NURSES' PERFORMANCE REGARDING DEVICES' ALARMS IN INTENSIVE CARE UNIT

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Abstract

Background Clinical alarms are the most essential component of most of the medical devices in intensive care units that gain attention of critical care nurses for immediate or potential threats facing critically ill patients .If nurses not have enough knowledge and skills to management clinical alarms that can lead to deterioration of patient condition or even death, so assessment of nurses' performance when managing clinical alarms is very critical. **Aim :**This study aimed to assess nurses' performance regarding devices' alarms in ICU. **Design:** A descriptive exploratory research design was used. **Setting:** The study was conducted in ICU at ELFayoum General Hospital. **Subjects:** A Convenient sample of all available nurses (50) nurse from both sex working in the intensive care. **Tools:** three tools were used for data collection. Tool I: Nurses' self administered interview Questionnaire: which included (a) Demographic characteristics of nurses (b) Nurses' knowledge regarding devices alarms in ICU, Tool II: Observational check list for nurses` practice which included (a) Observational checklist for assessment of nurses 'practice in devices alarms management for three devices (monitor-ventilator-syringe pump)(b) False Alarm Prevention Checklist Tool III: Nurses` attitude rating scale assessment questionnaire. **Results:** the study results reported that 76% of the studied nurses had unsatisfactory level of total knowledge and 64% had incompetent level of total practices 58% had positive attitude regarding devices alarms in ICU. **Conclusion:** There was highly statistically significant, correlation between total knowledge, practice and attitude regarding devices alarm in ICU. **Recommendations:** Continuing educational program to improve knowledge and practices of nurses regarding devices alarms in ICU.

Keywords: *Devices Alarms*, *ICU, Nurses performance.*

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Introduction

Intensive care unit is a place where intensive care is provided to treat life-threatening conditions to minimizing damage to the patient's organs. It is equipped with up-to-date medical devices necessary to provide intensive care, including a monitoring system to observe the patients' conditions. An intensive care expert relies heavily on the information provided by monitoring devices to make clinical decisions in ICUs and reduce mortality and morbidity within critical environment **(Zhao,et al ., 2021)**.

The intensive care unit (ICU) is one of the most technically advanced environments in healthcare, using a multitude of medical devices for drug administration, mechanical ventilation and patient monitoring. However, these technologies currently come with disadvantages, namely noise pollution, information overload and alarm fatigue all caused by excessive alarms **(Koomen, et al .,2021)**.

The clinical alarm system is important component of most of machines in icu and includes afull spectrum of alarms that are designed to warn the staff immediate or potential adverse patient conditions. Most patients in the critical care units cannot speak for themselves hence cannot pinpoint when their condition deteriorate. Nurse ability to interpret and response to clinical alarms is very essential to maintain patient safety so assess the nurses' interventions when managing clinical alarms is very important (**Lee, et al ., 2021).**

A clinical alarm may indicate a serious fatal incident or even a medical device malfunction. Alarms are indeed vital in inpatient care; however, an endless stream of alarms can frustrate the medical staff and jeopardize patient safety. Alarms are associated with a higher risk of false alarms, that is, alarms without clinical significance. Usually, the repetition of the droning of beeping environmental sounds may cause clinicians to be jaded and ignore or mishandle alarms a condition known as "alarm fatigue" **(Lewis, & Oster, 2019).**

Clinical alarm overload was selected as one of the "2020 top 10 health technology hazards" as reported by the Emergency Care Research Institute. Nurses in ICUs with numerous medical devices that produce

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alarms. Some studies have proven that 344 alarms per bed per day went off in the ICU. That meant that each patient and nursing staff were disturbed every 3 or 4 minutes by an alarm experienced alarm fatigue, which could lead to being overwhelmed or desensitized to numerous alarms. That inevitably affects on patient safety. So It is necessary to reduce alarm fatigue and promote safe and effective alarm management practices among critical care nurses through sufficient education and steady training. Alarm fatigue should also be mitigated by employment of sufficient nursing personnel in ICUs **(Bourji, et al ., 2020).**

Excessive false clinical alarms compromise patient care and safety in intensive care units (ICU). Critical care nurses identified alarms from cardiopulmonary physiologic monitors are one of the most helpful in the ICU, and yet the monitors also contribute to the highest numbers of false alarms leading to the sensory overload at work.. These unnecessary false or irrelevant alarms have reached a noise peak of over 80 DB creating a noisy and annoying environment for both nurses and patients. Noise pollution from false alarms is viewed to be the most stressful noise in the ICU. It hinders patient recovery and quality of care. Moreover, constant demand and mistrust of the alarm system reduce the alertness of the clinicians leading to alarm fatigue**(Huo, et al ., 2022).**

