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Assessment Knowledge of Nurses about clinical alarms in critical setting in ELRebat University Hospital -August2017

A Thesis submitted as partial requirement for the full filament of MSc degree in critical and emergency nursing

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بسم الله الرحمن الرحيم

قَالَ تَعَالَىٰ:

﴿ شَهِدَ ٱللَّهُ أَنَّهُۥ لَآ إِلَٰهَ إِلَّا هُوَ وَٱلْمَلَٰٓئِكَةُ وَأُوْلُواْ ٱلْعِلْمِ قَآئِمَۢا بِٱلْقِسْطِۚ لَآ إِلَٰهَ إِلَّا هُوَ ٱلْعَزِيزُ ٱلْحَكِيمُ ﴾

سورة آل عمران

{18}

صدق الله العظيم

Dedication

Every challenging work needs self-efforts as guidance of elders especially those who were very close to our heart.

I dedicate to my sweet loving Father &mother

Mother

:a strong and gentle soul who taught me to trust in Allah, believe in hard work and that so much could be done with little.

Father

Whose affection, love, encouragement and prays of day and night make me able to get such success and honor.

My grandmother

For binge my first teacher,

My sister& my brother for supporting and helping me

My uncle

For being my guarding during my educational career

All my teachers big thank and respect.

Acknowledgement

There have been many people who have walked alongside me during the last two year they have guide me, placed opportunities in front of me and showed me the doors that might be useful to open .i would like to thank each and every one of them I would especially like to thank Prof Higazy , Dr Mohammed geber aldaar , without your encouragement the road would have seemed lonely place ,Avery big thank you must also go to the preens ,and staff who made me welcome in their centers .

Finally and without hesitation I would like to thank my family to thesis dedicated for your belief in me and support and continuous encouragement throughout my years of my study and throughout the process of researching and writing this thesis. This accomplishment would not have been possible without them. Thank you.

Abstract

In these descriptive cross-sectional hospital-based study aim to assessment nursing knowledge about clinical alarm in critical area, Nurses are the key professionals responding to alarms and managing the alarm.

With the development of medical technology, clinical alarm from diverse medical devices, are becoming a new issue in intensive care unit, medical devices (clinical alarm),which were designed to draw medical staff attention , in our study Clinical alarms are the top hazard listed in the 2014 Emergency Care Research Institute's (ECRI) "Top Ten Health Technology Hazards" . Fatal incidents related to clinical alarms are well documented [5, 6].

The data was collected by questionnaire composed of (31) questions, part one about demographic data, part two about nurses knowledge about clinical alarm.

The data analyzed using computer software (statistical package for social sciences (SPSS),deferent statistical measures was used {frequency ,percentage% ,mean, chi-test},the result of my research analysis is, 70%no attend training course about clinical alarm,52%no records the alarm frecuoncy,44% strong agree the clinical alarm is noise,50%agree that clinical alarm can caused work disruption ,46%agree the purpose of clinical alarm is to alert staff,50%strong agree the inadequate staff can lead to un respond to alarm,50%strong agree the staff sensitive to alarm and responds quickly, 58 % of the sample of the study agree that (The alarms used on my floor/ area of the hospital are adequate to alert staff of potential or actual changes in a patient condition), 46 % agree that the (Frequent false reduced attention or response to alarm), 38% disagree that the (Difficulty in understanding the priority of an alarm can affect the patient safety) , 38 % of the sample of the study agree and strong disagree that the (Lack of training on alarm systems can cause false management) .

ملخص البحث

تمت هذه الدراســة في مســتشــفى الرباط الجامعي وهي تهدف إلى تقييم مدي معرفه واســتجابه اصطاف التمريض حول التنبيه السريري في المناطق الحرجة.

مع تطور التكنولوجيا الطبية، والتنبيه السريري من الأجهزة الطبية المتنوعة، أصبحت قضية جديدة في وحدة العناية المركزة، والأجهزة الطبية (التنبيه الســريري)، والتي تم تصــميمها لجذب انتباه الموظفين الطبيين.

الإنذارات السريرية ادرجت ضمن الاعلي خطوره في عام 2014 حسب دراسه اجرتها معهد بحوث الرعاية الطارئة(ادرجت ضمن العشرة الأوائل من مخاطر التكنولوجيا الصحية).

تم جمع البيانات من خلال استبانة مكونة من (31) سؤالا، الجزء الأول عن البيانات الديموغرافية، الجزء الثاني عن معرفة اصطاف التمريض عن الإنذار السريري.

تم استخدام المعطيات الإحصائية التي تم تحليلها باستخدام برامج الحاسوب (حزمة إحصائية للعلوم الاجتماعية)، وتم اســتخدام مقاييس إحصــائية مؤثرة {تردد، نســبة مئوية، متوســط، اختبار كاي (chie)}،اوضحت نتيجة التحليل البحثي، ان 50٪ يوافقون على أن التنبيه السريري يمكن أن يسبب اضطراب العمل، 46٪ توافق على الغرض من التنبيه السريري هو تنبيه الاصطاف،و 50٪ يوافقون بشده ان الاصطاف يستجيب بسرعة للانزار، 58٪ من عينة الدراسة توافق على أن (أجهزة الإنذار المســتخدمة في المســتشــفى كافية لتنبيه الموظفين) ، واتفقت عينة الدراســة على ان 38٪ يوافقون بشدةعلي ان عدم التدرب يؤدي الي المعالجة الخاطئة .

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List of Abbreviations

ECRI	Emergency Care Research Institute
ICU	Intensive care unit
NPSG	National Patient Safety Goal
AACN	American Association of Critical Care Nurses
AARC	American Association for Respiratory Care
CCN	Critical Care Nursing
ERC	Ethics and Research Committee
ERC	Ethics and research Committee

Chapter One

Introduction

INTRODACTION

Clinical alarm systems safety is a national concern, specifically in intensive care units (ICUs) where alarm rates are known to be the highest. Interventional projects that examined the effect of changing default alarm settings on overall alarm rate and on clinicians' knowledge clinical alarms[(1)]

The high number of false alarms has led to alarm fatigue. Alarm fatigue is sensory overload when clinicians are exposed to an excessive number of alarms, which can result in desensitization to alarms and missed alarms. Patient deaths have been attributed to alarm fatigue. Patient safety and regulatory agencies have focused on the issue of alarm fatigue, and it is a 2014 Joint Commission National Patient Safety Goal. Quality improvement. [(2, 3)]

Bedside physiologic monitors are equipped with alarm systems for patient safety and appropriate functionality. Nevertheless, the problematic high volume of false and clinically insignificant non actionable true positive alarms—up to 99.4%—results in clinicians' failure to appropriately respond to alarms signaled from monitoring devices Clinicians become overwhelmed and desensitized with the number of alarms, a phenomenon known as alarm fatigue.[{4}] Alarm fatigue leads to different forms of unsafe workarounds, including a delayed response, disabling alarms, turning the volume to inaudible or adjusting alarms' settings to hazardous limits, all of which can result in missing lethal alarms. The Joint Commission (JC), which accredits and certifies health care organizations and programs in the United States, attributed alarm-related incidents and deaths to alarm fatigue and issued a 2014 National Patient Safety Goal to improve the safety of clinical alarm systems [(5, 6)]

Alarm safety is a priority in intensive care units (ICUs) where alarm rates are known to be the highest Adjusting default alarm settings and staff education on alarm management are two strategies recommended by safety and professional

Organizations to reduce the number of false alarms and alarm fatigue however, most research on alarm safety is observational. Interventional projects that examined the effect of changing default alarm settings on overall alarm rate and on clinicians' attitudes and practices toward clinical alarms and alarm fatigue [7].

Clinical alarms are supposed to alert caregivers that an intervention with a patient is required, or to remind them that care needs to be delivered. Unfortunately, patient-facing clinical staff are forced to respond to hundreds of daily alarms—the majority of which require no intervention—leading to alarm fatigue, disrupted clinical workflows, and compromised patient safety. The issue has become so severe that the ECRI Institute identifies "the failure to recognize and respond to actionable clinical alarms… in a timely manner" as the second highest patient safety risk in its Top 10 Health Technology Hazards for 2016. Across the industry, response to this concern has grown, with organizations such as the Association for the Advancement of Medical Instrumentation actively leading the effort on alarm management safety, The American Association of Critical Care Nurses and the National Association of Clinical Nurse Specialists also offer resources materials to help organizations develop best practices. Most recently, in 2016, Phase II of the Joint Commission's (NPSG) on clinical alarm safety mandated the establishment of clinical alarm management policies and education as an institutional priority, However, many stakeholders struggle to accurately define the current state of their alarm ecosystem, much less identify and implement potential solutions. (2.1) Scope of the Problem. Identifying the root causes of alarm proliferation, and standardizing approaches appropriate to specific patient populations, policies, and procedures, can be exceedingly difficult for even the most innovative organizations [7]. Where, for example, should hospital leadership target their focus? Reducing the total number of alarms? Reducing the average number of alarms per bed? Addressing the problem of "alarm flood," which is what happens when a caregiver is inundated with more alarms than they can physically respond to? The sheer volume of technical and physiological alarm-equipped medical devices in many hospital units, in addition to other factors, such as lack of standards on the proper configuration of alarm parameters, inaccurate default settings, and narrow alarm limits contribute to the scope and complexity of the problem. This white paper will outline the current state of clinical alarm management, demonstrate how to establish a baseline of a hospital's alarms, and outline innovative alarm reduction strategies to promote more efficient workflow, increase patient safety, and put hospitals on the path toward real-time patient monitoring and intervention.

Alarms in the critical areas are an important component of most of the machines as they alert nurses on the change in the patients' condition. Most patients in the critical care units cannot speak for themselves hence cannot pinpoint when their condition changes. It is therefore important to

assess the nurses' interventions when managing clinical alarms. The purpose of this study was to assess interventions employed by nurses in the management of clinical alarms in the care of patients in the Critical Care Unit (CCU), Kenyatta National Hospital (KNH). [8]

Nurses adjust the order of their activities by evaluating alarm urgency in relation to the patients' condition and have a greater tendency to react to alarms of longer duration and considered rare,. As workload complexity increases, alarm response and task performance deteriorates. Thus signal duration is an important influence to the nurses' response but workload, patient condition and task complexity may lead to other reaction strategies. Adjusting alarms to patient's actual needs ensures that alarms are valid and provides an early warning to potential critical situations. [10]

Nurses are at risk of becoming desensitized to the alarms that are meant to protect patients when the frequency of alarms is high. Nurses in the CCUs in the Northeastern academic medical center in the USA stated that the primary with alarms is that they are continuously alarming and that the largest contributor problem to the number of false alarms in the CCUs is the pulse oximetry alarm [11].

According to the American Association of Critical-Care Nurses (AACN, 2012) practice alerts, alarm fatigue develops when a person is exposed to an excessive number of alarms of which most could be false alarms. This may result in sensory overload, which may cause the person to become desensitized to the alarms. Patient deaths have been attributed to alarm fatigue [12]. The AACN therefore has suggested several strategies to improve patient safety in the event of reducing the number of false alarms

The AACN also recommends that institutions should provide initial and ongoing education about devices with alarms. The education should be on monitoring systems and alarms as well as operational effectiveness to new nurses and all other health care staff on a periodic basis [13].

Problem statement

False and fatigue alarm can effect in patient safety in the critical area.

Justification:

Nurses are the key professionals responding to alarms and managing the Clinical alarms are the top hazard listed in the 2014 Emergency Care Research Institute's (ECRI) "Top Ten Health Technology Hazards". Fatal incidents related to clinical alarms are well documented [13, 14].

Objectives

General Objective:

To study nurses knowledge about clinical alarms in critical setting.

Specific objective:

- To determine level of nurses knowledge about clinical alarm in critical area.
- To detect the barriers of nursing response regarding clinical alarm in critical area.
- To identify who the nurses deal with false alarm in critical area.
- To assess the barriers to response to clinical alarm.

Chapter Two

Literature review

Background

Clinical alarm systems in acute and critical care health care settings ―challenge human limits for recognition and actions.[15] Understanding alarm-related terminology and the scope of contributing factors (including, but not limited to, alarm fatigue) will equip nurses to devise and implement appropriate strategies for alarm management at the individual practice level and beyond. All alarms in clinical settings should be ―actionable and clinically significant. Actionable alarms are those that require timely intervention. In reality, only a small percentage of clinical alarms signal life-threatening or urgent conditions (e.g., ventricular tachycardia) that require a clinical response. Research suggests that 80% to 99% of clinical alarm signals are either clinically insignificant or *false alarms* (*false-positive* or *false-negative*). These false alarms, combined with device alarms, comprise ―the most significant sources of excessive alarms‖ in clinical settings. [16]

Excessive clinical alarms may cause an alarm hazard, which includes inappropriate application of alarms, alarm fatigue, and the application of a uniform alarm range to every patient [17]. While defects of devices threatened patient safety in the past, alarms indiscriminately generated by the explosive increase in the number of medical devices now threaten their safety. Reports on safety accidents related to the diversity of medical device alarms have raised awareness of the clinical alarm hazard. In 2002, 65% of 23 sentinel events were related to dysfunction and disuse of alarm devices and inappropriate alarm setting. Five-hundred sixty-six deaths related to the monitoring of device alarms, severe burns due to neglect of alarms from hyperthermia machines, and hypoxic brain damage, were also reported. In 2012, alarm hazard was ranked first among ten types of medical technology hazards in the United States2 [18]

Previous research on ICU nurses' recognition of clinical alarms: "alarms sound and/or visual displays should differentiate the priority of alarms" and "alarms sound and/or visual displays should be distinct based on the parameter or source". These results were similar with the present results: 94.8% of the respondents agreed or strongly agreed that "alarm sounds and/or visual displays should differentiate the priority of alarms" and 87.0% agreed or strongly agreed that "alarm sounds and/or visual displays should be distance based on the parameter or source (e.g., EKG, BP, SPO2)". Similarly, the majority of respondents recognized the problem of false alarms. Their agreement with such items as "nuisance alarms occur frequently" (76.6%), "nuisance alarms disrupt patient care" (66.3%), and "nuisance alarms reduce trust in alarms and cause caregivers to turn alarms off at times other than setup or procedural events" (79.2%) was also at similar levels to those in prior research [19,23].

