Relation between Nurses' Perception of Using Technological Medical Devices and Patient Safety at Intensive Care Units

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Abstract

Background: Due to ongoing research and the advancement of new technology, critical care settings are experiencing rapid changes in patient demand and the provision of patient care. **Aim:** To assess relation between nurses' perception of using technological medical devices and patient safety at intensive care units. **Design:** correlational research design. **Setting:** This study was conducted at Neurological and Surgical Intensive Care at Tanta Main University Hospital. **Subjects**: All nurses (115) who were working within the already specified setting were included All nurses (115) who working in the previously mentioned setting were included. **Tools**: Three tools were used in the process of data collecting. **Tool I**: Nurse Perception regarding Technological Medical Devices. **Tool (II):** Patients' Safety Checklist regarding Use of Technological Medical Devices. **Tool (III):** Nursing Practice Observational Checklist regarding Use of Technological Medical Devices. **Results**: It was revealed that most of the nurses had high perception level of the positive aspect of technological devices. On the other hand most of the studied nurse had a low perception level of the negative aspect of technological devices, there was a significant statistical association between total perception level, total safety level and total practice level respectively were r = 0.693 , 0.000** , r = 0.359 , 0.000** respectively. **Conclusion:** There were statically significant correlation between total perception level and total safety level. **Recommendations:** Updating the nurse's knowledge and safety practice about positive and negative aspect of using technological medical devices in patient care and applying the study on larger probability sample.

Key words: Nurses perception, technological medical devices and patient safety

Introduction

A specialized department within a hospital, the Critical Care Unit offers intensive care and presents the biggest challenge for machine technology in nursing. In these environments, machines play a critical role in patient care by providing life support and managing patient care. The creation of ICU facilities enabled the treatment of severely ill patients **(Wung, 2018).**

No matter the machines' intended uses and functions, nurses must still deliver safe and high quality care to patients. The essential role that technology plays in patient care, particularly in the ICU, which relies heavily on cutting-edge technology, offers a unique chance to enhance patient care and results. Nevertheless, there may be difficulties for ICU staff in effectively using, updating, and up keeping these devices **(Alsohime et al., 2021).**

Medical devices with technology can improve patient' safety through automation, alerting for medications, reminding clinicians of important information, better diagnostic and consultation reports, sharing information, enhancing clinical decision-making, preventing errors, standardizing practices, addressing staff shortages, and ensuring complete patient information **(Henriksen et al., 2021)**.

The National Quality Forum (NQF) stated that patients in the US healthcare system face a greater chance of being exposed to preventable medical errors than those in other advanced nations. The National Quality Forum (NQF) states that the U.S. healthcare system experiences more than 10,000 medical mistakes per day, leading to around 44,000 to 98,000 injuries and fatalities annually. Preventable errors cost an estimated 20 billion dollars annually, including healthcare costs, disability, and reduced productivity. Healthcare costs are increasing by seven percent every year while patient safety is only rising by one percent annually **(Rhagnanan-Kramer, 2020)**.

The impact of technology in ICU has greatly affected patient care and nursing practice in the past 30 years, with continuous advancements leading to a transformation in nursing practice. Nurses and healthcare professionals employ more than 5,000 medical devices with technology **(Rhagnanan-Kramer, 2020)**. Technology usage is on the rise in healthcare, aiming to enhance care quality and simplify tasks for healthcare workers. Nurses make up the biggest group of healthcare workers. It was foreseen that nurses will need to serve as advisors for technological tools and information systems, as well as act as interpreters for colleagues and patients in the future **(Rezayi et al., 2022)**.

Nurses have various considerations regarding medical devices. While certain nurses see medical technology as beneficial for enhancing patient results, others perceive it as causing stress, being time-consuming, and encroaching on nursing independence. Nurses encounter both favorable and unfavorable experiences when utilizing technology in nursing practice **(Rutanen et al., 2019)**.

Nurses mentioned that technology had a detrimental impact on communication between nurses and patients, as well as on the individualization of patient care. They stated that dealing with technology was challenging and led to moral distress because of the ethical dilemmas arising from the use of advanced technology and procedures to extend patients' lives. Nevertheless, the nurses admitted that technology made patient care in the ICU easier and enhanced nursing practice.

Discovering creative methods to incorporate modern technology in nursing practice plays a vital role in pushing the nursing field forward **(Ozan & Duman, 2020)**.

Significance of the study:

Focus on utilizing advanced medical technology in providing nursing care for severely ill patients has been continuously growing in Egypt during the last ten years. Using advanced and innovative technologies is a vital aspect of current nursing practice, which includes modern tools such as ventilators, pumps, and transducer monitoring systems that assist in managing and treating patients to ensure their biological and physiological functions are maintained **(Saleh, 2021).**

Globally, more than 1.5 million medical devices and healthcare technologies are used for providing care **(Rhagnanan-Kramer, 2020)**. Hence, it was crucial to evaluate nurses' current views on how technological medical devices impact patient safety in critical care units. This would assist in focusing on the positives and minimizing the negatives to maintain optimal health, reduce risks, ensure patient safety, and deliver effective care **(Jyh et al., 2018)**.

Aim of the study: to Assess the relation between nurses' perception of using technological medical devices and patient safety at intensive care units

Research questions:

- What is the level of nurses' perception of using technological medical devices?
- What is the relation between nurses' level of perception regarding use of technological medical devices and patient safety?