Alarm fatigue defined as a condition characterized by nurses' unresponsiveness to unnecessarily high monitor alarms. Given the extremely busy, extensive, and frustrating nature of patient care apart from the existence of many clinical monitors and alarms, critical care units are a major area for alarm fatigue **(Storm, & Chen, 2021).** Alarm fatigue in healthcare is caused by excessive medical device alarms that are often not accurate or clinically relevant. Nurses become desensitized to alarm signals or lose trust in alarms to signify an important event, and as a result, may delay their response to alarms or ignore them altogether. Alarm fatigue may also cause nurses to change alarm parameter settings to unsafe levels or to disable alarms. As a result, deteriorations in patient conditions have been missed and patient deaths have occurred **Ruppel, , et al ., 2018).**

Critical care nurses are responsible for detecting and rapidly acting upon changes in patients' clinical conditions, and monitoring patients' physiologic parameters and intervening when needed are among their key responsibilities .The alarm management of physiological monitoring systems is a core responsibility of critical care nurses so nurses must have sufficient knowledge and skills about clinical alarm management until able to identify problem that face patient and provide effective response to maintain his life (**Shih, 2022).**

Significance of the study

According to the Society of Critical Care Medicine, More than 5 million patients are admitted annually ICUs to for different reasons ranging from airway, breathing, and circulation support, intensive or invasive monitoring, stabilization of life-threatening medical problems, or comfort while dying within an interdisciplinary and collaborative environment to comprehensive management of complex injury, illness and symptoms. The mortality rate in an adult ICU ranges from approximately 10-29% globally. Although ICU patients are a heterogeneous population, they all share a state of clinical fragility and a need for frequent assessment and realignment of care goals **(Amen, et al., 2021***)*.

In April 2013, The Joint Commission published its first Sentinel Event Alert, which addressed the safety of medical device alarms in healthcare facilities and revealed **98** adverse events were recorded in the United States due to an incorrect or delayed reaction to an alarm, including **80** that ended in the **death**, 13 patients had permanent cardiac damage, and five patients had an additional stay in the hospital. Alarm fatigue is a risk to patient safety **(Alsuyayfi,& Alanazi, 2022).**

A case report is described in which the medical personnel did not respond to the low-heart-rate alarm, which in consequence resulted in the patient's death. In the investigation following this incident, the Centers for Medicare and Medicaid Services reported: "Nurses not recalling hearing low-heart-rate alarms were indicative of alarm fatigue, which contributed to the patient's death". Attempting to shorten the alarm exposure of monitoring devices additionally leads to silencing of alarms in the monitoring center, without directly checking the patient's condition **(Lewandowska, et al ., 2020).**

Aim of the Study

The aim of this study was to assess nurses' performance regarding devices alarms in intensive care unit. This aim achieved through the following objectives:

1.Assess nurses' level of knowledge regarding devices alarms' in intensive care unit.

2.Assess nurses' level of practice regarding devices alarms' in intensive care unit.

3.Assess Nurses' attitude regarding devices alarms' in intensive care unit.

Subjects and methods:

I-Technical item:

Research design: Descriptive exploratory research design was used in this study.

Setting:

This study was conducted at Intensive Care Unit in Elfayoum General Hospital .

Subjects:

A convenient sample of all available nurses (50)

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nurse from both sex who working in the selected setting and agreed to participate in the study.

Tool for data collection:

There were three tools utilized to collect the data during the study period:-

Tool I : Nurses' self administered interview Questionnaire:

This tool was adapted from **(Mabrouk, et al ., 2019)** and was modified by the investigator based on reviewing related literature and was written in simple Arabic language to suit nurses level of education. To assess nurses knowledge regarding devices alarms in intensive care unit . It was divided into the following two parts:

Part 1: Demographic characteristics of nurses: Such as (gender, age, marital status, level of education, years of experience , training courses on ICU devices, benefits from this training or no). It composed of (7) closed ended questions.

Part 2: Nurses' knowledge regarding devices alarms in ICU: This part consisted of 40 items in form of multiple choice questions(MCQ) and true /false to assess nurses knowledge regarding devices alarms in intensive care unit.

This tool was divided into four parts as the following:

•**The 1st part:** to assess nurses' knowledge about devices alarms (12 questions,8 MCQ and 4 Yes/NO questions).