Clinical alarm definition:

Components of medical instrumentation used for physiological evaluation of patients, Medical device (clinical) alarms, which were designed to draw medical staff's attention when a patient's conditions goes beyond the proper range, are causing a new alarm hazard problem [21]

Purpose of clinical alarms:

Is to alert staff of an existing or potentially hazardous patient condition

Type of alarm

False alarms:

There are 2 types of alarms:

1. False-positive alarms: Patient movement triggers artifact-related alarms.

2. false-negative alarms: No alarm was heard.

It is important to distinguish between the 2 types of false alarms during event analysis in order to identify appropriate actions. Technically incorrect (or false-positive) alarms are largely a function of emphasis on high sensitivity and low specificity during system design. In the immediacy, these alarms have limited clinical consequence for the individual patient8; however, they contribute to alarm fatigue. False-negative alarms are rare but feared because they offer no opportunity for clinical intervention (e.g., a monitored patient is in a systole, no alarm sounds, and the patient is found dead). Nuisance alarms also contribute significantly to the alarm profile of a unit. They frequently result from overly ―tight‖ parameters, generating excessive true-positive but clinically insignificant alarms.[22,23]

The issue of "frequent false alarms, which lead to reduced attention or response to alarms when they occur" was regarded as most important among the nine obstacles, and it was ranked first by 42% of the respondents in HTF . In 2011, six years after the research by HTF [23], Funk et al. [17] also found that it was ranked first and remained an important issue, still unsolved. Similarly, Christensen et AL found that 81% of the 48 ICU nurses indicated false alarms and inappropriate alarm setting as main causes of alarm fatigue. To make ICU nurses less likely to feel fatigue associated with alarms, therefore, it is necessary to make efforts to reduce false alarms. [24] In the previous study, 32 devices generated 45 different alarms to warn nurses of abnormality in a patient or in device operation. Similarly, Borowski et al. [1] found about 40 different alarms in ICUs in 2011. Thus, it can be inferred that there is no significant difference in the types of alarm-generating medical devices in ICUs in Korea and abroad. Based on the finding from previous studies, that a nurse can distinguish 6–14 different alarms, it can be inferred that nurses may distinguish a device for up to 31% of 45 different alarms. It is therefore necessary to reduce the number of alarms that

medical staff should differentiate by standardizing the alarms for each device, as suggested by Cvach[13].

As a single medical device, a patient bedside monitor generated the largest number of alarms, probably because it is an essential device for every ICU patient, and it monitors diverse variables of biorhythm. Previous studies have found that patient monitors generated 28.8–39.2 alarms per hour. Such a gap between previous research and this study may partly result from differences in the number and type of variables monitored by patient monitors. The variation in the research period ranging from 6 hours to 18 days and the differences in the method of counting alarms—manual counting and automatic counting based on a system— also could account for this gap. It may be necessary to take these differences in counting and observation period into account in interpreting results [11, 12, and 13]

Alarm fatigue:

The problematic high volume of false and clinically insignificant non actionable true positive alarms—up to 99.4%—results in clinicians' failure to appropriately respond to alarms signaled from monitoring devices Clinicians become overwhelmed and desensitized with the number of alarms, a phenomenon known as alarm fatigue.

Occurs when medical staff are overwhelmed by excessive clinical alarms in particular, false (positive) alarms, inappropriate alarms-setting ranges, and the overuse of patient monitors act as principal factors that cause alarm fatigue. Of these, the most problematic factor is false alarms: frequent false alarms may produce the 'cry wolf' effect and may cause nurses to regard significant alarms as false and thus fail to respond properly. It may also make an alarm system less reliable and may cause nurses not to use alarm devices [14, 15]. It is therefore essential to effectively manage medical device alarms and develop good interventions that can reduce false alarms.

Since medical device alarms in ICUs and alarm fatigue are directly linked to the issue of patient safety [17].

Previous research simply regarded alarm fatigue as overexposure to alarms and reported that clinical alarms caused nurses to feel alarm fatigue. While it is impossible to make a direct comparison because no researcher has tried to quantify alarm fatigue, we have developed an alarm fatigue scale to estimate fatigue in this study. It is presumed that the nurses felt alarm fatigue at moderate or higher levels: they scored 24.3 (±4.0) out of 35—69.4 out of 100—for alarm fatigue. Similarly, Chung and Kang found that operating room nurses scored 69.2 for fatigue in general. Thus, the nurses in this study felt alarm fatigue at similar levels to those in general. Since no

researcher has quantified alarm fatigue either in Korea or abroad, it is necessary to conduct further research on this issue to reconfirm the results. [27]

In the present study, false alarms represented 63.8% of all the alarms. Patient monitors accounted for 62.5% of all the alarms. This rate of false alarms from patient monitors was higher than 52.3% that the false alarms were only generated for electrocardiograms. In contrast, another research reported that the rate of false alarms was 86%, and the largest number of false alarms was generated by a device measuring oxygen saturation. Such differences between the present study and previous studies may occur because the prior research had alarms counted automatically via a system and set a wider range of upper and lower limits than this study. [28]

The Impact of Noise in Healthcare

Effects of Noise on Staff:

• Increases occupational stress (irritation, fatigue, and tension headaches)

• Reduces staff work performance (quality of work, concentration, vigilance), work satisfaction, and health outcomes)

• Delays recognition and response to medical device alarm signals, which affects patient safety

• Affects oral communication and increases errors, which has a direct impact on patient safety.[25]

Effects of Noise on Patients and Families

• Sleep disturbances

• Delirium

• Increased blood pressure and heart rate

• Negative effects on the immune system

• Slower healing and recovery process

• Increased length of stay

• Impact on patient satisfaction surveys[25]

Alarm Management:

Incorrect to view alarm management as a skill simply acquired implicitly through time and clinical experience. Analyses of alarm-related events often reveal that users do not understand the purpose of the system, did not have an optimal level of knowledge or training before use, or had not had clinical competence validated. In the clinical case, clinically irrelevant alarms. The RCA also indicates that other, unit-level and facility-level factors contributed to the event, and the RCA team requests the unit and facility policies on alarm management. [23]

The team reviews the policies, looking specifically at roles and responsibilities. A facility-level policy reads: ―All staff is expected to respond immediately to all critical alarms. The nurse on the team didn't know the alarm was critical, busy and didn't even hear it. And how can ―all‖ of the nurses respond to ―all‖ of the alarms all of the time? The team members agree the facility policy, as written, offers limited meaningful guidance for staff. They also review their unit policy, which states: ―Telemetry monitoring technicians may not turn off or otherwise disable critical alarms without verifying with the patient's assigned [nurse]. Several team members note that it was a nurse, not a technician, who changed the alarms, and that she did not disable the alarm, but ―suspended it. Others point out, however, that she was not the assigned nurse at that time. Jackie reports that her own orientation to the monitors was minimal, and most of her understanding of this particular system was acquired during day-to-day use.

Effort to manage medical device alarms effectively and reduce alarm fatigue can also prevent potential hazardous events, Technology plays a critical role in clinical alarm management and reduction, but it is one piece of a larger solution. Achieving measurable progress in clinical alarm management requires that hospitals identify and support internal champions in all relevant departments, including nurses, respiratory therapists, biomedical engineers, and information technology staff. [23]

Proactive alarm management is the best way to reduce alarm hazards, reduce excessive alarms, and prevent alarm fatigue. [28] It is incorrect to view alarm management as a skill simply acquired implicitly through time and clinical experience.26 Analyses of alarm-related events often reveal that users do not understand the purpose of the system, did not have an optimal level of knowledge or training before use, or had not had clinical competence validated.29 In the clinical case, both of the nurses who cared for the patient (Pamela and Susan) had opportunities to manage the alarm settings and parameters proactively to reduce the frequency of clinically irrelevant alarms. The RCA also indicates that other, unit-level and facility-level factors contributed to the event, and the RCA team requests the unit and facility policies on alarm management.

Top Five Gaps in Alarm-Management-Related Knowledge

1. Lack of documentation and data to analyze reported events and near misses to understand root problem(s)
2. Lack of evidence-based rationale for the configurations of alarm settings
3. Lack of understanding of the best types of alarm signals to elicit a response
4. Lack of knowledge regarding who should be monitored and for how long
5. Lack of understanding about the best secondary alarm notification systems[38]

10 Ideas for Safe Alarm Management

The ideas that follow are synthesized from the AAMI Foundation's Safety Innovation Series of reports, white papers, seminar recordings, meeting presentations, and handouts profiling the alarm management strategies of leading practitioners.

These ideas represent approaches common to robust, multidisciplinary teams. Healthcare systems and hospitals carried out these approaches in a variety of ways—a reflection of different challenges, goals, and institutional cultures. Consider how you can use some or all of these 10 ideas to make your alarm management initiative successful:

1. Issue a call to action, championed by executive leadership, which recognizes the challenges and risks—and opportunities—of alarm management and commit to solving them.
2. Bring together a multidisciplinary team to spearhead action and build consensus.
3. Gather data and intelligence to identify challenges and opportunities—and be open to surprises.
4. Prioritize the patient safety vulnerabilities and risks to target with alarm management improvements.
5. Set and share goals, objectives, and activities to address patient safety vulnerabilities and risks.
6. Develop and pilot potential solutions.
7. Evaluate the effectiveness of improvements and make adjustments as needed.
8. Develop policies and procedures.
9. Educate to build and maintain staff competencies.
10. Scale up and sustain by creating ownership at the unit level and with continuous improvement. [31]

Tips for Developing Alarm Management Policies and Procedures

• There should be an institution standard for alarm management.

• Alarm parameters should be set for actionable levels and to decrease false alarms—monitor this as part of your unit performance improvement (PI).

• Nurses must be educated to the policy so there is consistency as to how the alarms are set.

• At least once per shift, the staff should analyze alarm parameters and alarm levels to determine if they are appropriately set.

• Allow staff input to the policy.

• Work with staff to audit compliance to the policy.

Leadership Goals for Alarm Management

• Enhance patient care and patient safety.

• Decrease nuisance alarms and alarm fatigue.

• Ensure staff accountability and responsiveness to alarm signals and ensure they know their responsibility.
• Improve productivity and work flow.
• Increase patient and staff satisfaction.
• Optimize technology.
• Align with/meet The Joint Commission National Patient Safety Goal on alarm management.
• Make the organization an environment of healing, where there is a decrease in the noise. [32]

Nursing response:

Clinical alarms in ICUs were estimated to be more than 80 dB, which is close to the noise level generated by a pneumatic drill in an operating room [7].

In addition to the noise problem caused by alarms, ICU nurses may have difficulty in distinguishing alarms for urgent intervention from others since different device manufacturers use different types of alarms. For example, they need to differentiate alarms for replacing the syringe of an infusion pump from those for a life-threatening emergency when they hear both types of alarms. ICU nurses were found to have difficulty in differentiating more than 6 different alarms and could differentiate no more than 9–14 out of 23 alarms on average [34].

In one study, medical staff members were repeatedly exposed to an average of 771 patient monitor alarms per patient per day [35]. Medical staff overexposed to alarms may experience a decrease in concentration, become careless, and commit mistakes. Moreover, overexposure may make medical staff less sensitive to alarms and may cause them to cope improperly with significant alarms that can affect patients' safety [12]. The excessive medical device alarms may cause nurses to feel alarm fatigue.

False alarms from patient monitors were due to technical problems, such as separation of a sensor. This is higher than false alarms resulting from technical problems. Such a gap is due to the differences in categorization of alarms, the result that there were lots of false alarms with technical problems implies the possibility of reducing alarms most easily, for example, by replacing sensors. Alarms could be reduced by replacing skin electrodes for electrocardiogram monitors regularly and removing foreign materials from the skin before sensors are attached [13]. This method can be applied immediately to reduce the frequency of alarms in clinical practice. Usually respond to alarms of all durations, that is whether of short duration, frequently occurring or rare alarms. This therefore shows that the respondents in this study value the importance of alarms. In contrast to other studies where the findings indicate that nurses respond to alarms for different reasons, not just the fact that the alarm sounds. In a study conducted in the US nurses were found to adjust the

order of their activities by evaluating alarm urgency in relation to the patients' condition and had a greater tendency to react to alarms that beep for long and alarms that occur rarely as opposed to all the time. As workload complexity increases, alarm response and task performance deteriorates. Thus signal duration is an important influence to the nurses' response but workload, patient condition and task complexity may lead to other reaction strategies [(1)].

Most of the respondents in this study reported that they do not fill alarm checklists and no alarm checklists are available in the unit and yet reported that documenting alarm parameters in the medical record was found to be an effective intervention for improving alarm adjustment compliance. This therefore shows that no alarm protocols are available in the institution as echoed by some of the respondents. The fact that no research has been undertaken on alarm management in the country also plays a role as it shows how little attention has been paid to alarm management.

On the various actions or nursing interventions that were posed to the respondents, the respondents reported that they carry out most of the interventions/actions. The respondents however scored 60% and above in some of the questions on alarm actions when the questions were tested against the social demographic factors. Since alarm management is very critical in the management of critically ill patients, it was expected that the scores would all be from around 90% to 100%. These scores therefore show that the staffs in the CCU need to be sensitized on the importance of alarm management. From the findings it was also noted that there was a statistically significant relationship between the nurses' action of assessing the cause of the alarm beep and age. The nurses aged 36–44 years scored the highest as compared to those aged between 25 and 35 years and 45–55 years who more or else scored the same. This should probably be looked into in future studies. The younger nurses could be ignoring to assess the cause of the alarm beep because of the assumption that it is a false alarm and the older ones from experience could ignore because they can use the patient's physiological status to detect whether they need to respond or not.

Health care personnel have been shown in previous studies to use alarms in a variety of ways depending on the particular process on which they are working. Sometimes when they appear not to have noticed the alarms, they may have in fact made use of the information and respond much later, perhaps after a minute or so [(9)].

Nurses do not fill alarm checklists and majority of them still manage to respond to all {arms appropriately. Due to the scores the respondents received in this study, the researcher concludes that the respondents need training on alarm management and sensitization on the importance of alarm management.