Subjects and method:

Study design: A correlational research design was utilized.

Study Setting:

This study was conducted at Neurological Intensive Care Unit and Surgical Intensive Care Unit at Tanta Main University Hospitals, which was affiliated to Ministry of Higher Education and Scientific Research The two units are equipped with the same technological medical devices required for patient care.

Study Subjects: All nurses (115) who are working in the previously mentioned setting and provide direct care for critically ill patients were included. Surgical Intensive Care Unit includes (80) nurses and Neurological Intensive Care Unit includes (35) nurses.

Tools of data collection:

To achieve the aim of the present study the data was collected using the following tools.

Tool I: Nurse Perception Regarding Technological Medical Devices: Part (A): Socio-demographic Characteristics of The Nurses: It was developed by the researcher and was included data about age, gender, level of education, years of experiences, and training courses on technological equipment. **Part (B): Nurse's Perception Regarding Use of Technological Devices Questionaire:** It was adopted from **(kiekkas et al., 2006)** and modified **by (Adel et al..., 2014),** and was used to assess nurse perception regarding use of technological medical devices. It included two subscales as the following:

(A)Positive effect of using technological devices: It included six items related to the positive aspects of technological medical devices on patient care and nursing practice

(B) Negative effect of using technological devices: which included eight items related to the negative aspects of technological equipment on patient care and nursing practice

Scoring system: The responses were measured on five points likert scale ranging from 1 to 5 as strongly disagree =1, disagree=2, neutral=3, agree=4 and strongly

agree=5. Scoring on negative effects items reversed for analyses purpose only. Total scores calculated by summary of categories as the following: High level of nurse perception ≥ 80%. Moderate level of nurses' perception ≥ 60 - < 80%. Low level of nurse perception < 60%.

Tool (II): Patients' Safety Checklist Regarding Use of Technological Medical Devices:

The researcher developed it after reviewing of the relevant literature **(Tlili et al., 2022; Porte et al., 2018).** It involved assessment safety measure related to defined technology of equipment as the use of novel mechanical ventilator, smart pumps and transducing monitoring system. It included observational checklist of four dimension as following: Safety measures related to environment, nurses, patients and medical devices.

Scoring system: The responses for all dimensions measured by observational checklist, categorized as present scored (1), and not present scored (0) and classified based on statistical cut of point as the following: Fully met safety 80-100%. Partially met 60 - < 80 %. Not met < 60%.

Tool (III): Nursing Practice Observational Checklist Regarding Use of Technological Medical Devices: It was developed by the researcher after reviewing the literature **(Botros et al., 2019; Zaborowski, 2018; Wiegand, 2016).** It was used to assess nursing practice regarding technological medical devices, observation checklist covered the following three types of technological devices such as smart pumps, mechanical ventilator and transducing monitoring system

Scoring system:

The observed practice was measured by two levels of score for each device used as following: done was scored (1), not done was scored (0) the scoring system calculated and classified as the following: Satisfactory level of practice will be > 80 %. Un satisfactory level of practice will be < 80 %.

Method

The following steps were taken to complete the study.

2. **Obtaining approval**:

Obtaining approval prior to commencing the research, official authorization was sought from the dean of the Faculty of Nursing and the administrators of the Surgical and Neurological ICU at Tanta University Hospital. This authorization was granted to enable the researcher is required to gather data at the specified site.

3. Ethical and Legal Considerations:

a) Ethical committee approval was acquired from the Faculty of Nursing Tanta University before conducting the study with code No. (210-2-2023) was obtained.
b) The core of the research did not induce any discomfort to any of the participants.
c) Confidentiality of data of the nurses was taken into consideration regarding data collection.
d) An informed consent was taken from each participant in the study after explaining the aim of the study. All participants were notified of the study's objective and their option to withdraw whenever they chose.

3- Tools development:

Tool (I) of the study was adopted from (**kiekkas et al., 2006)** and modified **by (Adel et al..., 2014).** The researcher developed Tool (II) after reviewing the relevant literature **(Tlili et al., 2022; Porte et al., 2018)**. **Tool (III)** was developed by the researcher after reviewing the relevant literature **(Botros et al, 2019; Zaborowski, 2018& Wiegand, 2016).**

4- Validity of the tools:

A panel of five Jury specializing in critical care and emergency nursing, as well as intensives evaluated the clarity and content validity of each instrument prior to its

utilization

4-Reliability of tools:

All tools were tested for reliability using Cronbach's α coefficient test and it was. Tool I is 0.922 for 19 items applied on 12 nurses. Tool II is 0.781 for 58 items applied on 12 nurses.Tool III is 0.906 for 80 items applied on 12 nurses. The sheet in total is 0.881 for 157 items applied on 12 nurses.

6- A pilot study:

It was conducted on 10% (12 of nurses) of the study sample to test the feasibility and applicability of the tools and to determine any obstacles that may encountered during the period of data collection, accordingly, needed modification was done, and pilot study was excluded from the study subjects

7- Data collection:

Data were collected within 6 months started from the first of April 2023 to the end of September 2023.

8- Tools of data collection was developed and translated into Arabic by the researcher.