•**The 2nd part:** to assess nurses' knowledge of monitor alarms in intensive care unit(9 questions, 7MCQ and 2 Yes/NO questions).

•**The 3rd part:** to assess nurses' knowledge regarding ventilator device alarms: it includes (10 true/ false)

•**The 4th part:** It concerned with the assessment of nurses' knowledge regarding syringe pump alarms in intensive care unit: it includes (9 true/false).

Scoring system

Regarding scoring system: the self-administrated questionnaire nurses' total score was 40 points. The scoring system was distributed according to the following**:-** Correct response scored as(one) point and incorrect response scored as(zero) point. The score were summed up and were converted into a percentage score .

It was classified into two categories :

Satisfactory knowledge if score ≥85%.

Un satisfactory knowledge if score < 85%.

Tool II: Nurses' Practice Observational Checklist sheet:

It was adapted from **(Mabrouk, et al ., 2019)** and was developed by the investigator based on reviewing related literature. It consisted of (86) point to assess nurses' level of practice regarding clinical alarm management for patients connected with devices in intensive care unit.

It was divided into the following two parts:

Part I: Observational checklist for assessment of nurses practices regarding devices alarms management of (monitor, ventilator and syringe pump) alarms. It consists of three subscales(A) pre procedure it contain 3 points, (B) during procedure it contain 55 point which include three sub items: 1-monitor alarms management 10 point, 2-mechanical ventilator alarms management which include 5 sub items (high pressure alarm 7 points, low pressure alarm 7 points, apnea alarm 5 points, low tidal volume 6 points, power failure alarm 6 points) and (C) post procedure it consisted of 6 points.

Part II: False Alarm Prevention Checklist : It was adopted from **(Lipschultz, 2014 ; Koch, et al., 2012)** to assess nurses' ability to prevent false alarm for three devices (monitor-ventilator-syringe pump). It consist of 22 items**.**

Scoring system

Regarding scoring system: the nurses' performance checklist, the total score was 86 points. The score was distributed according to the following, the task which is performed correctly done was graded as(one) point, the task which is performed incorrectly or not done was graded as(zero) point. The score were summed up and were converted into a percentage score .

It was classified into two categories :

Competent if score ≥85%

Incompetent if score < 85% .

Tool III: Nurses' Attitude regarding devices alarms in intensive care unit:

This tool was developed by the investigator based on related literature review **(Funk, et al., 2014)** and was written in Arabic language to assess nurses' attitude regarding devices alarms in intensive care unit. Which consists of (16) items. Nurses were asked to respond to statements with agree or disagree.

The scoring system for nurses attitude:

The tool consists of 16 negatively worded statements with response options of disagree. The total scores were 16 scores correct answer (No=1)and incorrect answer(Yes=0). Positive attitude if percent score was 85% or more(≥14score) and Negative attitude if the percent score was <85%(<14 score).

II- Operational Item: operational item included the preparatory phase, validity, reliability of the developed tools, pilot study and field work.

Preparatory phase: This phase conducted through reviewing literature related to nurses' performance regarding devices alarms in intensive care unit. Areview of the current aspects and past available literature in the various aspects of the problems using books, articles, internet, periodicals and magazines where done. This served to develop the study tools

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for data collection. During this phase, the investigator also visited the selected place to get acquainted with the personal and the study setting. The development of the tools was under supervisors' guidance and experts opinions were considered.

Validity:

The tools of study were revised by a jury of 5 experts: assistant professors and lecturer of medical surgical nursing from faculty of nursing, Helwan University to review tools for clarity, relevance, comprehensiveness, understanding and applicability. Modifications of tools were done according to the panel judgment on clarity of sentence, appropriateness of content, sequence of items and accuracy of scoring.

Reliability:-

Cronbach's Alpha was used to determine the internal reliability of the tools. Reliability of the tools was tested to determine the extent to which the questionnaire items are related to each other and the result was as the following self-administrated questionnaire (0.795), nurses' practice observational checklis(0.804) nurses' attitude questionnaire (0.835) and nurses' perception toward palliative care obstacles questionnaire (0.856). Statistical equation of Cronbach's alpha reliability coefficient normally ranges between 0 and 1; higher values (more than 0.7) denote acceptable reliability.

Pilot study:

The pilot study was done on (10)% (5)of the sample to examine the clarity of questions, to test applicability and time needed to complete the study tools. Based on the results, subjects included in the pilot study were included in the main study sample if no modification were done.

Field work:

An approval was obtained from a scientific ethical committee of the faculty of nursing at Helwan University.