Alarm protocols should also be established in the unit and the element of alarm checklists should be introduced. Finally more research should be undertaken on alarm management where all the nurses, doctors and biomedical personnel should be included.

Many elements of NPSG 06.01.01 are focused on establishing roles and responsibilities through policy and procedure, including who may make decisions about alarm parameters, who may change alarm settings, and who is responsible for responding to alarms and alerts. However, the mere presence of a policy does not translate into improved safety, as noted in the case study. Policy, procedure, and protocols may define responsibility without differentiating clearly between role, title, responsibility, and scope of clinical practice. Such tools may fail to address reasonably expected contingency scenarios (eg, a nurse watching the telemetry monitors). This failure can generate loopholes and inconsistencies in practices. In this case, the nurse watching the monitors is serving in a contingency role (monitor technician). Her decisions are based on clinical context and her clinical expertise; her actions are those of a nurse rather than a technician, and she may be unaware of the specific responsibilities or constraints on the telemetry technician. Based on unit policy, the nurse caring for the patient could reasonably assume that the monitoring technician (nurse or not) would not change alarm parameters. Alternatively, she may have adjusted her practice based on the fact that a nurse, especially one who had previously cared for the patient in question, was serving as the monitor technician. [35]

Previous research on ICU nurses' recognition of clinical alarms [23] found that over 90% of the respondents agreed or strongly agreed with two items: "alarms sound and/or visual displays should differentiate the priority of alarms" and "alarms sound and/or visual displays should be distinct based on the parameter or source". These results were similar with the present results: 94.8% of the respondents agreed or strongly agreed that "alarm sounds and/or visual displays should differentiate the priority of alarms" and 87.0% agreed or strongly agreed that "alarm sounds and/or visual displays should be distance based on the parameter or source (e.g., EKG, BP, SPO2)". Similarly, the majority of respondents recognized the problem of false alarms. Their agreement with such items as "nuisance alarms occur frequently" (76.6%), "nuisance alarms disrupt patient care" (66.3%), and "nuisance alarms reduce trust in alarms and cause caregivers to turn alarms off at times other than setup or procedural events" (79.2%) was also at similar levels to those in prior research [17,23].

The issue of "frequent false alarms, which lead to reduced attention or response to alarms when they occur" was regarded as most important among the nine obstacles, and it was ranked first by 42% of the respondents in HTF . In 2011, six years after the research by HTF [23], Funk et al. also

found that it was ranked first and remained an important issue, still unsolved. Similarly, Christensen et al. [7] found that 81% of the 48 ICU nurses indicated false alarms and inappropriate alarm setting as main causes of alarm fatigue. To make ICU nurses less likely to feel fatigue associated with alarms, therefore, it is necessary to make efforts to reduce false alarms.

Borycki [28] warned that new healthcare technologies could introduce technology-induced errors, while we have not paid much attention, in terms of patient safety, to medical device alarms. There is no Korean study that can be compared with this study; however, the results of this study were differed insignificantly from those of previous studies. The nurses recognized false alarms as an important issue in alarm management, set individualized alarms ranges in very few cases although they felt a moderate level of fatigue from medical device alarms, and used an alarm systems inefficiently. Since medical device alarms in ICUs and alarm fatigue are directly linked to the issue of patient safety, effort to manage medical device alarms effectively and reduce alarm fatigue can also prevent potential hazardous events [22].

Chapter Three

Methodology

Methodology

Study design

Descriptive, cross-sectional hospital-based study, conducted in Elrebat University hospital, at Khartoum city,

Study area:

the study area had been chosen was in Elrebat University hospital, which was located in Khartoum, burry the distances from Khartoum center was 6KM, which was surrounded by Elrebat University from the weastern, and from north by saheron hospital, east almaarad strate.

Study setting:

I cu and CCU located in Al Hedaery building, floor one, ICU composed of (8)beds , and 36 nurses staff. CCU composed of (6) beds, and 14 sisters are work in.

Study population:

The study include all nurses in the hospital {I C U and C C U } staff members during the time of the study

Sampling:

All nurses were enrolled in the study.

Sample size:

50 nurses were participated in the study.

Data collection tools:

The data was collected by questionnaire composed of (31) questions , part one about demographic data , part two about nurses, knowledge and atetiuote.

Data collection techniques:

The data was within four weeks , during all shifts , after the purpose of the study was explained to the participant , every nurses were allowed to fill the data by themselves no one refused.

Data analysis

The data analyzed using computer software (statistical package for social sciences (SPSS),deferent statistical measures was used {frequency ,percentage% ,mean, chi-test}

Ethical confederation

The research is respecting the rights of participant, treat data with confidentiality no harm for the subjected, Since here is no interventions. All study subjects provided verbal consent prior to participations in the study. Approval from study area was taken ,attached as appendix.

Chapter Four

Analysis and Result

Result

Table (1) Distribution of study group according to their age.

Item	Frequency	Percent
25-30 years	36	72.0
31-35 years	11	22.0
36-40 years	3	6.0
Total	50	100.0

The above table showed that 72% of the study group their age is 30-35, 11% from 25-30,6% from 35-40.

Table (2) Distribution of study group according to their gender.

Item	Frequency	Percent
male	6	12.0
female	44	88.0
Total	50	100.0

The above table showed that 88% female, 12% male.

Table (3) Distribution of study group according to their education level.

Item	Frequency	Percent
diploma	2	4.0
bachelors	42	84.0
master	6	12.0
Total	50	100.0

The above table showed that 84% bachelors, 12% master,4% diploma.

Table (4) Distribution of study group according to their work area.

Item	Frequency	Percent
I C U	36	72.0
C C u	14	28.0
Total	50	100.0

The above table showed that 72% work in ICU, 28% work in CCU.

Table (5) Distribution of study group according to their experience years.

Item	Frequency	Percent
1- 2years	26	52.0
3-5years	7	14.0
6-7 years	1	2.0
8-9 years	8	16.0
More than 9 years	8	16.0
Total	50	100.0

The above table showed that 52 % experience years from 1to 3 years, 14% 3to 5 years, 16% 7to 9 and more than 9 years, 2% 5 to 7 years.

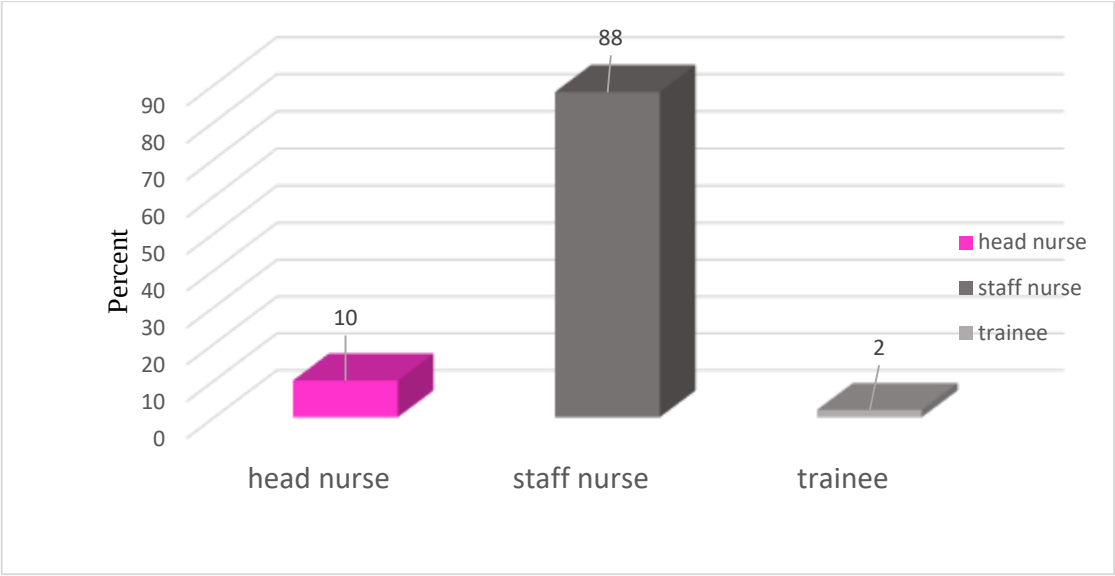


Figure (1) showed the distribution of the study according to their current position.

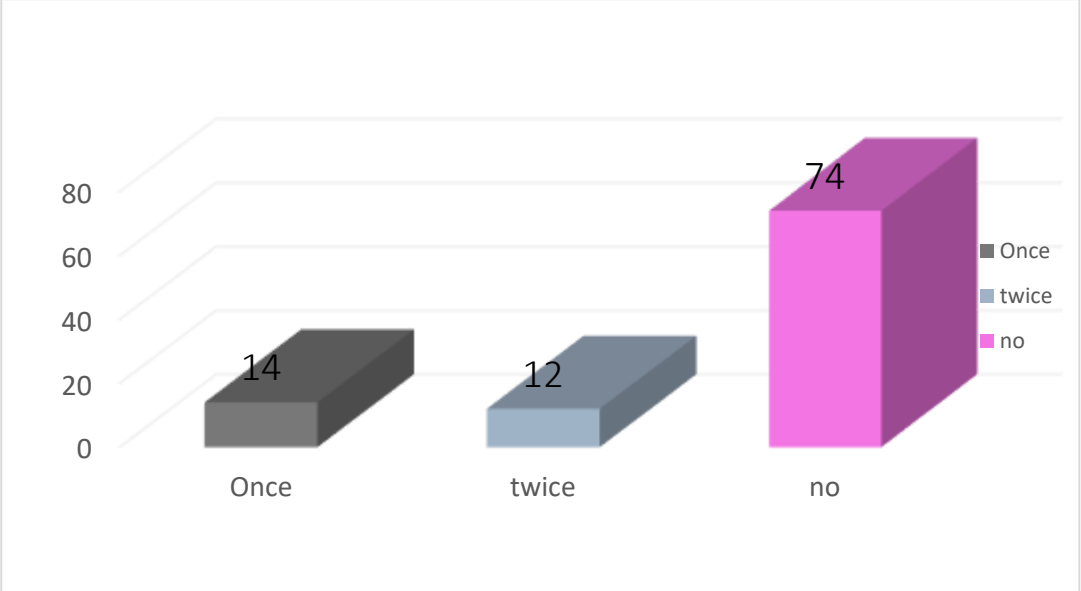


Figure (2) showed the distribution of the study attuned training course about clinical alarm.

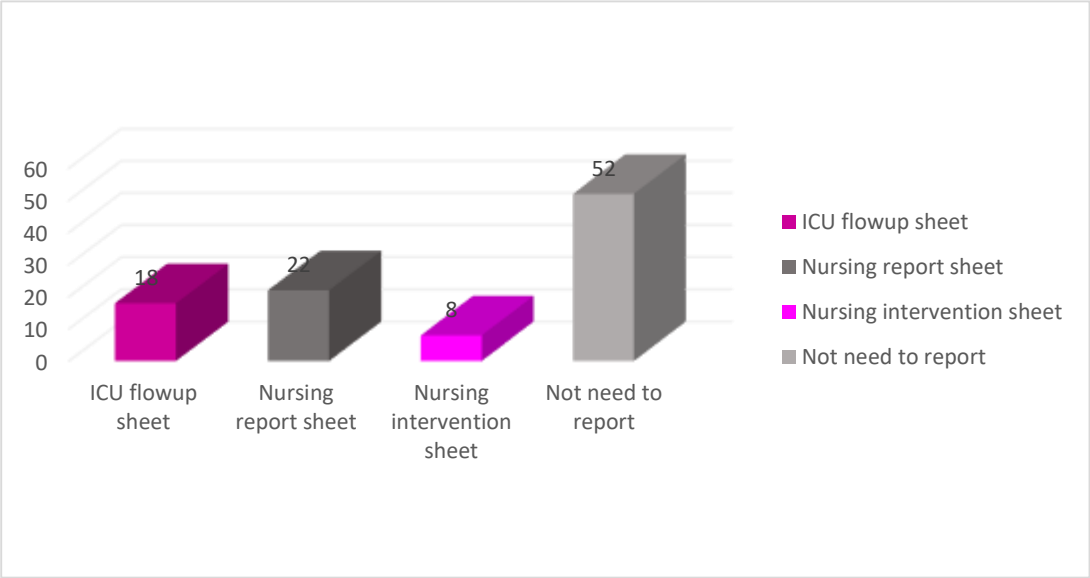


Figure (3) showed the distribution of the study the type used of clinical alarm reported.

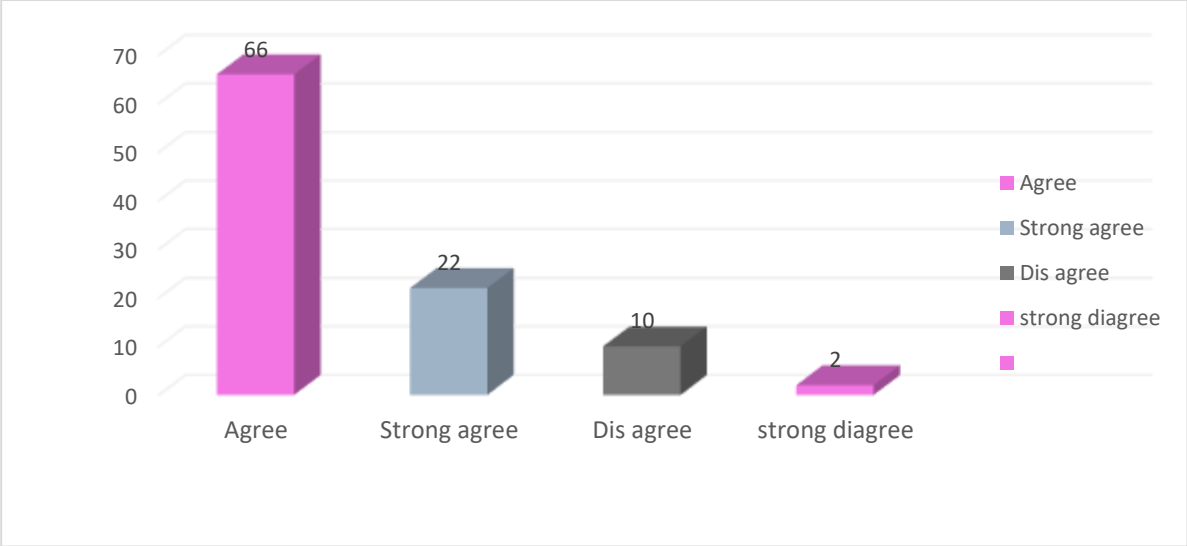


Figure (4) showed the distribution of the study that clinical alarm is nose.