The study was carried out into four phase:

1-Preparing phase:

- Met the head nurse, introduce myself, explained the aim of the study and take acceptance for collecting data
- Estimate the appropriate time for meeting the staff nurse about 15 minute
- Collect staff nurse on the nurse station
- Introduce myself to the staff nurse, explained the aim of the study
- Explain the questionnaire sheet items, given the staff opportunities red clearly and asked for more questions

e) Estimate the time required for data collection: It is estimated that it will take around 5 minutes for nursing staff to complete the questionnaire items. Observational checklist, varied according to patient status and type of technological medical devices attached to him and availability of nurses who responsible for the patient.

2- Assessment phase:

- Assessment of nurses by using tool I nurse perception regarding technological medical devices: by using Part (A): Socio-demographic characteristics of the nurses: to collect data about age, gender, level of education, years of experiences, and training courses on technological equipment.
- Assess nurse perception regarding use of technological medical devices by using Part (B): nurse's perception regarding use of technological devices: It included two subscales as following: part (A) positive effect of using technological devices, and using part (B) negative effect of using technological devices.
- Assessment of safety measure related to the use of novel mechanical ventilator, smart pumps and transducing monitoring system. It included observational checklist of four dimension as following: Safety measures related to environment, nurses, patients and medical devices by using Tool (II).
- Assess nursing practice regarding use of technological medical devices, observation checklist covered the following three types of technological devices such as smart pumps, mechanical ventilator and transducing monitoring system by using Tool (III).

3-Implementing phase:

1-The nurse was given the questionnaire sheet, and the subjects provided their answers in front of the researcher to ensure that every question was addressed in order to fill tool I.

2-The researcher assessed the patients' safety regarding use of technological medical devices.

It included observational checklist of four dimension as following: Safety measures related to environment, nurses, patients and medical devices.

3-The researcher assessed nursing practice regarding use of technological

medical devices. It included observational checklist to assess nursing practice regarding use of technological medical devices that covered the following three types of technological devices such as smart pumps, mechanical ventilator and transducing monitoring system

Results

Table (1) Illustrates Distribution of the studied nurses regarding their sociodemographic characteristics. In This result, it was showed that, the majority (86.1%) of staff nurses age were in age group of (21-<30) years with mean ± SD (26.61±3.703) year, and more than half (59.1%) of studied nurse were female. Regarding to educational level, two third (60.0%) of staff nurses had Bachelor and around more than half (58.3%) had experience less than five years old with mean ± SD (4.21±3.498) and more than the half (59.1%) of studied nurse do not receive training course on technological equipment.

Table (2) Illustrate distribution of the studied nurses regarding their positive perception of using technological devices. It was noticed that about two third (67.8%) of studied nurse strongly agreed that the using of technological medical devices ensured patient safety as prompt and proper recognition of complications or adverse effects through safety features that helped to control of critical situations. Additionally about two third (65.2%) agreed that it provided professional improvement for nurses by acquired updated knowledge and provided the opportunity to learn new skills. Also about two third (62.6%) agreed that it helped the nurse to overcome the shortage of nurses.

Moreover about the half (52.2%, 49, 6%, 46,1%) of the studied nurse agreed that it provided higher care effectiveness, achieved better patient outcomes, enabled adequate and direct care by performed physiological measurement activity, saved a significant amount of nursing time by taking on nursing procedures and performing tasks, allowing for quicker and easier completion of nursing duties by executing tasks with reduced fatigue and workload, while continuously monitoring vital parameters and documentation" respectively.

Table (3) Demonstrated the Distribution of the studied nurses regarding their negative perception of using technological devices. This table revealed that, the majority (83,5%) of studied nurse disagreed that using technological medical device wasted patients' time, such as spent a lot of time on medical devices, instead of caring for patients. While about three quarters(71,3%, 70,4%) of them disagreed that it diverted attention from patients by focused attention on medical devices and technical skills rather than their physical needs and minimized attention to the emotional/psychosocial needs of patients or overlooked the human characteristics of patients respectively.

About half (52,2%, 52,1%, 51.3%) of the studied nurse disagreed that it increased complications resulting from nursing staff errors such as improper handling of devices and misinterpretation of data provided by machines, increased dependence on other health care professionals and limited decision-making due to lack of skill or mechanical error, increased patient risk due to mechanical failures such as equipment failure due to defective manufacturing or poor maintenance respectively.

Half of the studied nurse (50.4%) are neutral that it increased pressure on the nursing staff, such as psychological pressure and a feeling of uncertainty about unpredictable harmful effects, due to the nature and complexity of medical devices and many

devices connected to the patient. About one third (34.8%) of them neutral that it cause feeling the nurses of lack of self-confidence and low self-esteem due to lack of experience in dealing with devices.

Table (4) Showed the Mean scores and ranking of the studied nurses according their perception domains regarding technological devices. This table reveal that, the majority (83.23%) of studied nurse had perceived the positive effect of using technological devices followed by negative effect of using technological medical devices, in addition total average min (39), total average max (62) and total perception Mean ± SD (52.54±5.532).

Table (5) Showed the Mean scores and ranking of the safety measures domains of the studied nurses regarding technological devices. This table revealed that, 75% of the studied nurse applied environmental safety measures followed by nurse safety measures related to use of device (73.06%), then Technological devices safety measures (61.25%) and finally (56.67%) perform patient safety measures with total Min (8), total Max (54) and total safety Mean ± SD (40.11±10.471) of total safety domain.