An approval was obtained from the director of Elfayoum General Hospital.

The investigator introduced her-self to ICU nursing staff and the approval of nurses was obtained orally after explaining the purpose of the study in addition to clear and brief idea about aim of the study and its expectation.

The actual field work was carried out for data collection over 3 months in the period from the beginning of May 2022 and completed by the end of July 2022. The investigator attended the pre-mentioned settings 3 days/week from 9.00 a.m. to 5.00 p.m. to collect data till the sample size reached the pre-determined number.

The investigator start to collect data from the study sample as follow:

First, demographic data questionnaire was filled by each nurse by her/ himself. It took about 5-10 minute.

Second, knowledge assessment questionnaire was answered by each nurse individually, it took about 20-30 minute.

Third, nurses' attitude regarding devices alarms in intensive care unit , it took about 10-20minute.

Fourth, regarding the observational checklist the investigator observe each nurse directly and indirectly once during management of patients connected with devices(monitor - ventilator - syringe pump)**.**

III- Administrative Item:

An official permission was obtained from the dean of Faculty of Nursing Helwan University and official permission from the director of Elfayoum General Hospital to conduct the study this letter included a permission to collect the necessary data and explain the purpose and nature of the study.

Ethical considerations:

An official permission to conduct the proposed study was obtained from the Scientific Research Ethics Committee of the faculty of Nursing at the Helwan University and the study subjects prior to data collection . Participation in the study is voluntary and subjects was given complete full information about the study and their role before signing the informed consent. The ethical considerations was include explaining the purpose and nature of the study, stating the possibility to withdraw at any time, confidentiality of the information where it was not be accessed by any other party without taking permission of the participants. Ethics, values, culture and beliefs were respected.

IV- Statistical Item:

The collected data were organized, categorized, tabulated and statistically analyzed using the statistical package for social science (SPSS) version 26 and Microsoft excel 20/0.Quantitative data were presented as mean and standard deviation (SD) while qualitative data were expressed as frequency and percentage. Chi – square test (χ^2) was used as a test of significance to test relations between quantitative variables.

The observed difference and associations were considered as follows:

P > 0.05 was considered non- significant (NS).

P $\leq$ 0.05 was considered significant (S).

P $\leq$ 0.01 was considered highly significant (HS).

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Results

Table (1): Frequency and percentage distribution of demographic characteristics for the studied nurses(n=50):

Demographic data		N	%
Gender:			
•	**Male**	11	22
•	**Female**	39	78
Age :			
•	**20-29 Yrs**	37	74
•	**30-39Yrs**	11	22
•	**40-49Yrs**	2	4
Age:		**Mean ± SD** **27.26±5.22`**	
Marital Status:			
•	**Single**	23	46
•	**Married**	22	44
•	**Divorced**	5	10
Level of Education:			
•	**Nursing diploma**		
•	**Technical institute**	4	8
of nursing		34	68
•	**Bachelor of**	10	20
nursing		2	4
•	**Postgraduate**		
Years of experience:			
•	**Less than 5 year**		
•	**5-15 years**	35	70
•	**More than 15**	9	18
years		6	12
Mean ± SD		**5.56±6.37**	
Training courses on care of ICU devices alarms?			
•	**No**	36	72
•	**Yes**	14	28
If yes, did you benefit from this training? (n=14)			
•	**No**	1	7.1
•	**Yes**	13	92.9

Table(1): Reveals that 78% of the studied nurses were females. As regards to age, 74% of them were 20 to 29 years old. Also this table showed that 46% of the studied nurses were single, 68% had graduated from technical institute of nursing, while 4% of them were postgraduate. Relation to the years of experience 70% of them were less than five years. Regarding training courses and performance enhancement 72% of them didn't attend any training courses and 28% attended courses about care of ICU devices.