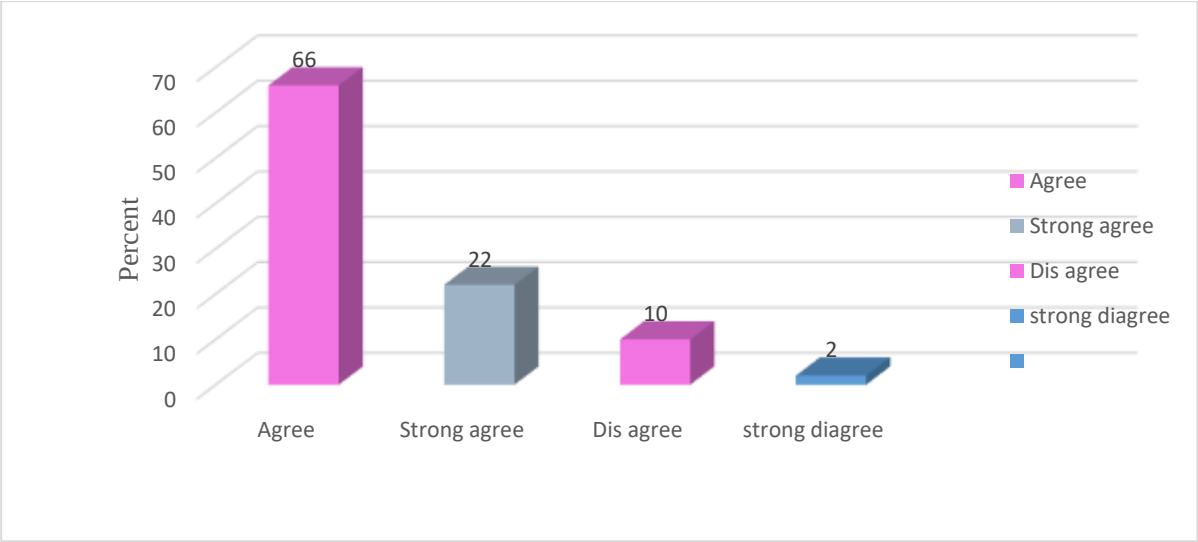
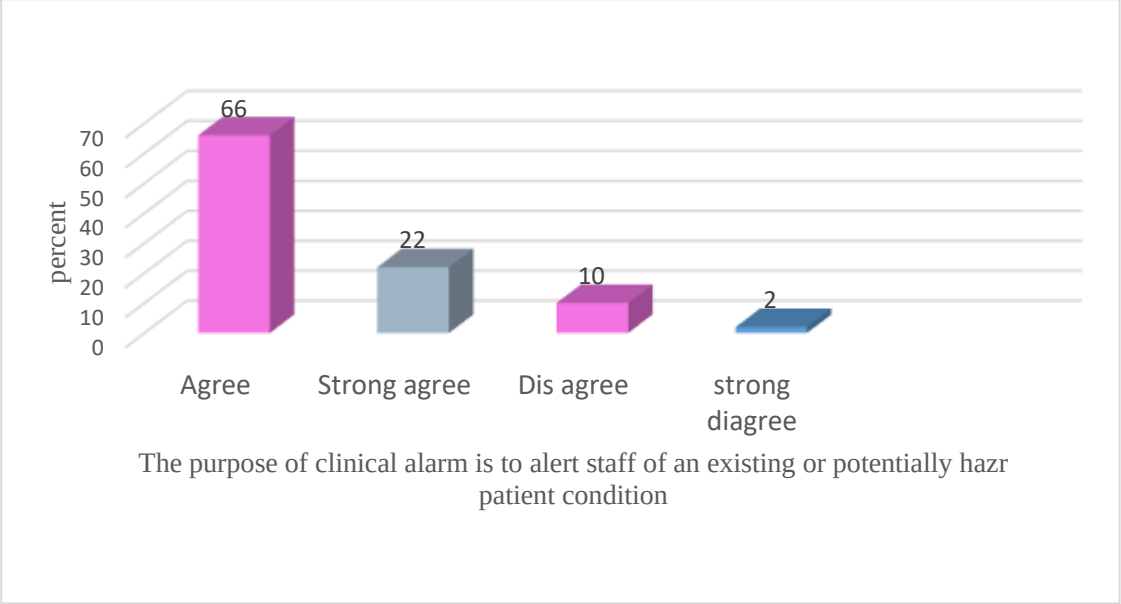
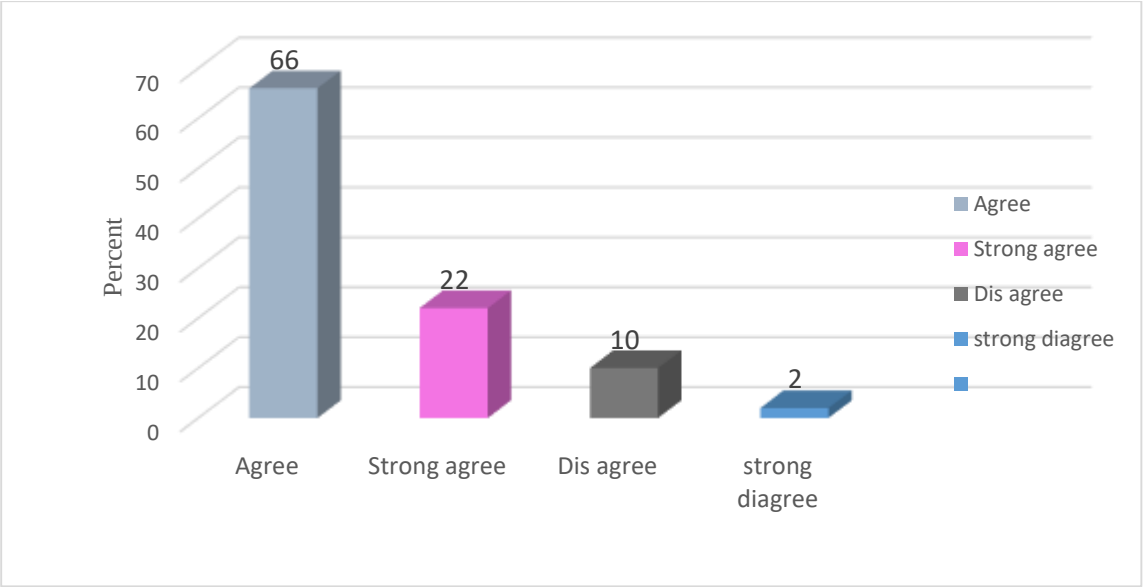


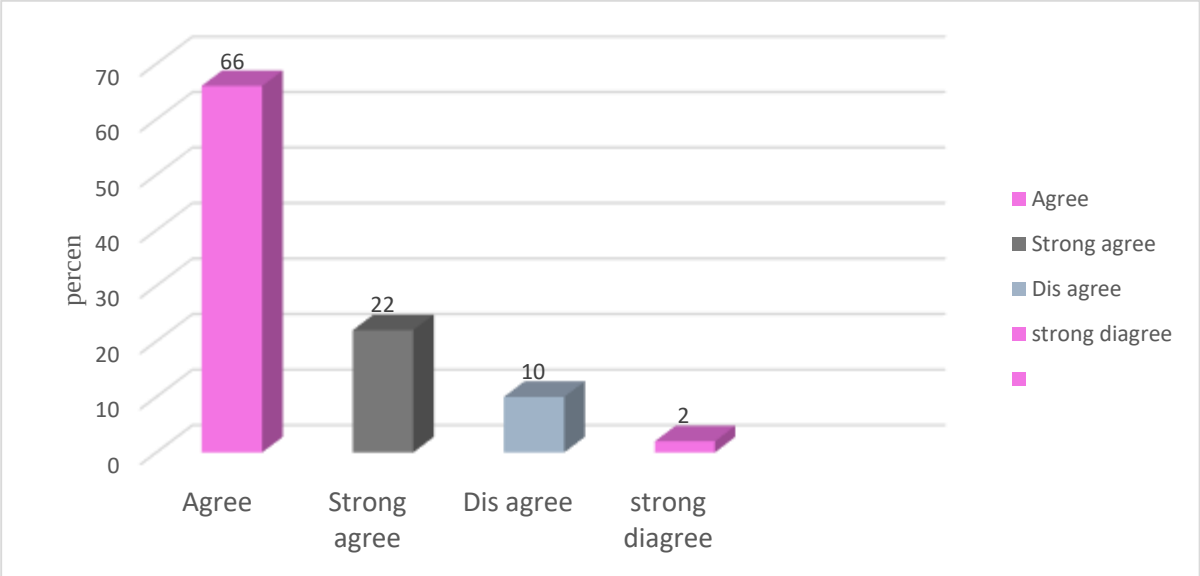
Figure (5) showed the distribution of the study if the clinical alarm can caused work disruption.



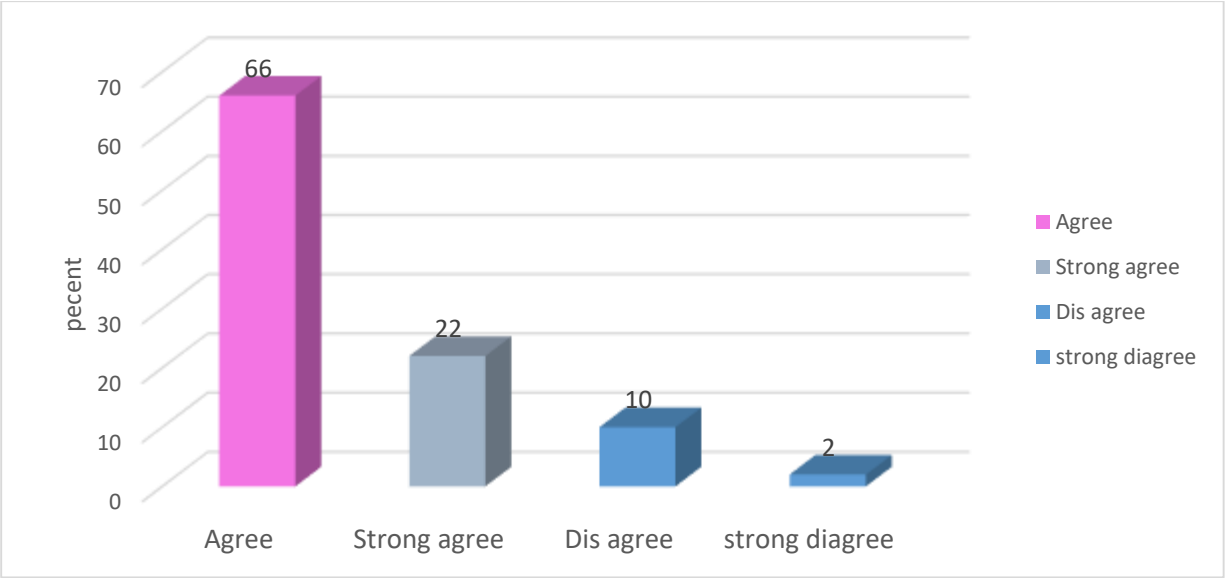
Figure(6) showed the distribution of the purpose of clinical alarm is to alert staff of an existing or potentially hazard patient condition.



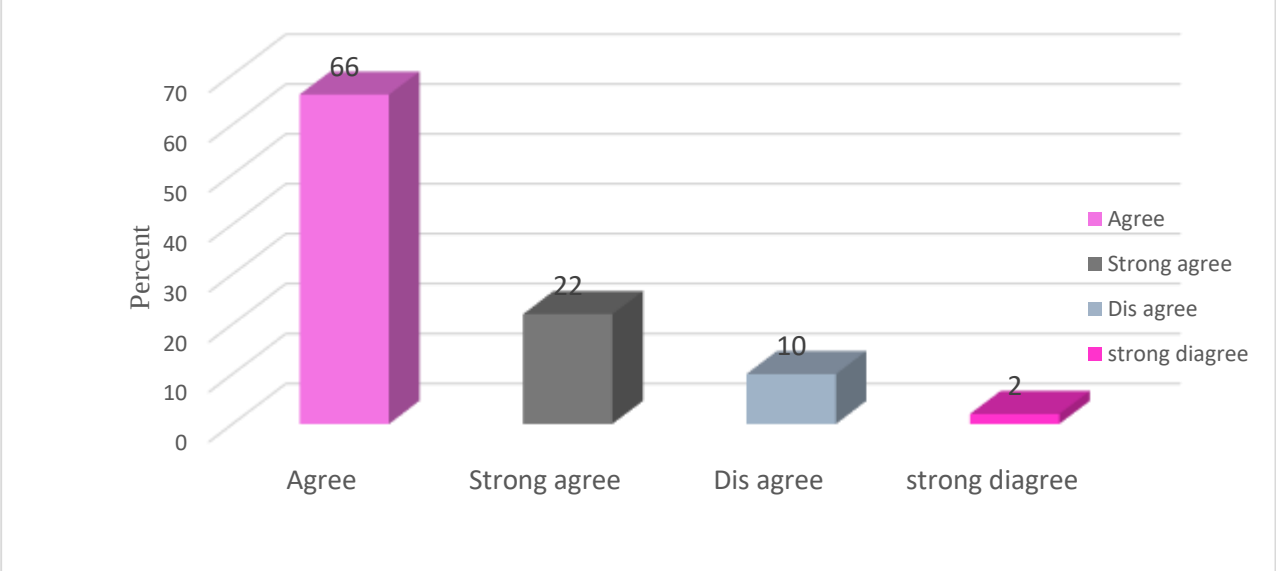
Figure(7) showed the distribution of the in adequate staff can lead to un response to alarm.