Table (6) Showed the percent mean scores and ranking of the practice domains of the studied nurses regarding technological devices. This table revealed that, about three quarter (74.65%) of studied nurse had the highest mean percentage of practice domain related to mechanical ventilation compared to the other technological device practice domain .With total Min (15), total Max (76) and total practice Mean ± SD 55.29±15.465.

Table (7) Represented the Percentage comparison and correlation between perception level of the studied nurses regarding technological devices, safety level and their practice level. This table revealed that, there was a significant statistical association between nurse perception level and total safety level of the nurses where P 0.000*, also there were a significant positive correlation among total perception level, total safety level and total practice level respectively were r = 0.693 , 0.000** , r = 0.359 , 0.000** respectively.

Table (8) Represented Relation between socio-demographic characteristics of the studied nurses and total perception score regarding technological devices. In this table, there are significant relation among the age, years of experience and training course on technological equipment of studied nurses and total perception score (where P = 0.000*, P = 0.000*, P = 0.003* respectively.

Table (9) Relation between socio-demographic characteristics of the studied nurses and total safety measures score regarding technological devices. This table revealed that, there are significant relation among the age and years of experience on technological equipment of studied nurses and total safety measures score (where P = 0.002*, P = 0.000*) respectively.

Table (10) Represent relation between socio-demographic characteristics of the studied nurses and total practice score regarding technological devices. It was observed that, there are significant relation among the age and years of experience on technological equipment of studied nurses and total practice score (where P = 0.003*, P = 0.000*) respectively.

Table (1): Distribution of the studied nurses regarding their sociodemographic characteristics.

Characteristics	The studied nurses (n=115)	
	N	%
Age (in years)		
(21-<30)	99	86.1
(30-<40)	16	13.9
Range	**(21-38)**	
Mean ± SD	**26.61±3.703**	
Gender		
Male	47	40.9
Female	68	59.1
Educational level		
Technical institute	43	37.4
Bachelor	69	60.0
Post graduate	3	2.6
Years of experience		
< 5	67	58.3
(5-10)	43	37.4
>10	5	4.3
Range	**(0-18)**	
Mean ± SD	**4.21±3.498**	
Training course on technological equipment		
Yes	47	40.9
No	68	59.1

Table (2): Percent distribution of the studied nurses regarding their positive perception of the effect of using technological devices

Positive aspect of using technological devices	The studied nurses (n=115)	
	N	%
1. Provide higher care effectiveness and achieving better patient outcomes. Enable adequate and direct care by ongoing physiological measurement activity		
Agree	60	52.2
Strongly agree	55	47.8
2. Ensure patient safety as prompt and proper recognition of complications or adverse effects through safety features that help to control of critical situations		
Disagree	21	18.3
Agree	16	13.9
Strongly agree	78	67.8
3. Enable faster and easier completion of nursing duties as performing nursing tasks with less fatigue and workload through continuous monitoring of vital parameter and documentation		
Neutral	33	28.7
Agree	53	46.1
Strongly agree	29	25.2
4. Saves a considerable amount of nursing time by taking over nursing procedures and performing nursing tasks		
Neutral	19	16.5
Agree	57	49.6
Strongly agree	39	33.9
5. Provide professional improvement for nurses by acquiring updated knowledge and providing the opportunity to learn new skills		
Disagree	19	16.5
Neutral	1	0.9
Agree	75	65.2
Strongly agree	20	17.4
6. Help the nurse to overcome the shortage of nurses		
Disagree	3	2.6
Neutral	5	4.3
Agree	72	62.6
Strongly agree	35	30.4

Table (3): Distribution of the studied nurses regarding their negative perception of using technological devices

Negative aspects of using technology	The studied nurses (n=115)	
	N	%
1. Increased patient risk due to mechanical failures, such as equipment failure due to defective manufacturing or poor maintenance.		
Strongly agree	2	1.7
Agree	30	26.1
Neutral	14	12.2
Disagree	59	51.3
Strongly disagree	10	8.7
2. Increased complications resulting from nursing staff errors, such as improper handling of devices and misinterpretation of data provided by machines		
Strongly agree	1	0.9
Agree	32	27.8
Neutral	22	19.1
Disagree	60	52.2
3. Divert attention from patients by focusing attention on medical devices and technical skills rather than their physical needs		
Disagree	82	71.3
Strongly disagree	33	28.7
4. Wasting patients' time, such as spending a lot of time on medical devices, instead of caring for patients.		
Neutral	3	2.6
Disagree	96	83.5
Strongly disagree	16	13.9
5. Increased dependence on other health care professionals, and limited decision-making due to lack of skill or mechanical error		
Strongly Agree	2	1.7
Agree	24	20.8
Neutral	29	25.2
Disagree	60	52.1
6. Minimizing attention to the emotional/psychosocial needs of patients or overlooking the human characteristics of patients		
Neutral	19	16.5
Disagree	81	70.4
Strongly disagree	15	13.0

7. Increased pressure on the nursing staff, such as psychological pressure and a feeling of uncertainty about unpredictable harmful effects, due to the nature and complexity of medical devices and many devices connected to the patient.		
Strongly agree	20	17.4
Agree	37	32.2
Neutral	58	50.4
8. Feeling The nurses of lack of self-confidence and low self-esteem due to lack of experience in dealing with devices		
Strongly Agree	3	2.6
Agree	34	29.6
Neutral	40	34.8
Disagree	38	33.0