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Figure (1): Percentage distribution of total nurses' level of knowledge regarding devices alarms in ICU .
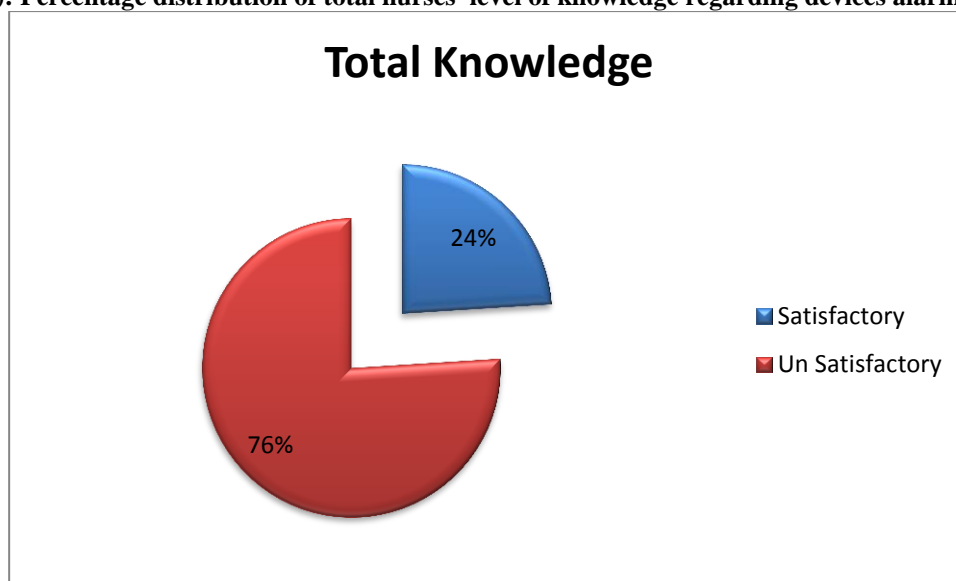

Figure (1) shows that, 76% of the studied nurses had unsatisfactory level of total knowledge regarding devices alarms in ICU .

Figure(2): Percentage distribution of total nurses' level of practices regarding devices alarms in ICU.
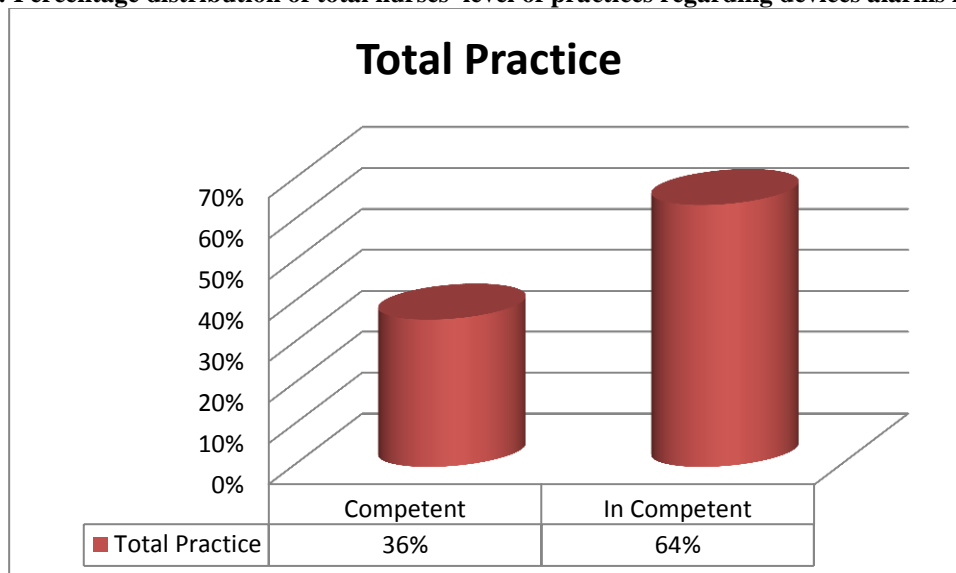

Figure (2) shows that, 64% of the studied nurses had incompetent level of total practice regarding management of devices alarms in ICU.

Figure(3): Percentage distribution of total nurses' level of attitude regarding devices alarms in ICU.

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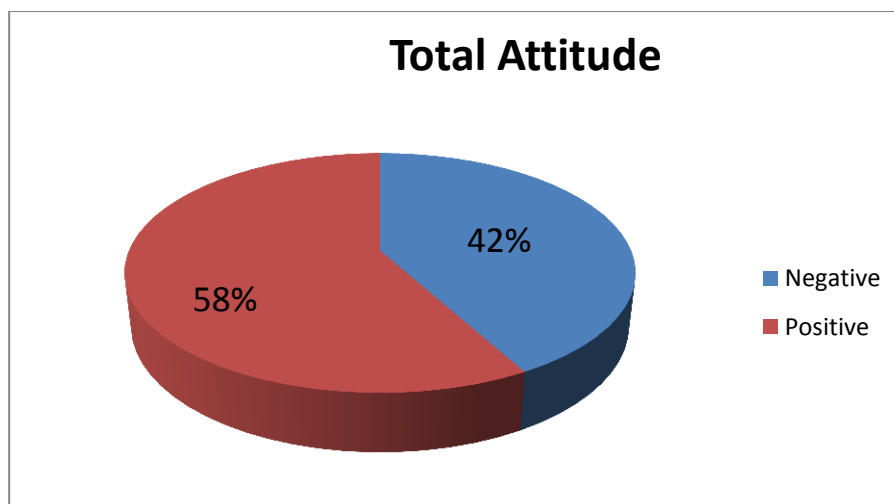Eur. Chem. Bull. 2023, 12 (Si6), 6219- 6232

Figure (3) reveals that, 42 % of the studied nurses had a negative attitude, while 58% had a positive attitude.