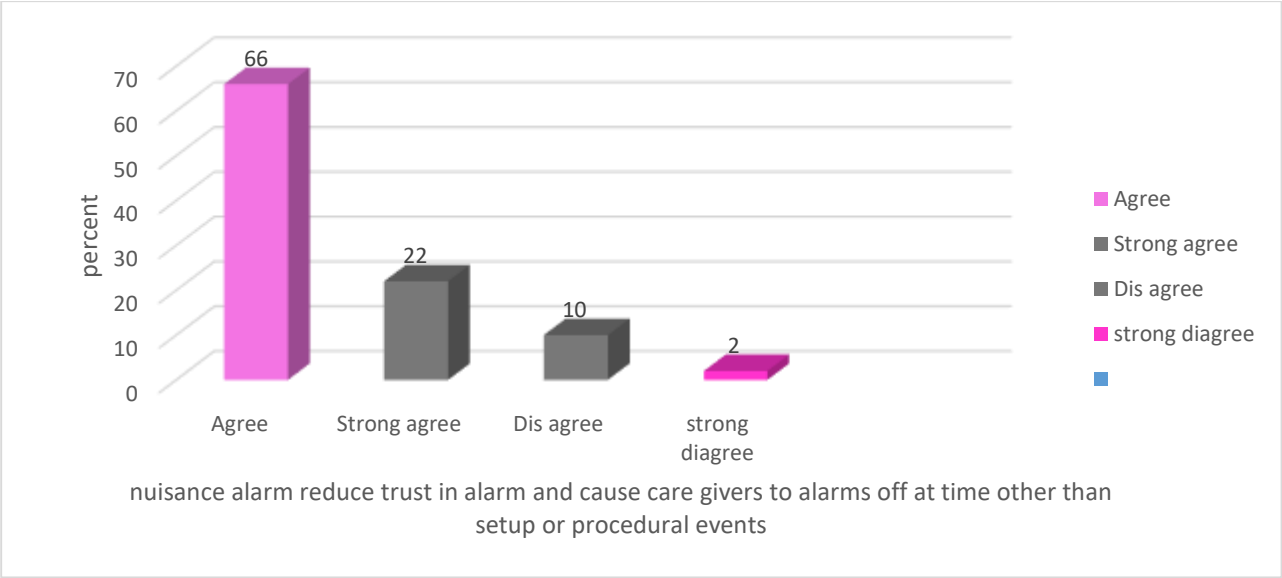
Figure(8) showed the distribution of the Alarm sound and /or visual displays showed be differentiate the priority of alarm.



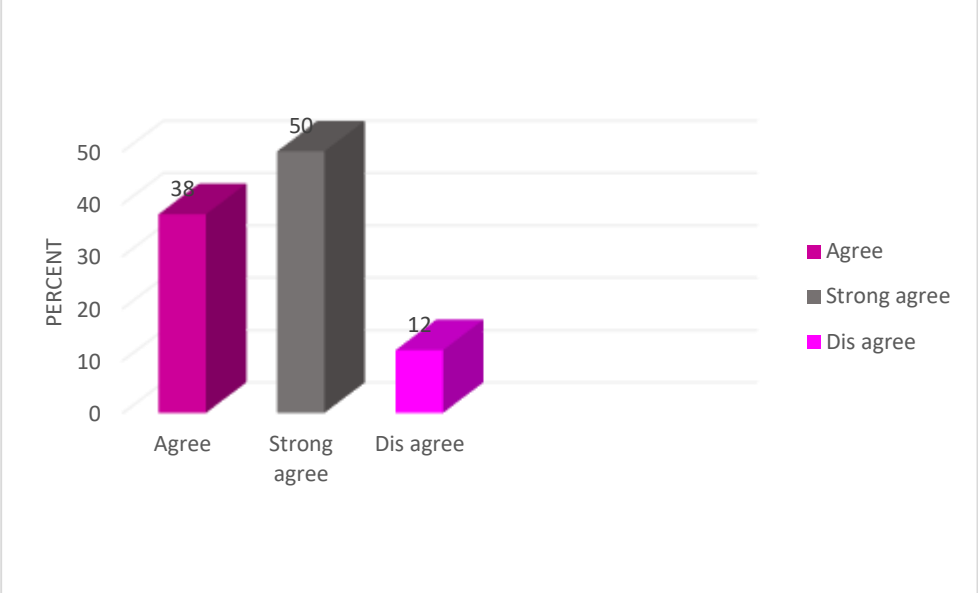
Figure(9) showed the distribution of the alarm sounds and /or visual displays should be distance based on the parameters or source (e.g.BP,SPO2) .



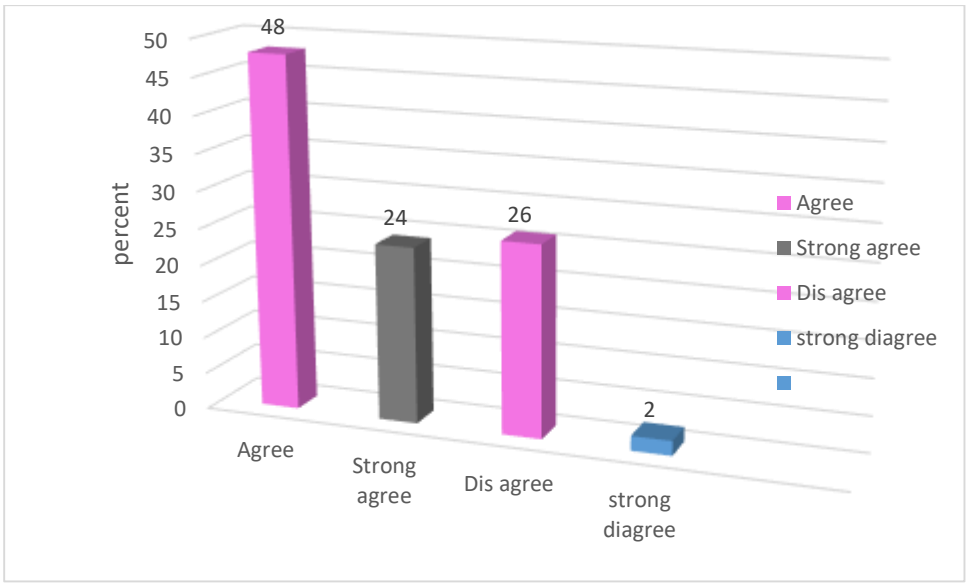
Figure(10) showed the distribution of the Nuisance alarm occur frequently.



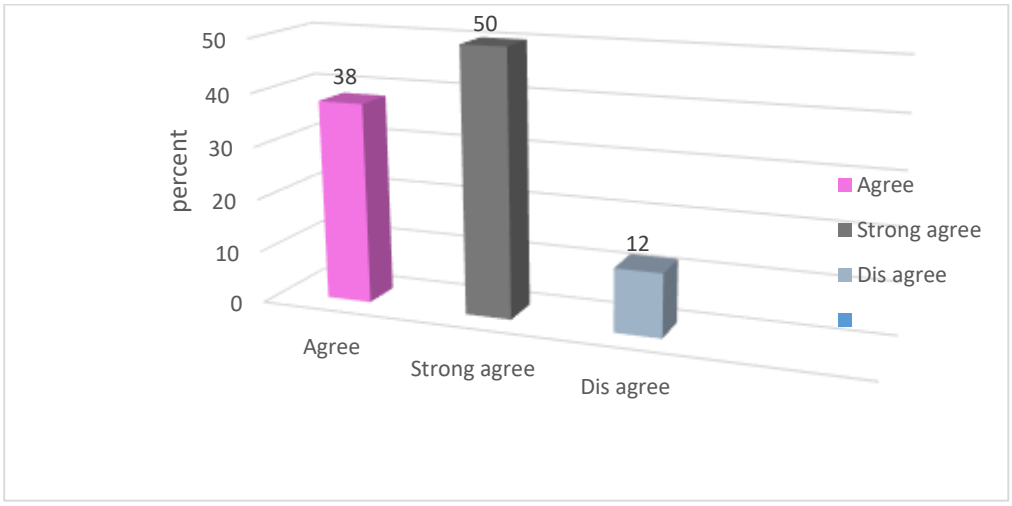
Figure(11) showed the distribution of the Nuisance alarm reduce trust in alarm and cause care givers to alarms off at time other than setup or procedural events



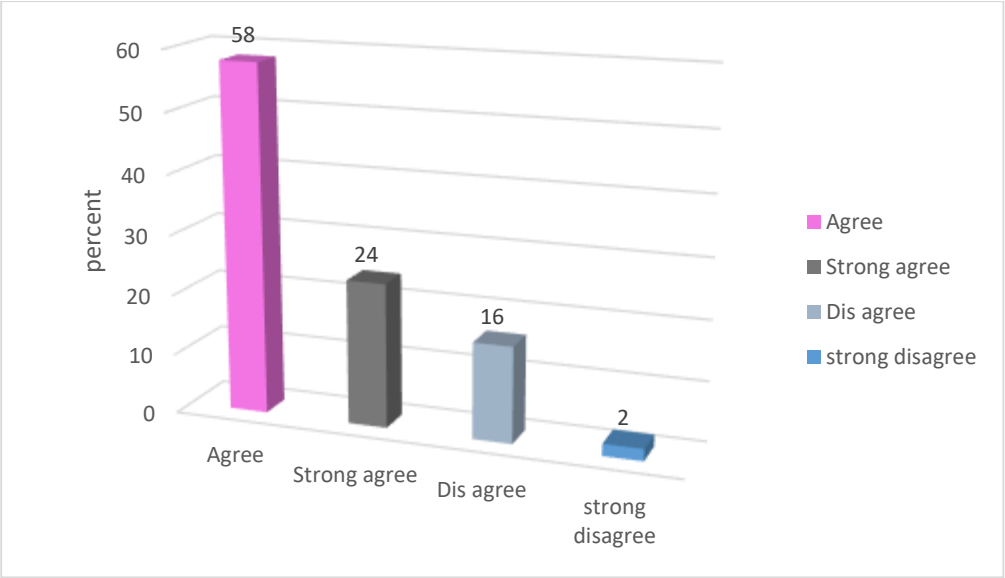
Figure(12) showed the distribution of the alarm should impact multiple sense (audio, visual, proprioceptive, etc.)



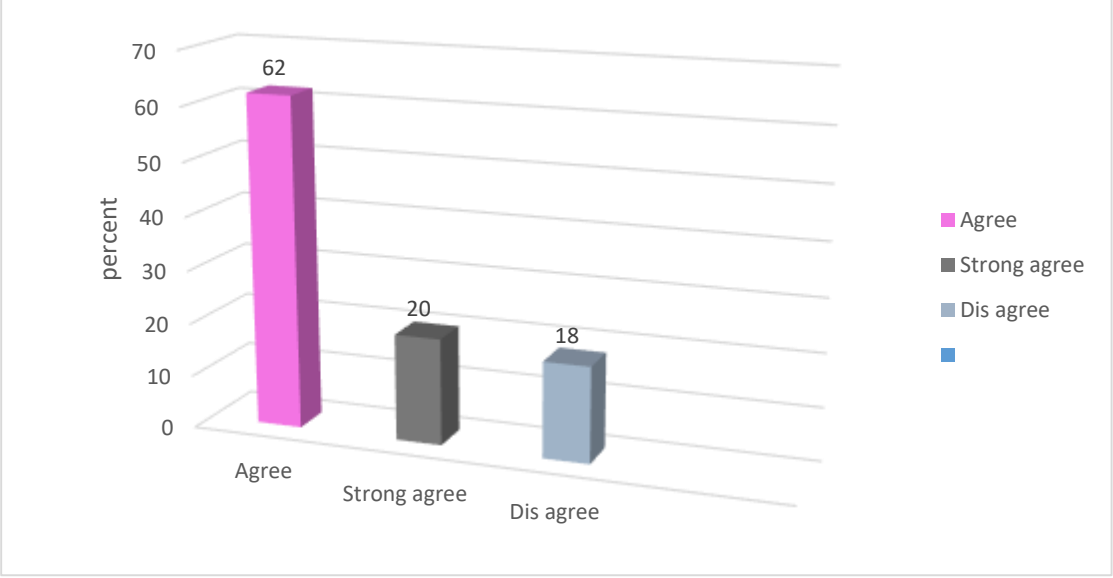
Figure(13) showed the distribution of the nuisance alarm disrupt patient car



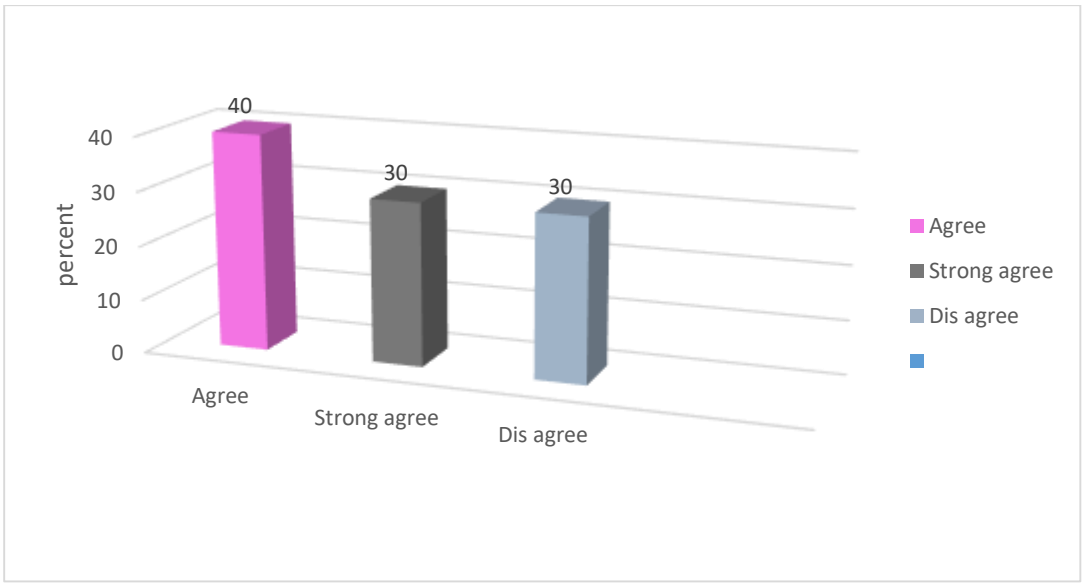
Figure(14) showed the distribution of the staff is sensitive to alarm and responds quickly