Table (4): Percent Mean scores and ranking of the studied nurses according their perception domains regarding technological devices

Perception Domains	**The studied nurses (n=115)**					
	No items	**Min**	**Max**	**Mean ± SD**	**Mean Percentage %**	**Rank**
A. Positive aspect of using technological devices	6	19	29	24.97±2.729	**83.23**	**1**
B. Negative aspects of using technology	8	19	35	27.57±3.452	68.93	2
Total perception score	**14**	**39**	**62**	**52.54±5.532**		

Table (5): Illustrate Mean scores and ranking of the safety measures domains of the studied nurses regarding technological devices

Safety Domains	The studied nurses (n=115)					
	No items	Min	Max	Mean ± SD	Mean Percentage %	Rank
A. Environmental safety measures	6	0	6	4.50±1.975	**75.00**	**1**
B. Patient safety measures	3	0	2	1.7±0.609	**56.67**	**4**
C. Nurse safety measures related to use of device	33	7	31	24.11±5.208	73.06	2
D. Technological devices safety measures	16	1	15	9.8±3.828	61.25	3
Total safety score	**58**	**8**	**54**	**40.11±10.471**		

Table (6): Percent Mean scores and ranking of the practice domains of the studied nurses regarding technological devices

Practice Domains	The studied nurses (n=115)					
	No items	Min	Max	Mean ± SD	Mean Percentage %	Rank
A. Mechanical ventilation	23	6	23	17.17±4.288	74.65	**1**
B. Smart pump	23	3	23	16.86±5.509	**73.30**	2
C. Transducing system	34	6	32	21.26±7.135	**62.53**	**3**
Total practice score	**80**	**15**	**76**	**55.29±15.465**		

Table (7): Percent comparison and correlation between perception level of the studied nurses regarding technological devices, safety level and their practice level

	The studied nurses (n=115) Total perception level						χ^2 P
	Low (n=23)		Moderate (n=70)		High (n=22)		
	N	%	N	%	N	%	
Total safety level							
Not met	22	19.1	6	5.2	0	0.0	**81.315**
Partially met	0	0.0	40	34.8	11	9.6	**0.000***
Fully met	1	0.9	24	20.9	11	9.6	
r , P	**0.693 , 0.000****						
Total practice level							
Unsatisfactory	19	16.5	28	24.3	13	11.3	4.577
Satisfactory	4	3.5	42	36.5	9	7.8	0.101
r , P	**0.359 , 0.000****						

r: Pearson' correlation coefficient

* Significant at level P<0.05

Table (8): Relation between socio-demographic characteristics of the studied nurses and total perception score regarding technological devices

Characteristics	The studied nurses (n=115) Total perception score Mean ± SD	F/t P
Age (in years)		
(21-<30)	51.54±5.250	**29.23**
(30-<40)	**58.75±2.176**	**0.000***
Gender		
Male	51.64±4.641	2.13
Female	**53.16±6.026**	0.147
Educational level		
Technical institute	53.12±6.056	2.59
Bachelor	51.91±5.133	0.080
Post graduate	**58.67±1.155**	
Years of experience		
< 5	49.58±4.850	**40.94**
(5-10)	56.26±3.310	**0.000***
>10	**60.20±0.837**	
Training course on technological equipment		
Yes	**54.34±5.976**	**9.02**
No	51.29±4.869	**0.003***

* Significant at level P<0.05

Table (9): Percent Relation between socio-demographic characteristics of the studied nurses and total safety measures score regarding technological devices

Characteristics	The studied nurses (n=115) Total safety score Mean ± SD	F/t P
Age (in years)		
(21-<30)	38.89±1.688	**10.54**
(30-<40)	**47.69±3.979**	**0.002***
Gender		
Male	39.40±1.049	0.36
Female	**40.60±1.107**	0.549
Educational level		
Technical institute	38.33±1.012	1.21
Bachelor	41.01±1.166	0.301
Post graduate	**45.00±7.550**	
Years of experience		
< 5	35.97±1.519	**16.18**
(5-10)	45.56±4.687	**0.000***
>10	**48.80±2.049**	
Training course on technological equipment		
Yes	**41.89±9.058**	2.33
No	38.88±1.246	0.130

* Significant at level P<0.05

Table (10): Percent Relation between socio-demographic characteristics of the studied nurses and total practice score regarding technological devices

Characteristics	The studied nurses (n=115) Total practice score Mean ± SD	F/t P
Age (in years)		
(21-<30)	73.26±4.776	**8.960**
(30-<40)	**76.88±1.455**	**0.003***
Gender		
Male	**73.87±4.495**	0.042
Female	73.69±4.758	0.838
Educational level		
Technical institute	73.23±4.700	0.821
Bachelor	73.99±4.645	0.443
Post graduate	**76.33±2.887**	
Years of experience		
< 5	71.90±5.156	**16.893**
(5-10)	76.26±1.720	**0.000***
>10	**77.40±0.548**	
Training course on technological equipment		
Yes	**74.23±3.979**	0.813
No	73.44±5.038	0.369

* Significant at level P<0.05

Discussion:

A number of technology experts claim that the nursing field has been impacted by the introduction of new technology. Technology and nursing have always been intertwined. The close connection between nursing and technology has impacted the values and methods of modern nursing, as well as significantly impacting patient safety. Technological devices are viewed as essential components of clinical care in critical care environments **(Rohmawati et al., 2021).**

On a daily basis, nurses use a number of devices, which offer monitoring of patients vital parameters (monitors), support of vital functions (ventilators, hemodialysis systems), administration of drugs (infusion pumps) and other more specific functions as (defibrillators, forced-air warmers and cell-savers). As a result of continuous research and development of new technologies, critical care settings are rapidly changing as regards demand from patients and response to patient care. Nurses face an increase in the number, complexity and potentialities of the devices available to them. This increase affects theory, research and education of Nursing Science **(Esper et al., 2022)**.

Patient safety is linked to factors such as human fallibility, weaknesses in healthcare organizations, problem with technological devices, communication, inappropriate coordination among teams and professionals, as well as task burden and limited knowledge about safety. One of the safety pillars is the institutional culture, which is based on

good communication, trust, organizational learning, commitment of the hospital management to safety, leadership, non-punitive approach of errors and a shared perception of the importance of this theme. Therefore, the health institutions need to promote a culture based on these values to improve the patient safety **(Song et al., 2020; Atashzadeh-Shoorideh et al., 2022).** Therefore, the present study aimed to assess the relation between nurses' perception of using technological medical devices and patient safety at intensive care units.

Sociodemographic characteristic of the nurse:

The current study showed that the majority of staff nurses age were in age group of (21-<30) years with mean ± SD (26.61±3.703) year, this may be due to that the most of nurses had bachelor degree in ICU This could indicate that they are youthful and can handle the demanding work environment, which is crucial as they have been exposed to the latest technology. In the same line, a research conducted by **(Sayed et al., 2022)**. Who assessed the impact of introducing an educational program on preventive nursing measures for medical device-related pressure injuries on nurses' performance and patients' clinical outcomes, and found that most participating nurses were between the ages of 21 and 30.

On the contrary, a study by (**Tan et al., 2020)** who studied nurses' perception and experiences towards medical device and noted that more than two thirds of nurses were in age group 31–40 years old. Additionally, a study by **(Bagherian et al., 2017)** that assessed the effects of technology on nursing care and caring attributes of a sample of Iranian critical care nurses and revealed that the

majority of nurses were between 31 and 40 years old.

Concerning the gender of nurses, the present study noted that more than half of studied nurse were female. This may be due to the nature of nursing profession in Egypt as most of nurses were female, also this may be related to legislations of studying nursing science in Egyptian Universities and schools which were solely only for females till eight years ago where male are introduced. Similarly, a study by **(Rhagnanan-kramer, 2020)** studied Critical Care Nurses' Perceptions of Safety Related to Using Complex Medical Devices in Daily Nursing Practice who noted that most of studied participants were female. On the other hand, a study which was done by **(Sönmez & Bahar, 2022)** who studied Knowledge levels of nurses' related medical device- and factors affecting these, they reported that more than half of the studied nurses were males. Also, **(Zabin et al., 2022)** who studied patient safety culture in Palestine and noted that most of studied nurses were males.

Regarding to educational level, two third of staff nurses had Bachelor. This might elaborate the current condition of nursing qualification. In the same context **(Erbay & Kelebek, 2022)** studied knowledge, perception and prevention performance of intensive care unit nurses about medical device-related pressure injuries and reported that majority of studied nurses had a bachelor's degree. On the other hand, a study which was done by **(Rohmawati et al., 2021)**who studied the Overview of Nurses Perception about Caring Based on Technology in the ICU and ER of Jember Regional and noted that the majority of respondent in this study earned a diploma degree.

Regarding years of experience, more than half had experience less than five years old. This is due to the young age of most of the nurses participating in the study, which is reflected in their short period of experience. In the same line, a study by **(Ghonem & Ibrahim, 2023)** that assessed nurses' attitudes towards the use of computer and their informatics competences in nursing practice and reported that more than half of studied had experience less than five years old. In addition, a study by **(Osman et al., 2019)** who studied the Relationship between Nurses' Competencies and Quality of Patient Care at Intensive Care Units found that less than half of the study sample has less than 5 years of experience.

As regard to training program, the current study found that more than the half of studied nurse do not receive training course on technological equipment. This may be explained by the lack of training programs for modern technologies and their impact on patient safety. On the contrary, a study by **(Sönmez & Bahar, 2022)** they noted that more than half of the nurses had received training on medical devices and received this during an in-service training program in ICU. Also, **(Erbay & Kelebek, 2022)** stated that most of studied nurses received training about medical device.

Nurses perception regarding use of technological medical devices:

Regarding nurses positive perception of the effect of using technological devices: The current study explained that about two third of studied nurse strongly agreed that the using of

technological medical devices ensured patient safety as prompt and proper recognition of complications or adverse effects through safety features that helped to control of critical situations, provided professional improvement for nurses by acquired updated knowledge and provided the opportunity to learn new skills. Also, they agreed that it helped the nurse to overcome the shortage of nurses. **This may be due to** the fact that modern technological medical device reduce the complication occurred to patients in ICU and improve all nursing care process and cover shortage in staff by saving time and effort. Also, When nurses focus on using the computer system, they save time previously wasted on manual data entry, enabling them to spend more time with patients; therefore, nurses need to have proper tools that can handle data efficiently. **(Mohammadnejad et al., 2023)**.