Table (2): Relation between total level of knowledge and demographic characteristics of the studied nurses(n=50):

Items	Nurses' Knowledge				$X2$	*P*-value
	Un satisfactory		satisfactory			
	No	%	No	%		
Gender:						
• ale	7	18.4	4	33.3	1.18	0.240
• emale	31	81.6	8	66.7		
Age :						
• 0-29 Yrs	33	89.2	4	33.3	13.74	0.001*
• 0-39Yrs	4	10.5	7	58.3		
• 0-49Yrs	1	2.6	1	8.3		
Marital Status:						
• ingle	20	52.6	3	25.0	10.13	0.006*
• arried	17	44.7	5	41.7		
• evorced	1	2.6	4	33.3		
Level of Education:						
• ursing diploma	3	7.9	1	8.3	5.09	0.01*
• echnical institute	30	78.9	4	33.4		
• achelor of nursing	5	13.2	5	41.7		
• ostgraduate	0	0	2	16.6		
Years of Experience :					9.75	0.004*
• Less than 5 year						

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• 5-15 years • More than 15 years	30 5 3	78.9 13.2 7.9	5 4 3	41.7 33.3 25		
Training courses on care of ICU devices alarms? • No • Yes	28 10	73.7 26.3	4 8	33.3 66.7	1.434	0.02*

*: Significant at P ≤ 0.0

Table (2) shows that, there is a statistically significant relation between the age , marital status, level of education, years of experience, training courses and the nurses knowledge (*P*-value=0.01, 0.006,0.01, 0.004, and 0.02 respectively.

Table (5): Relation between total level of practice and demographic characteristics of the studied nurses(n=50):

Items	Nurses' Practice				$X2$	*P*-value
	Incompetent		Competent			
	No	%	No	%		
Gender: • ale • emale	7 25	22.9 78.1	4 14	23.2 77.8	0.256	0.472
Age : • 0-29 Yrs • 0-39Yrs • 0-49Yrs	26 5 1	81.2 15.6 2.0	11 6 1	61.1 33.3 2.0	2.44	0.02*
Marital Status: • ingle • arried • ivorced	16 15 1	50 46.9 2.0	7 7 4	38.9 38.9 8.0	4.68	0.103
Level of Education: • ursing diploma • echnical institute • achelor of nursing • ostgraduate	4 26 2 0	12.5 81.2 7.3 0	0 8 8 2	0 44.4 44.4 12.2	9.75	0.004*
Years of Experience: • Less than 5 year • 5-15 years • More than 15 years	29 2 1	90.6 6.2 3.8	6 7 5	33.3 38.8 27.7	3.25	0.001*

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Training courses on care of Icu Devices alarms?						
• No • Yes	24 8	75.0 25.0	12 6	66.7 33.3	0.397	0.03*

*: Significant at $P \leq 0.05$

Table (3) shows that, there is a highly statistically significant relation between age, level of education, years of experience, training courses and the nurses' practice (*P*-value=0.02, 0.004, 0.001, & 0.03 respectively).

Table (4): Relation between total level of attitude and demographic characteristics of the studied nurses(n=50):

Items	Nurses' Attitude				$X2$	*P*-value
	Positive		Negative			
	No	%	No	%		
Gender: • ale • emale	7 22	24.1 75.9	4 17	19 81	0.184	0.741
Age group: • 0-29 Yrs • 0-39Yrs • 0-49Yrs	25 3 1	86.2 10.3 3.4	12 8 1	57.1 38.1 4.8	5.706	0.058
Marital Status: • ingle • arried • evorced	15 13 1	51.7 44.8 3.4	8 9 4	38.1 42.9 19	3.466	0.177
Level of Education: • ursing diploma • echnical institute • of nursing • ostgraduate	2 20 7 0	6.9 69 24.1 0	2 14 3 2	9.5 66.7 14.3 9.5	3.468	0.003*
Years of Experience: • Less than 5 year • 5-15 years • More than 15 years	24 3 2	82.8 10.3 6.9	11 6 4	52.4 28.6 19	5.352	0.069
Training courses on care of Icu Devices alarms? • No • Yes	22 7	75.9 24.1	14 7	66.7 33.3	0.511	0.534

*: Significant at $P \leq 0.05$

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Table (4) shows that, there is a highly statistically significant relation between level of education and the nurses attitude with (P-Value =0.003).

