials with better options for recycling, disposing, and remanufacturing.
4. Green hospital principles should be included in undergraduate nursing curriculum as new trend concept to reduce the harm of climate change health consequences on patients.
5. Further study should be implemented in different healthcare settings.

Data Availability Statement: All data presented in the study are available in case of being requested from the corresponding author.

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