This result was supported with a study by **(Bayomee et al., 2020)** who studied nurses' perception regarding utilization of information technology at primary health care centers in Port Said city and It was reported that nurses who were studied agreed on the benefits of using information technology. They found that using computers made completing nursing tasks easier and reduced their workload. Additionally, IT played a role in advancing medical research and using technological devices improved perceptions of the professional role of nurses. It also enhanced nurses' knowledge and skills, leading to higher competence.

Also, **(Bimerew & Chipps, 2022).** Who conducted a study entitled Perceived technology use, attitudes, and barriers among primary care nurses **This finding is consistent with** a study by **(Kiekkas et al. 2006)** that assessed use of technological equipment in critical care units and nurses' perceptions and revealed that most of the participants had positive aspect that technological equipment contributes to a higher effectiveness of care and a higher patient safety respectively, thought that equipment plays a role in making nursing tasks easier and faster, and also acknowledged that devices have the potential to enhance personnel performance. In addition, **(Turisco & Rhoads 2008)** discovered that technology enhances the work environment and boosts job satisfaction through enhancing efficiency, safety, speed, and quality of care.

On the contradiction with current results, a study by **(Geetha, 2022)** who assessed nurses' perception regarding the use of technological devices in the critical care units at selected hospital, in Chennai who revealed that majority of nurses agreed that technology cause focusing of interest on equipment and technical skills ignoring physical needs of patients.

Regarding nurses' negative perception of using technological devices: The current study noted that the majority of studied nurse disagreed that using technological medical device wasted patients' time, such as spent a lot of time on medical devices, instead of caring for patients. While about three quarters of them disagreed that it diverted attention from patients by focused attention on medical devices and technical skills rather than their physical needs and minimized attention to the emotional/psychosocial needs of patients

or overlooked the human characteristics of patients. This can explain by the real benefits of technological devices for patients in ICU that reflected on nurses' perception about it as it help nurses on focus attention on patients care and save time and efforts.

Technology use, attitudes, and barriers among primary care nurses found that the introduction of healthcare technology can facilitate the healthcare process and can help nurses to offer safe and effective care and reduce the occurrence of missed nursing care.

In the same line with current results a study by **(Ozan & Duman, 2020)** that assess Nurses' perceptions regarding the use of technological devices in nursing care practices found that Nurses do not believe that incorporating technological devices into nursing care practices automates tasks, disrupts patient-nurse communication, or dehumanizes care.

On the other hand a study by **(Bayomee et al., 2020)** It was reported that the most common concerns among the nurses studied regarding the negative aspects of using information technology were the need for advanced skills, the necessity of regular breaks from technology-induced stress, and the reduction in autonomy due to increased reliance on other healthcare professionals. This result on the line with **(Kisorio & Langley, 2019)** who studied the Critically ill patients' experiences of nursing care in the intensive care unit participants in the current study reported that some nurses concentrated on the machines and equipment, with less attention directed to the patient. This lack of attention and poor communication resulted in patients feeling neglected, objectified and dehumanized.

Concerning, mean scores and ranking of the studied nurses according their perception domains regarding technological devices. The current study depicted that the majority of studied nurse had perceived the positive effect of using technological devices followed by negative effect of using technological medical devices. This could be because nurses recognize the significance of technology in fostering the creation of new methods and interventions that aid in maintaining and improving nurses' skills in providing human care in technologically advanced ICU settings.

In the same line**, (Fajarini et al., 2021)** who conducted a study that assessed factors related to doctors' and nurses' perceptions of evidence-based practice and healthcare information access technology in Depok City, and estimated that nurses had positive perception in terms of knowledge dissemination related to using of information technology. Also, a study by **(Bagherian et al., 2017)** that assessed the effects of technology on nursing care and caring attributes of a sample of Iranian critical care nurses and revealed that nurses in this sample from Iranian critical care units had positive opinions regarding the influence of technology on their provision of care.

Additionally, a study by (Chang et al., 2016) who studied the Cultural Impact on the Intention to Use Nursing Information Systems of Nurses in Taiwan and China: Survey and Analysis, samples of nurses in Taiwan and in China showed that information literacy had a positive effect on performance and effort expectancies.

This result was in contrast with a study by **(Ghonem & Ibrahim, 2023)** who assessed nurses' attitudes towards the use of information technology competences in nursing practice in Assiut and noted that mean percentage of meaning that most of the studied nurses had negative attitudes toward nursing informatics and technology devices. Also, **(De Leeuw et al. 2022)** who studied Identification of Factors Influencing the Adoption of Health Information Technology by Nurses Who Are Digitally Lagging: In-Depth Interview Study, showed that there are still negative effects for nurses, where study on HIT applications discovered that nurses were unfriendly, unsupportive in daily professional practice, stressful, and unpleasant. Also, a study done by **(Christiansen et al. (2017)** which entitled "nurses' use and perception of a technology system for improving, coordination during hospital discharges: showed that the majority of the studied group had negative perception regarding positive aspects of using information technology.