Table (5): Correlation between Nurses knowledge, practice and Attitude:

Items	Nurses' knowledge	Nurses' practice
Nurses' Practice	R= 0.537 p=0.000*	
Nurses' Attitude	R=0.555 p=0.000*	R=0.634 p=0.000*

*: Significant at P ≤ 0.05   ** Highly significant at p< 0.001

Table(5): represents that, there was ahighly statistically significant positive correlation between total nurses' knowledge, practice and attitude (P-Value =0.000).

Discussion

In relation to nurses' demographic characteristics :

Regarding the study of nurse`s demographic characteristics, the results of the current study revealed that about three quarters of the study nurses were females. This is may be due to the greater segment of the nurse in Egypt were females and my also related to the studying of nursing in Egyptian were exclusive for females only till few years ago. These finding is agreed with(**Saritas, et al., 2019),** Who revealed that three quarters of the studied nurses were females. In other hand this finding disagreed with **Paredath & Al Jarary, (2023)**, who illustrated that, the majority of the participants was male .

As regards to age, the current study revealed that more than two third of them were 20-29 years of old with Mean ± SD27.26±5.22`. These findings explained by the investigator's experience may be due to the majority of nurses work power providing direct care for the patient in nursing field are young while higher age category senior nurses perform administrative role. These findings are also similar to **Jeong, & Kim, (2022),** who reported that two thirds of nurses' age less than 30 years old with a mean ± SD of 29.42 ± 6.65 years. Also this finding consistant with **Eltayeb, et al ., (2022),** who revealed that, the majority of studied nurses age was less than 30year.

As regards to marital status, the current study revealed that nearly half of the studied nurses were married this may be due to suit the living conditions and this is traditional in live. This finding was consistent with **Ahmed, et al.,**

(2022), who reported that two thirds of the studied nurses were married.

Concerning to years of experience, the current study illustrated that more than two thirds of the studied nurses having 1-5 years of experience, From the investigator point of view, this may be due to most of those nurses were newly graduated and were more interested to work in critical care units. This finding went in the same line with **Botros, et al., (2019)** , who showed that, three of fifth of the studied nurses having 1-5 years of experience.

In relation to the studied nurses' educational level, results indicated that, there were more than two thirds of the nurses had associated degree. These findings explained by the investigator's experience may be due to the financial burden and preference of bachelor degree nurses to work at private hospitals and travel abroad, and when working in the governmental hospitals, bachelor degree nurses work as head nurse not as bedside nurse. The majority of employed staff nurses are from nursing teaching schools following directorate of health affairs in Cairo. These findings are disagreed with **Ibrahim, et al., (2021)**,who reported that only one third of the studied nurses had a technical institute . Also this finding inconsistent with **Lee, et al**., **(2021)** ,who revealed that**,** three quarters of the studied nurses had bachelor degree.

Regarding training courses toward devices alarm in in intensive care unit**,** the study results revealed that**,** about three quarters of them didn't attend any training courses. From the investigator point of view, this may be due to poor reinforcement from hospital administrators, insufficient professional

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trainers in the hospital and time limits. The training courses for nurses is very critical to improve their performance that affect positively on quality of patient care and reduce mortality of critical ill patient in intensive care unit . This finding went hand in hand with **Ramlaul, et al., (2021)**, who illustrated that, more than three quarters of the studied nurses untrained about ICU devices alarm **.**

Concerning nurses' total knowledge score regarding devices alarm in intensive care unit, the present study results showed that, more than three quarters of the studied nurses had unsatisfactory total score about knowledge regarding devices alarm in intensive care unit. This might be due to that the wide base of nurses' education was technical institute of nursing , most of them new graduated and may be due to that clinical alarm management not included in pre-graduated courses. Also, this might be due to the authorized administrative staff of the hospital doesn't provide specialty courses for nurses and motivate them. Current finding was in agreement with **Aysha & Ahmed, (2019)**, who reported that, more than three quarters of the studied nurses had poor knowledge about devices alarms pre educational program. Also this findings consistent with **Obeid, (2021),** who reported that, most study participants were confirmed to have poor to moderate level of knowledge related to clinical alarms.