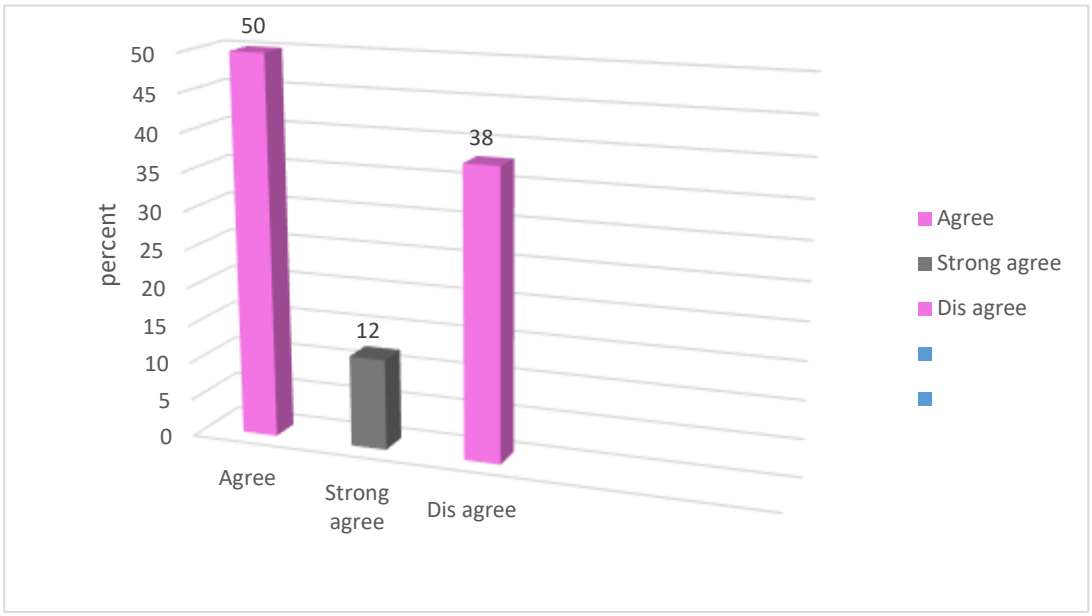
Figure(15) showed the distribution of the alarm used on my floor\area of the hospital are adequate to alert staff of potential or actual changes in patient condition



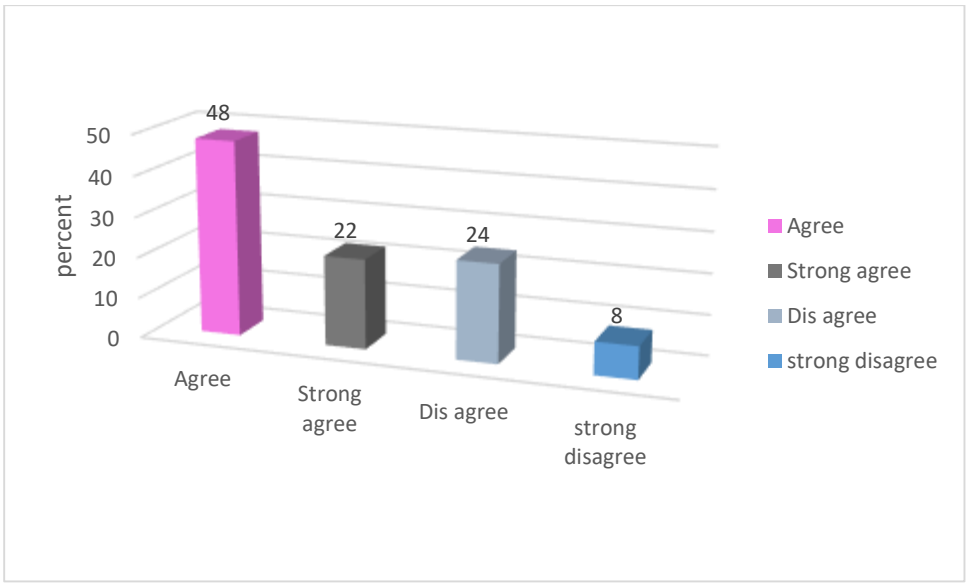
Figure(16) showed the distribution of the medical equipment used on my floor area all have distinct output (sound repletion rate, visual display)



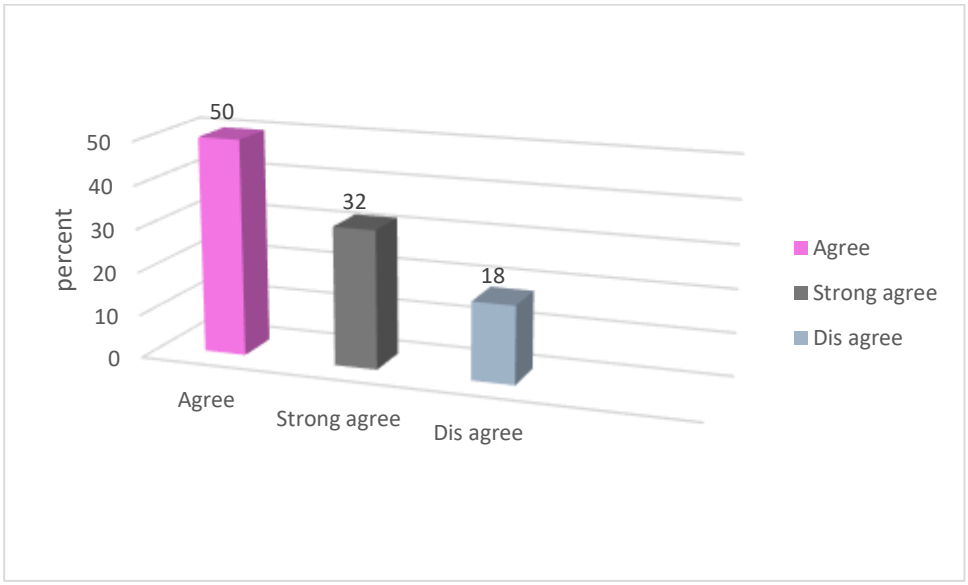
Figure(17) showed the distribution of the when number of device with alarm is used with a patient it can be confusing to determine, witch device is sounding an alarm



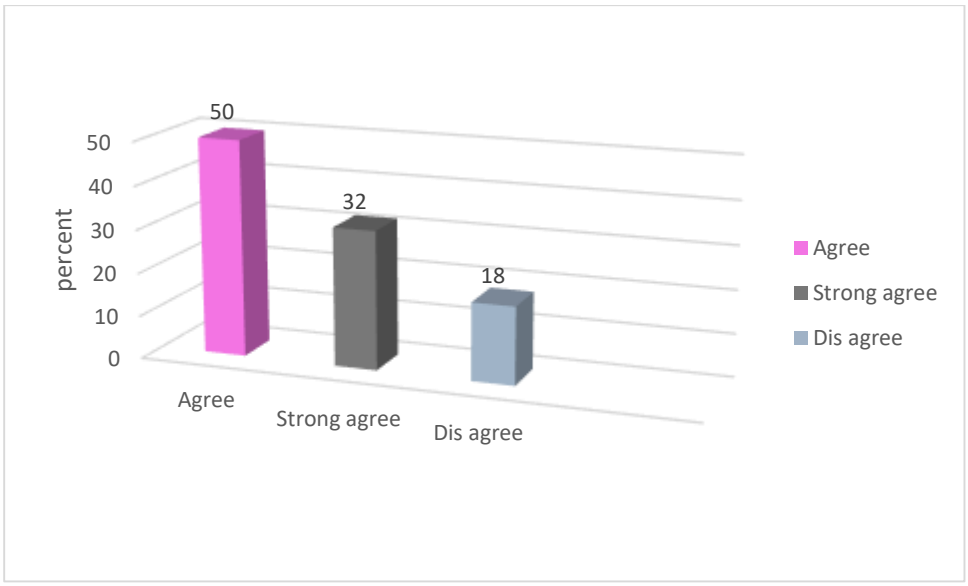
Figure(18) showed the distribution of the environmental background noise has interfered with alarm recognition



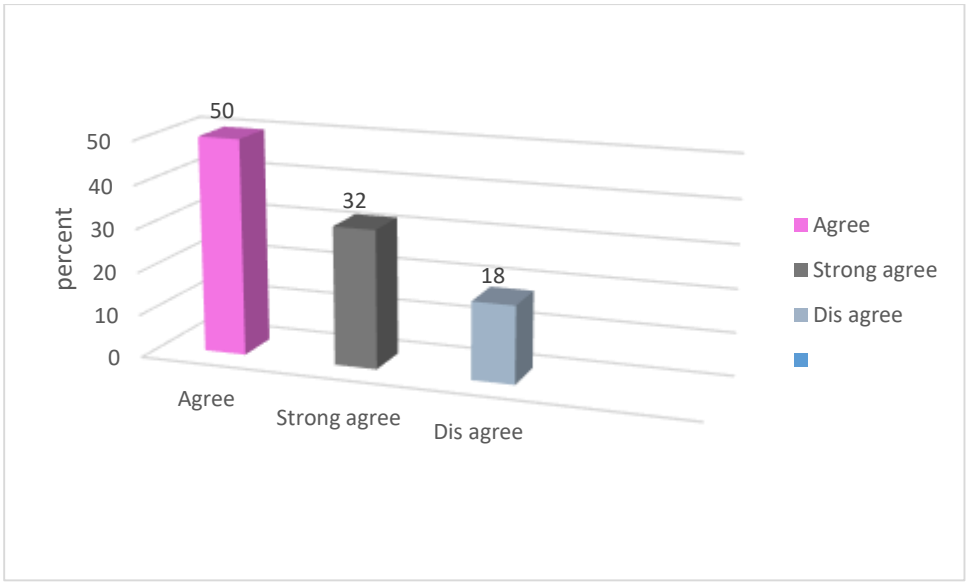
Figure(19) showed the distribution of the frequent false reduced attention or response to alarm



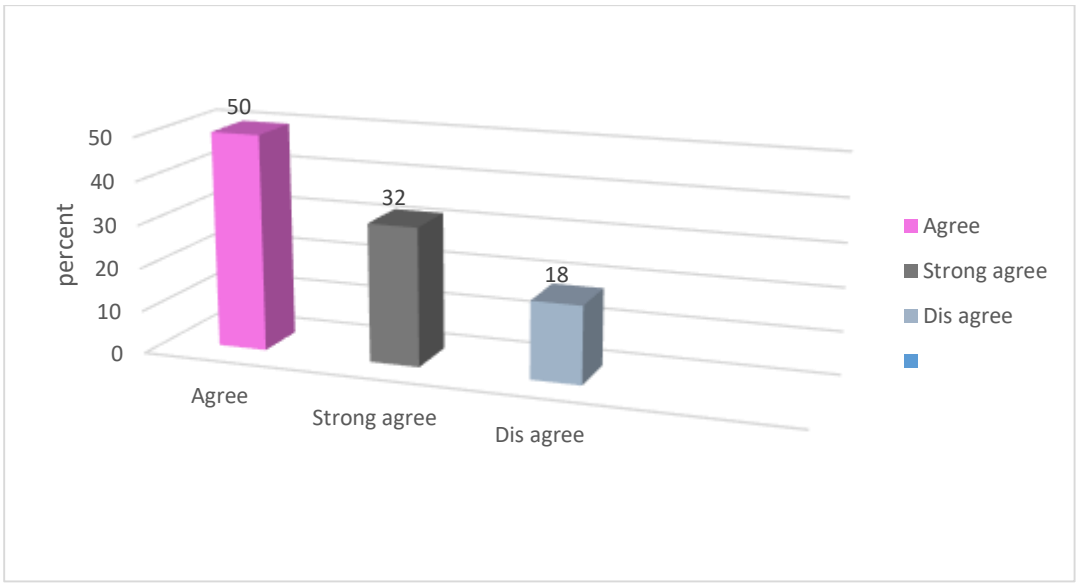
Figure(20) showed the distribution of the difficulty in understanding the priority of an alarm can affect the patient safety



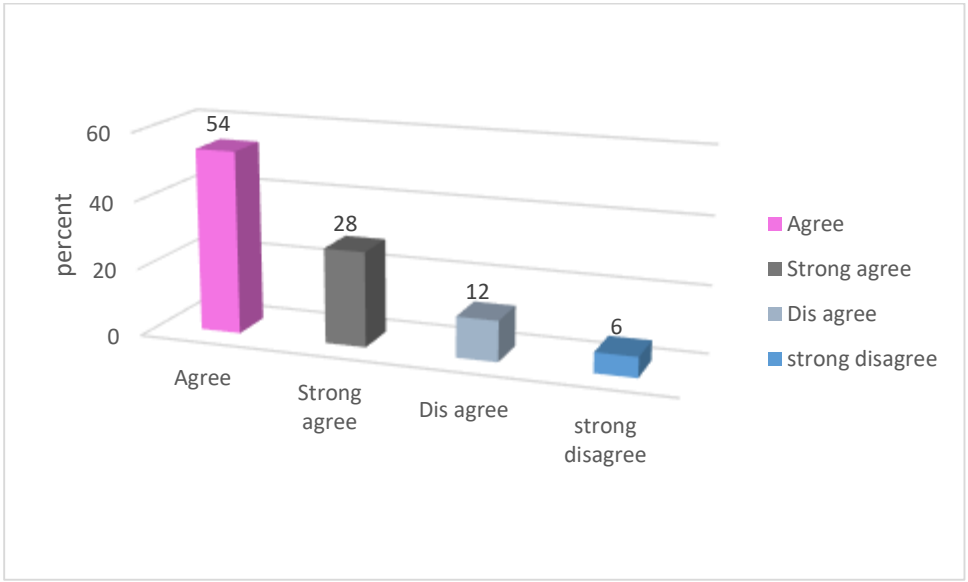
Figure(21) showed the distribution of difficulty to hearing the alarm can occur