Patients' safety measures regarding use of technological medical devices:

Concerning the distribution of the studied nurses according total safety level regarding technological medical devices, the present result noted that about half of the studied nurse partially met the total technological medical devices safety level. These might be due to nearly all of staff nurses at accredited hospitals had received training about patient safety practices that may have affect positively on their application of international patient safety goals, written policies of international patient safety goals are being present in all hospital units and announced to all nursing staff. This was in agreement of a study by **(Gamal Attia et al., 2021)** that assessed nurses' application of patient safety goals and reported that the vast majority and more than one quarter of studied staff nurses had good knowledge level about patient safety. On the other hand, a study by **(Ahmed et al., 2018) that assessed** critical care nurses knowledge and practice regarding patient safety in intensive care units.

Nursing practice measures regarding use of technological medical devices:

Concerning the Mean scores and ranking of the practice domains of the studied nurses regarding technological devices, the present result noted that about three quarter of studied nurses had a highest mean percentage of practice domain related to mechanical ventilation compared to other technological devices. This is likely attributed to the fact that a majority of ICU patients require mechanical ventilation for serious life-threatening conditions and the complexity of these devices. Consequently, the hospital focused on enhancing nurses' knowledge and practice in using these devices.

This result was in contrast with a study by **(Fialkow et al.,2016)** who studied Mechanical ventilation in patients in the intensive care unit of a general university hospital in southern Brazil: an epidemiological, showed that the incidence of MV increased by 11% over 7 years, with a higher burden of comorbidities and fewer discharges to home.

Regarding the relation between socio-demographic characteristics of the studied nurses and total perception score regarding technological devices, the current study showed that there are

significant relation between sociodemographic characteristic of studied nurses and total perception score through the age, years of experience and training course on technological equipment. This may explained by that young age of nurses encourage their ability to deal with technological devices also years of experience and training on technological devices help in increase perception of nurses about these devices. Also, this is may be related to improved experience regarding technology devices by training as training programs improved nurses perception.

In the same line a study by (**Sönmez & Bahar, 2022)** revealed that a positive relationship was determined between the level of knowledge about medical device and age and seniority. Also, a study by **(Bagherian et al., 2017)** revealed that there was a significant relation between influences of technology among our study nurses and with age and work experience, caring commitment was higher in older more experienced nurses.

This result was in constant with a study by **(Adel et al., 2018)**who reported that there were statistically significant relations between nurses' post-intervention positive perception about technology use and their gender, while no statistically significant relation between nurses' post- intervention positive perception about technology use and age and qualification.

As regard to relation between socio-demographic characteristics of the studied nurses and total safety measures score regarding technological devices, the present study revealed that there is significant relation between sociodemographic characteristic of studied nurses and total safety measures score regarding the age and years of experience. The finding was in agreement with a study by **(Aziz Mamdouh et al., 2020)** that assessed the nurses' performance regarding the implementation of patient safety and indicated that there was high statistically significant relation between nurses' knowledge on patient safety measures and their qualification and years of experience, also with their age and gender. Additionally, **(Despotou et al., 2020)** who reported that there is strong correlation between years of experiences, qualification about implementation patient safety measures. This finding was in contradiction with a study by **(Zabin et al., 2022)** that assessed patient safety culture in Palestine and found that there was no relationship between sex, and experience in work area and the total score of patient safety culture.

Concerning the relation between socio-demographic characteristics of the studied nurses and total practice score regarding technological devices, the current finding revealed that there are significant relation between sociodemographic characteristic of studied nurses and total practice score regarding age and year of experience. This may be related to that nurses' age will increase their technological experience as well as their technical expertise of their practices of work in hospital as young age nurses able to change and improve their practices regarding technological devices. In the same line with our results a study by **(Rohmawati et al., 2021)** who assessed nurses perception about caring based on technology in the ICU and ER and depicted that age is a significant factor in

nurses self-assessment of their perceived level of competence and increase their technological experience as well as their technical expertise of their sector of work.

Conclusion

Based on findings of the present study, it can be concluded that:

-Most nurses had a more positive view of utilizing technological medical devices in critical care units, while most had a less favorable perception of the negative aspects of such devices. - There were statistical significant relation between nurses' perception level and total safety level.

-There were significant positive correlation among total perception level, total safety level and total practice level.

-There are significant relation among the age, years of experience and training course on technological equipment of studied nurses and total perception score.

-There is significant relation among the age and years of experience on technological equipment of studied nurses, total safety measures score and total practice score. -Finally, there was relation between nurses perception of using technological medical devices and patient safety at intensive care unit.

Recommendation

Based on the result of this study the following recommendations are suggested: Recommendations for nursing practice:

-Enhance the nurse's understanding of the advantages and disadvantages of utilizing technology in medical devices and ensure patient safety in critical care units by staying informed.

-Motivate nurses to participate in scheduled, structured educational programs to stay updated on technological equipment.

-Regular evaluation of nurse's competences related to advanced technology in ICU.

-Encourage nurse to initiate self-evaluation after using technological equipment continuously**.**

Recommendations for hospital management:

-Availability of the manufacture instructional booklet that include comprehensive information about technological medical devices used in patient care.

- Provide handout about the principal guidelines of equipment maintenance, uses and the risks of uses. -Availability of adequate supplies for patient care.

Recommendation for further studies:

-Replication of this study with a large probability sample and different setting of the study is recommended.

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