Concerning the total nurses' level of practice the current study showed that, nearly two thirds of the studied nurses had incompetent level of practice regarding management of ICU devices alarms. From the point of view of the investigator, due to unsatisfactory knowledge level that lead to in competent practice, reduce continuing education and training, guideline books were unavailable, lack of supervision and continuous evaluation, most of nurses hadn't interest in work and nurses complains of overlapping of the activities by non-nursing activities.

This finding agreed with **Cameron, & Little, (2018),** who revealed that, the majority of the studied nurses had incompetent level of practice regarding devices alarm management pre provide instruction. On the other hand the present study disagreed with **Jeong, & Kim, (2022),** who showed that, more than half of the studied nurses had incompetent level of practice regarding devices alarm management.

Concerning the total nurses' level of attitude the current study showed that, more than half of the studied nurses had positive attitude. From the investigator point of view that, this may be due to awareness of the importance of emotional support to such group of patients. Also due to that nurses

educated people who know the benefit of patient condition. This result agreed with **Meng'anyi, et al., (2017)**, who reported that**,** more than half of the studied nurses had positive attitude.

Regarding relation between nurses' knowledge and demographic characteristics the present study results showed that, there was a statistically significant relation between the age, marital status, level of education, years' experience, training courses and the nurses knowledge. The current study findings agreed with **Hassen, et al.,(2023)** ,who revealed that, there was a statistically significant relationship was found between nurses' educational level and their knowledge. Also this findings agreed with **Ibrahim, et al., (2021)**, who illustrated that, there was a statistically significant relation between the studied nurses' total level of knowledge and their demographic data, namely educational level, years of experience, and training courses. On the other hand this finding was contradicted with **Al-Rawee, et al., (2022),** who reported that there was no significant relation between nurses' knowledge and demographic characteristics such as age, clinical experience and attending training courses.

Regarding relation between nurses' demographic characteristics and total practice, the present study finding revealed that there was ahighly statistically significant relation between age, level of education, years of experience, training courses and the nurses' practice. This findings were supported by **Botros, et al., (2019)**, who revealed that**,** there was astatistically significant relation between the nurses' practice and training course. Although this finding was inconsistent with **Ibrahim, et al., (2022)**, who revealed that insignificant relation between level of education, years of experience and tanning program and total level of participant practice .

Regarding relation between nurses' attitude and demographic characteristics the present study showed that, there was a highly statistically significant relation between level of education and nurses attitude. This findings agreed with **Bagherian, et al., (2017),** who revealed that**,** there was astatistically significant relation between nurses' attitude and level of education.

Regarding correlation between nurses knowledge, practice and Attitude about devices alarm in ICU.

This findings showed that, there was a highly statistically significant positive correlation between the studied nurses regarding total knowledge and their practice i.e an increase in their knowledge had an increase in the level of practice. Also, there was a highly statistically significant positive correlation between the studied nurses regarding to total knowledge and their attitude. This findings

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was similar to **Liao, et al., (2022)** ,who showed that**,** astatistically significant positive correlation between the studied nurses regarding to total knowledge and their attitude. Also this findings went in the same line with **Aziz, et al.,(2020),** who showed that**,** astatistically significant between total nurses' knowledge and their total practice level.

Regarding correlation between nurses practice and Attitude about devices alarm in ICU, the current study revealed that**,** there was a highly statistically significant positive correlation among the studied nurses regarding total practice and their attitude. This findings agreed with **Zhang, et al., (2021),** who illustrated that**,** there was astatistically significant positive correlation among the studied nurses practice and their attitude.

Conclusion

Based on the results of the current study, the following can be concluded:
More than three quarter of the studied nurses had unsatisfactory knowledge regarding devices alarms in intensive care unit, nearly two thirds of the studied nurses had incompetent level of practice regarding devices alarms in intensive care unit and more than half of the studied nurses had positive attitude regarding devices alarms in intensive care unit. Also, there was a highly statistically significant correlation between total knowledge, practice and attitude.

Based upon the results of the current study, the following recommendations were suggested:

● Continuing educational programs to improve knowledge, practice and attitude of nurses regarding devices alarms in ICU.

● Providing written nursing guidelines for management of clinical alarm in ICU.

● Providing training courses to new graduate specially who will working in ICU.

Recommendations for further researches

● Replication of the study on large sample selected from different hospitals setting in Egypt to generalize the study results.

● Further study is recommended to evaluate the reflection of educational training program regarding management ICU devices alarms on nurses' performance and consequently on the patients outcomes.

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