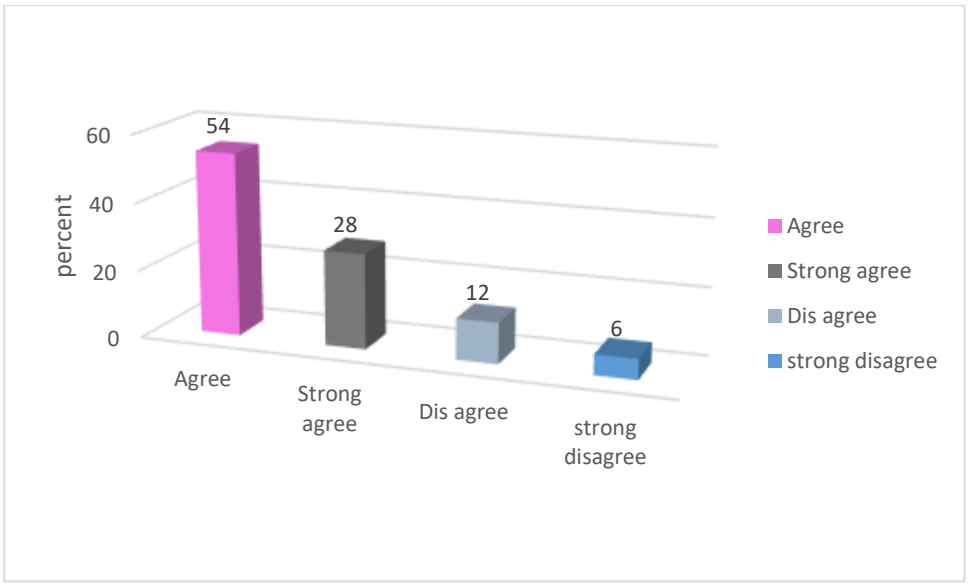
Figure(22) showed the distribution of the difficulty to identifying the source of alarm



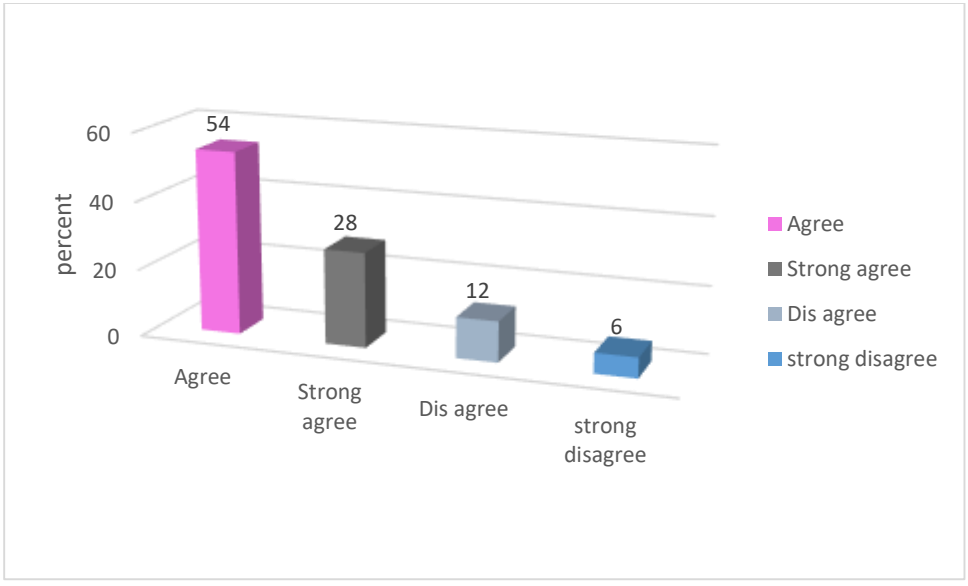
Figure(23) showed the distribution of the over reliance on alarm to call attention to patient problem



Figure(24) showed the distribution of the noise competition from non-clinical alarm and bags



Figure(25) showed the distribution of the lack of training on alarm systems cause false management



Figure(26) showed the distribution of the technical problems alarm can be easily managed

Chapter Five

Discussion

Conclusion

Recommendations

Discussion:

The purpose of this study was to assessment knowledge of nurses with clinical alarm in critical setting Elrebat University hospital. A total of half seven nurses (50) from the critical care unit participated in the study and responded to questions related to the types of alarms in the unit, the audibility of the alarms in the unit, the reliability of the alarms, knowledge on alarms and nurses' responses to the alarms as well as the relationship between the nurses' responses and the patient's outcome.

Socio demographic characteristics of the half nurses who participated in the study majority were females and males were less than half. These results show that nursing is still a female dominated profession as it was several years ago although many males are now joining the profession. Of the half nurses, majority had undergone training in critical care nursing. Thus we can conclude that the nurses in the unit are highly qualified academically in relation to matters concerning critical care nursing. Thirty eight percent more than one third of the nurses had worked in the unit for more than five years less than one third for more than ten years, less than twenty for less than two years and (15%) for more than two years.

Has the situation related to clinical alarms hazards improved since the 2005-2006 survey? It appears not. A key finding in our data is the limited change in the results from the 2005-2006 survey to the 2011 survey. The 2011 results also reveal that only a small percentage of hospitals report alarm improvement initiatives and nearly 20% of the respondents had studies and/or appropriate surrogates for these relatively rarely occurring outcomes. It will also be important to measure changes in outcomes over time. In the meantime, bedside clinicians can implement common-sense strategies, such as improving the preparation of patients' skin before applying monitor electrodes and changing electrodes and telemetry unit batteries daily. They can customize alarm thresholds to the individual patient to avoid non actionable alarms and consider establishing unit-specific default thresholds. They should also make informed decisions regarding when to initiate and terminate monitoring to avoid unnecessary monitoring with the accompanying false alarms. [14,15]

In non-ICU settings, requiring an order to continue monitoring after a certain period of time is one way to address unnecessary monitoring.

A decrease in false alarms should result in a marked reduction in alarm burden with a higher proportion of clinically meaningful alarms. With fewer alarms, nurses' response time to these clinically meaningful alarms should be shorter.

The statements "Difficulty in identifying the source of an alarm" and "Difficulty in hearing alarms when they occur" both moved up in the rankings of importance in 2011. This increase in perceived importance may be related to the increase in the number of monitored patients, the lack of standardized alarm annunciation, and the use of more and more devices with alarms. The increasing levels of background noise in hospitals may also play a role. adverse events related to alarms. The relatively high proportion of respondents reporting adverse events may be due to an increased awareness of alarm safety.

Results of the 2011 survey reveal a significant improvement in the items related to the frequency of nuisance alarms and nuisance alarms disrupting patient care. Possible reasons for this improvement include devices being better able to filter noise and analyze signals, improved preparation of patients for monitoring or therapy, or increased use of monitor watchers to respond to alarms.

The perceived effectiveness of alarm management policies and procedures decreased in the 2011 survey.

These priorities are likely to change with the need to address the Joint Commission's 2014 NPSG on alarm management.11 Sources of alarm hazards include sensor artifact, poor human factors design, complexity of ancillary alarm systems, inadequate facilities design, environmental noise, the lack of well communicated or poorly designed care management and alarm escalation processes, and limited staff education on alarms and equipment with alarms.

Center in Boston, and Christiana Care Health System in Delaware embarked on long-term improvement projects that have produced measureable and sustainable results. Despite the reduction in alarms, they report that clinical care has been improved and true alarms have not been missed. Patient and staff satisfaction have both increased, as the noise and frequency of alarms have been reduced. [18,21]

Their work has generated strategies that other institutions can implement. This study has both strengths and limitations.

The national survey was broadly distributed to health care professionals working in clinical environments where alarms have proliferated in recent years.

Although the 2011 survey had more than 3 times the number in the initial survey, it still represents only a tiny fraction of clinicians in the field.

Conclusion:

Clinical alarm safety has been an ongoing challenge that has received considerable attention, but it appears that little measurable progress has been made. Since 2005-2006, when the first survey was conducted, not much has changed except at a few major health care institutions. False and non-actionable alarms continue to contribute to a noisy hospital environment, and sentinel events related to alarm fatigue persist. Perhaps hospitals will pay more attention to this significant patient safety issue with the implementation of the Joint Commission's NPSG on alarm management., And training of medical staff to deal with modern devices and clarify the importance of early warning and the way to deal with the patient.

Recommendation

Our results highlight the complexity of overall alarm management in ICUs and that ICU nurses may have different perceptions toward alarm management than other nurses.

- The administration of the hospital have to pay attention to the training and development of nurses staff to provide high quality of care specially in critical area
- The head nursing have to established rules and regulation concerning I C U and C C U nurses staff quality

Annexes

Reference

1. Sowan, A. K., Gomez, T. M., Tarriela, A. F., Reed, C. C., & Paper, B. M. (2016). Changes in Default Alarm Settings and Standard In-Service are Insufficient to Improve Alarm Fatigue in an Intensive Care Unit: A Pilot Project. JMIR Human Factors, 3(1), e1. https://doi.org/10.2196/humanfactors.5098.

2. Sowan, A. K., Tarriela, A. F., Gomez, T. M., Reed, C. C., & Rapp, K. M. (2015). Nurses' Perceptions and Practices Toward Clinical Alarms in a Transplant Cardiac Intensive Care Unit: Exploring Key Issues Leading to Alarm Fatigue. JMIR Human Factors, 2(1), e3. https://doi.org/10.2196/humanfactors.4196

3. Sendelbach, S., & Funk, M. (2013). Alarm fatigue: a patient safety concern. AACN Advanced Critical Care, 24(4), 378-86–8. https://doi.org/10.1097/NCI.0b013e3182a903f9

4. Solet, J. M., & Barach, P. R. (2012). Managing alarm fatigue in cardiac care. Progress in Pediatric Cardiology, 33(1), 85–90. https://doi.org/10.1016/j.ppedcard.2011.12.014

5. Cvach, M. (2012). Monitor alarm fatigue: An integrative review. Biomedical Instrumentation and Technology. https://doi.org/10.2345/0899-8205-46.4.268

6. Regalbuto, R., Maurer, M. S., Chapel, D., Mendez, J., & Shaffer, J. A. (2014). Joint commission requirements for discharge instructions in patients with heart failure: Is understanding important for preventing readmissions? Journal of Cardiac Failure, 20(9), 641–649. https://doi.org/10.1016/j.cardfail.2014.06.358

7. Anonymous. (2016). Gartner's Top 10 Technology Trends for 2016. Information Management, 50(1), 18–18.

8. Lucy W. Meng'anyiEmail author,Lilian A. Omondi andMargaret N. MuivaBMC NursingBMC series – open, inclusive and trusted201716:41https://doi.org/10.1186/s12912-017-0235-1

9. Konkani, A., Oakley, B., & Bauld, T. J. (2012). Reducing hospital noise: A review of medical device alarm management. Biomedical Instrumentation and Technology. https://doi.org/10.2345/0899-8205-46.6.478

10. Tsien, C. L., & Fackler, J. C. (1997). Poor prognosis for existing monitors in the intensive care unit. Critical Care Medicine, 25(4), 614–9. https://doi.org/10.1097/00003246-199704000-00010

11. Graham KC, Cvach M. Monitor alarm fatigue: standardizing use of physiological monitors and decreasing nuisance alarms. Am J Crit Care. 2010;19(1)View ArticlePubMedGoogle Scholar

12. Welch J. Alarm fatigue hazards: the sirens are calling. JAMA. 2012;307:1591. https://www.psqh.com/analysis/alarm-fatigue-hazards-the-sirens-are-calling/. Accessed 16 Apr 2014.

13. Kenny, P. E. (2011). Alarm fatigue and patient safety. The Pennsylvania Nurse, 66(1), 3, 22.http://scienceofcaring.ucsf.edu/acute-and-transitional-care/battling-alarm-fatigue.(Accessed at 12.47p.m.21/1/2014).

14. Cochran W G, (1977). Sampling Techniques. 3rd Edition. John Wiley & Sonjs,Inc. ISBN 0–471-16240-X.USA.Google Scholar

15. Cho, O. M., Kim, H., Lee, Y. W., & Cho, I. (2016). Clinical alarms in intensive care units: Perceived obstacles of alarm management and alarm fatigue in nurses. Healthcare Informatics Research, 22(1), 46–53. https://doi.org/10.4258/hir.2016.22.1.46

16. Borowski, M., G??rges, M., Fried, R., Such, O., Wrede, C., & Imhoff, M. (2011). Medical device alarms. Biomedizinische Technik. https://doi.org/10.1515/BMT.2011.005

17. Funk M, Clark JT, Bauld TJ, Ott JC, Coss P. Attitudes and practices related to clinical alarms. Am J Crit Care. 2014;23(3):e9–e18. [PubMed]

18. Cvach MM, Biggs M, Rothwell KJ, Charles-Hudson C. Daily electrode change and effect on cardiac monitor alarms: an evidence-based practice approach. J Nurs Care Qual. 2013;28(3):265–271. [PubMed]

19. Purbaugh T. Alarm fatigue: a roadmap for mitigating the cacophony of beeps. Dimens Crit Care Nurs. 2014;33(1):4–7. [PubMed]

20. Gazarian PK. Nurses' response to frequency and types of electrocardiography alarms in a non-critical care setting: a descriptive study. Int J Nurs Stud. 2014;51(2):190–197. [PubMed]

21. Inokuchi R, Sato H, Nanjo Y, Echigo M, Tanaka A, Ishii T, et al. The proportion of clinically relevant alarms decreases as patient clinical severity decreases in intensive care units: a pilot study. BMJ Open. 2013;3(9):e003354. [PMC free article] [PubMed] Baillargeon E. Alarm fatigue: a risk assessment [master's theses] Providence (RI): Rhode Island College; 2013.

22. Graham KC, Cvach M. Monitor alarm fatigue: standardizing use of physiological monitors and decreasing nuisance alarms. Am J Crit Care. 2010;19(1):28–34. [PubMed] ACCE Healthcare Technology Foundation. Impact of clinical alarms on patient safety. Plymouth Meeting (PA): ACCE Healthcare Technology Foundation; 2006.

23. Borowski, M., Siebig, S., Wrede, C., & Imhoff, M. (2011). Reducing false alarms of intensive care online-monitoring systems: An evaluation of two signal extraction algorithms. Computational and Mathematical Methods in Medicine, 2011. https://doi.org/10.1155/2011/143480PubMed

24. Phillips, J., & Barnsteiner, J. H. (2005). Clinical alarms: improving efficiency and effectiveness. Critical Care Nursing Quarterly, 28(4), 317–23. https://doi.org/10.1016/j.ccell.2006.01.002

25. Clinical Alarms in Intensive Care Units: Perceived Obstacles of Alarm Management and Alarm Fatigue in Nurses

Ok Min Cho, RN, MSN, Hwasoon Kim, PhD, RN, Young Whee Lee, PhD, RN, and Insook Cho, PhD, RN

26. Christensen M, Dodds A, Sauer J, Watts N. Alarm setting for the critically ill patient: a descriptive pilot survey of nurses' perceptions of current practice in an Australian Regional Critical Care Unit. Intensive Crit Care Nurs. 2014;30(4):204–210. [PubMed]

27. Bernoulli White Paper - Clinical Alarm Mgmt and Reduction 2016-07. Chung CH, Kang HY. Job stress and fatigue of the nurses in the operating room. J Korea Contents Assoc. 2013;13(12):291–298

28.Bell L. Monitor alarm fatigue. Am J Crit Care. 2010;19(1):38. [PubMed. Page 73 of 77

29. ERCI Institute. The hazards of alarm overload. Keeping excessive physiologic monitoring alarms from impeding care. Health Devices. 2007;36(3):73–83. [PubMed.

30. Bell L. Monitor alarm fatigue. Am J Crit Care. 2010;19(1):38. [PubMed]

31. Welch J. Alarm fatigue hazards: the sirens are calling. JAMA. 2012;307:1591. https://www.psqh.com/analysis/alarm-fatigue-hazards-the-sirens-are-calling/. Accessed 16 Apr 2014. Mary Logan, JD, CAE

32. 2015 Alarm Management Compendium President & CEO. Marilyn Neder Flack, MA Executive Director

33 . Edworthy J, Hellier E. Alarms and human behaviour: implications for medical alarms. Br J Anaesth. 2006;97(1):12–17. [PubMed]

34. AACE Health Technology Foundation, Clinical Alarm Task Force. Impact of clinical alarms on patient safety: a report from the American College of Clinical Engineering Healthcare Technology Foundation. J Clin Eng. 2007; 32(1):22–33.

35. Momtahan K, Hetu R, Tansley B. Audibility and identification of auditory alarms in the operating room and intensive care unit. Ergonomics. 1993; 36(10):1159–1176. [PubMed]

36. Association for the Advancement of Medical Instrumentation. Clinical Alarms 2011 Summit [Internet] Arlington (VA): Association for the Advancement of Medical Instrumentation; 2011. [cited at 2015 Dec 17}

http://s3.amazonaws.com/rdcmsaami/files/production/public/FileDownloads/Summits/2011_Alarms_Summit_publication.

37. .Sendelbach S. Alarm fatigue. Nurs Clin North Am. 2012; 47(3):375–382. [PubMed]

38. Borycki E. Trends in health information technology safety: from technology-induced errors to current approaches for ensuring technology safety. Healthc Inform Res. 2013;19(2):69–78. [PMC free article]

Shendi University

Faculty of graduate studies and scientific research

Master of Nursing Science

Assessment Knowledge of Nurses with clinical alarms in critical setting in ELrebat University Hospital

Please select one answer by (√)

1. Age

25-30 ( ) 30- 35 ( ) 35 – 40 ( )

2. Gender

Male ( ) female ( )

3. Education level

Diploma ( ) bachelors ( ) master ( ) PhD ( )

4. Work area

ICU ( ) CCU ( )

5. Experience year

1-3 ( ) 3 -5 ( ) 5-7 ( ) 7 -9 ( ) more than 9 ( )

6. Current position:

Head nurse ( ) staff nurse ( ) trainee ( )

7. Attend training course abut Clinical alarm:

Once, ( ) twice ( ) No ( )

8. Clinical alarm is reported on:

I cu flow up sheet nursing report book ( ), nursing intervention sheet ( )

Not need report ( )

9. Clinical alarm is noise

Agree ( ) Strong agree ( ) disagree ( ) Strong disagree ( )

10. Clinical alarm is can caused work disruption:

Agree ( ) Strong agree ( ) disagree ( ) Strong disagree ( )

11. The purpose of clinical alarms is to alert staff of an existing or potentially hazardous patient condition

Agree ( ) Strong agree ( ) disagree ( ) Strong disagree ( )

12. .Inadequate staff can lead to UN respond to alarm

Agree ( ) Strong agree ( ) disagree ( ) Strong disagree ( )

13. Alarm sounds and /or visual displays should differentiate the priority of alarm.

Agree ( ) Strong agree ( ) disagree ( ) Strong disagree

14. Alarm sounds and /or visual displays should be distance based on the parameter or source (e.g. BP.SPO2)

Agree ( ) Strong agree ( ) disagree ( ) Strong disagree

15. Nuisance alarm occur frequently

Agree ( ) Strong agree ( ) disagree ( ) Strong disagree ( )

16. Nuisance alarm reduce trust in alarm and cause caregivers to alarms off at times other than setup or procedural events

Agree ( ) Strong agree ( ) disagree ( ) Strong disagree ( )

17. Alarm should impact multiple sense (audible, visual, proprioceptive, etc.)

Agree ( ) Strong agree ( ) disagree ( ) Strong disagree ( )

18. Nuisance alarms disrupt patient care:

Agree ( ) Strong agree ( ) disagree ( ) Strong disagree ( )

19. The staff is sensitive to alarms and responds quickly

Agree ( ) Strong agree ( ) disagree ( ) Strong disagree ( )

20. The alarms used on my floor / area of the hospital are adequate to alert staff of potential or actual changes in a patient condition:
Agree ( ) Strong agree ( ) disagree ( ) Strong disagree ( )

21. The medical equipment used on my floor / area all have distinct output (sounds, repetition rates, visual displays)
Agree ( ) Strong agree ( ) disagree ( ) Strong disagree ( )

22. When number of device with alarms is used with a patient it can be confusing to determine, which device is sounding an alarm?
Agree ( ) Strong agree ( ) disagree ( ) Strong disagree ( )

23. Environmental background noise has interfered with alarm recognition.
Agree ( ) Strong agree ( ) disagree ( ) Strong disagree ( )

24. Frequent false reduced attention or response to alarm:
Agree ( ) Strong agree ( ) disagree ( ) Strong disagree ( )

25. Difficulty in understanding the priority of an alarm can affect the patient safety
Agree ( ) Strong agree ( ) disagree ( ) Strong disagree ( )

26. Difficulty to hearing the alarm can occur
Agree ( ) Strong agree ( ) disagree ( ) Strong disagree ( )

27. Difficulty to identifying the source of alarm
Agree ( ) Strong agree ( ) disagree ( ) Strong disagree ( )

28. over reliance on alarms to call attention to patient problem:
Agree ( ) Strong agree ( ) disagree ( ) Strong disagree ( )

29. N0ise competition from non-clinical alarm and pages:
Agree ( ) Strong agree ( ) disagree ( ) Strong disagree ( )

30. Lack of training on alarm systems can cause false management: Agree ( ) Strong agree ( ) disagree ( ) Strong disagree ( )

31. Technical problems alarm can be easily managed
Agree ( ) Strong agree ( ) disagree ( ) Strong disagree ( )

Cross tabulation and (Chi significant) of experience and other

		Experience yeas					Chi
		1-3	3-5	5-7	7-9	More than 9	
		Count	Count	Count	Count	Count	
Current position	Head nurse	1	0	0	2	2	.149[a,b]
	Staff nurse	25	6	1	6	6	
	Trainee	0	1	0	0	0	
Attend training course about clinical alarm	Once	2	1	0	2	2	.025[a,b,*]
	Twice	0	2	1	1	2	
	No	24	4	0	5	4	
Clinical alarm is reported on	ICU Flow up sheet	6	1	0	2	0	.682[a,b]
	Nursing report sheet	5	3	0	2	1	
	nursing intervention sheet	2	0	0	0	2	
	Not need to report	13	3	1	4	5	
Clinical alarm is noise	Agree	10	0	1	5	4	.472[a,b]
	Strong agree	11	6	0	3	2	
	Disagree	3	1	0	0	1	
	Strong disagree	2	0	0	0	1	

Clinical alarm is can caused work disruption	Agree	14	4	0	5	4	.400[a,b]
	Strong agree	9	2	0	3	2	
	Disagree	2	1	1	0	1	
	Strong disagree	1	0	0	0	1	
The purpose of clinical alarms is to alert staff of an existing or potentially hazardous patient condition	Agree	12	1	0	7	3	.455[a,b]
	Strong agree	11	4	1	1	4	
	Disagree	2	1	0	0	1	
	Strong disagree	1	1	0	0	0	
Inadequate staff can lead to un respond to alarm	Agree	7	2	1	3	4	.933[a,b]
	Strong agree	13	4	0	4	4	
	Disagree	5	1	0	1	0	
	Strong disagree	1	0	0	0	0	
Alarm sounds and/or visual displays should be differentiate the priority of alarm	Agree	19	1	0	6	5	.011[a,b,*]
	Strong agree	6	3	0	1	3	
	Disagree	0	3	1	1	0	
	Strong disagree	1	0	0	0	0	
Alarm sounds and/or visual displays should be distance based on the parameter or source (e.g. BP. SPO2)	Agree	14	2	1	3	7	.344[a,b]
	Strong agree	6	3	0	4	1	
	Disagree	6	2	0	1	0	
	Strong disagree	0	0	0	0	0	

Nuisance alarm occur frequently	Agree	16	3	0	8	3	.002[a,b,*]
	Strong agree	8	4	0	0	1	
	Disagree	2	0	1	0	4	
	Strong disagree	0	0	0	0	0	
Nuisance alarm reduce trust in alarm and cause caregivers to alarms off at times other than setup or procedural events	Agree	18	4	1	4	6	.471[a,b]
	Strong agree	4	3	0	3	1	
	Disagree	4	0	0	1	0	
	Strong disagree	0	0	0	0	1	
Alarm should impact multiple sense (Audible, visual, proprioceptive, etc.)	Agree	18	5	0	6	4	.001[a,b,*]
	Strong agree	6	1	0	0	3	
	Disagree	2	0	0	2	1	
	Strong disagree	0	1	1	0	0	
Nuisance alarms disrupt patient care	Agree	12	2	0	5	5	.837[a,b]
	Strong agree	6	3	1	1	1	
	Disagree	7	2	0	2	2	
	Strong disagree	1	0	0	0	0	
The staff is sensitive to alarm and responds quickly	Agree	10	3	0	2	4	.765[a,b]
	Strong agree	14	2	1	5	3	
	Disagree	2	2	0	1	1	
	Strong disagree	0	0	0	0	0	

The alarms used on my floor/ area of the hospital are adequate to alert staff of potential or actual changes in a patient condition	Agree	15	3	0	5	6	.274[a,b]
	Strong agree	8	1	0	2	1	
	Disagree	3	2	1	1	1	
	Strong disagree	0	1	0	0	0	
The medical equipment used on floor/ area all have distinct output (Sound, repetition rate, visual display)	Agree	19	4	1	2	5	.081[a,b]
	Strong agree	5	2	0	1	2	
	Disagree	2	1	0	5	1	
	Strong disagree	0	0	0	0	0	
When number of device with alarms is used with a patient it can be confusing to determine, which device is sounding an alarm?	Agree	9	2	0	5	4	.277[a,b]
	Strong agree	6	4	0	2	3	
	Disagree	11	1	1	1	1	
	Strong disagree	0	0	0	0	0	
Environmental background noise has interfered with alarm recognition	Agree	12	4	0	5	4	.057[a,b]
	Strong agree	1	3	0	0	2	
	Disagree	13	0	1	3	2	
	Strong disagree	0	0	0	0	0	
Frequent false reduced attention or response to alarm	Agree	11	5	1	3	3	.405[a,b]
	Strong agree	3	1	0	4	3	
	Disagree	8	1	0	1	2	

	Strong disagree	4	0	0	0	0	
Difficulty in understanding the priority of an alarm can affect the patient safety	Agree	9	0	0	6	3	.000[a,b,*]
	Strong agree	16	6	0	2	4	
	Disagree	1	1	0	0	1	
	Strong disagree	0	0	1	0	0	
Difficulty to hearing the alarm can occur	Agree	8	0	0	4	2	.039[a,b,*]
	Strong agree	2	1	1	0	2	
	Disagree	9	2	0	4	4	
	Strong disagree	7	4	0	0	0	
Difficulty to identifying the source of alarm	Agree	15	1	1	5	6	.587[a,b]
	Strong agree	1	1	0	1	0	
	Disagree	8	3	0	1	2	
	Strong disagree	2	2	0	1	0	
Over reliance on alarms to call attention to patient problem	Agree	12	2	0	6	5	.509[a,b]
	Strong agree	8	4	1	1	2	
	Disagree	6	1	0	1	1	
	Strong disagree	0	0	0	0	0	
Noise competition from non-clinical alarm and pages	Agree	9	3	0	4	6	.756[a,b]
	Strong agree	3	0	0	1	1	
	Disagree	12	3	1	3	1	

	Strong disagree	2	1	0	0	0	
Lack of training on alarm systems can cause false management	Agree	11	0	0	3	5	.515[a,b]
	Strong agree	9	5	1	2	2	
	Disagree	5	2	0	2	1	
	Strong disagree	1	0	0	1	0	
Technical problems alarm can be easily managed	Agree	14	3	1	2	7	.363[a,b]
	Strong agree	6	3	0	5	0	
	Disagree	3	1	0	1	1	
	Strong disagree	3	0	0	0	0	