Original Article

Nurses' Knowledge Regarding Ventilator's Alarms in Critical Care Units At Khartoum Public Hospitals 2021

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Abstract

Introduction

Ventilator Alarms are extensively utilized in critical areas. They are an important component of most machines, specifically mechanical ventilators (MV), because they notify nurses to changes in patients' conditions. As a result, nurses must understand the functions and limitations of ventilator modes, in addition to that they should have knowledge about alarm management [(1)]. Intensive care unit (ICU) nurses are constantly exposed to alarms, which may not require immediate attention [(2)] [(3)]. Excessive alarm exposure can affect patient safety [(4)] [(5)]. The study aimed to study nurses' knowledge regarding Ventilator's Alarms in Critical Care units.

Methods

This study is a descriptive cross sectional hospital based study, conducted at public hospitals in Khartoum State. 100 nurses working at Critical Care units were enrolled in this study. Data was collected by a self-administered questionnaire and analysed by statistical package of social sciences computer program.

Results

The study revealed that, total knowledge of participants was poor and there was a significant relationship between participants' qualification and their knowledge to manage ventilator alarms.

Conclusion

The level of knowledge regarding assessment of ventilator alarms was good while total knowledge about ventilation alarm management was poor.

Recommendation

Regular in-service training of staff based on evidence-based practices pertaining to mechanical ventilation alarm practices is imperative that research be done to perform those practices.

Key words: Keywords: Nurses, competence, mechanical ventilation alarm, critical care units.

Introduction

Mechanical ventilation is used for airway protection as well as the treatment of hypoxemic or hypersonic respiratory failure [(1)]. The most critical feature that every ventilator must have is ventilator alarms. These features are intended to keep the ventilated patient safe. Ventilator alarms rely solely on ventilator monitoring, which must be operational [(2)]. Ventilator alerts are recordings that are both puzzling and frustrating. A clinician may be unfamiliar with alarms and correction tools. This unpleasant scenario is exacerbated by a lack of fundamental knowledge of ventilator alarms, as well as a general dearth of easily available information on various alarms (high volume, low volume, etc.), the most prevalent causes of warnings, and what actions should be taken. Mechanical ventilation alarms, which include both invasive and noninvasive mechanical ventilation, give both audible and non-audible visual warnings to inform clinicians of changes in a patient's state. Clinicians can establish parameters to alert them if a device fails or if a patient's status changes [(1)]. Not all of the mechanical ventilator's audible alerts demand attention from the physician, and such alarms should not be muted or ignored [(2)].Ventilator Alarms are widely employed in critical regions, and they are an important component of most machines, particularly (MV), because they alert nurses of changes in patients' conditions, which is important because most patients in critical areas are in poor health. So, nurses must be knowledgeable about the function and limitations of ventilator modes, and alarm management. This has taken high priority levels in the US healthcare system. Nurses working in the CCUs in the Northeastern Academic Center of USA stated that the major problem contributing to the number of false alarms in the CCUs is the kinking alarm [(10)].

Nurses prioritize their tasks based on the urgency of the alarms in relation to the patient's condition, and they are more likely to respond to alarms that last longer and are considered rare. As a result of the increased workload complexity, alarm response and task performance deteriorate. As a result, signal duration has a significant impact on nurses' responses, other factors such as workload, patient status, and task complexity may prompt different responses.

According to the Joint Commission in 2013, alarm weariness is caused by a number of issues including the inadequacy or lack of alarm systems, inappropriate alarm settings, inaudible alarms, and switched off alarm signals. According to experts at the Association for the Advancement of Medical Instrumentation (2011), patient deaths and sentinel events are frequently the cause of nurses' alarm fatigue[(5)]. Much research has gone into finding strategies to reduce false positive alarms and hopefully lessen desensitization alarm immunity without jeopardizing patient safety when troubleshooting a ventilator low-pressure alarm. Check for a disconnection between the ventilator and the patient as soon as possible. Disconnect the ventilator and manually ventilate with a bag-valve-mask device if the alert continues to sound. Using a gloved finger, block the patient's ventilator circuit and watch for subsequent ventilator-delivered breaths. The vent circuit is intact, and the leak is with the patient or artificial airway device if the ventilator pressure manometer attempts to climb and the high pressure alarm rings [(6)]. The nurse caring for a mechanically ventilated patient must exhibit competence in order to notice and respond to adverse events that may occur, as well as to carry out the essential actions that may prevent the patient from progressing towards the ultimate objective of ventilator release. Mechanical ventilation remains the most prevalent therapeutic method used in intensive care units, despite the potential for life-threatening consequences. As a result, the use of technology in health-care settings grows, so does

the number of alerts associated with these equipment. For patients who are more alert and mobile in the critical care situation, audible mechanical ventilator alarms for high breathing frequency or high peak pressures might occur with regularity and brief duration. Employees are exposed to big groups of people. Staff exposure to large numbers of mechanical ventilator alarms, which can self-correct and are not any actionable, may end in an extended reaction time; the subsequent time the ventilator alarm sounds. Alarms are an integral part of mechanical ventilation because these systems provide vital life support functions. Alarms warn of technical or patient events that need attention or action, therefore, knowledge about alarms and the way to troubleshoot them is important.

Currently in intensive care units in South Africa the mechanically ventilated patient is most likely to be cared by, thus placing the patient at risk of complications which may not be correctly assessed by the non competence qualified nurse. The researchers' own experience of varying levels of competence amongst nurses regarding mechanical ventilation in intensive care units, prompted the researcher to further investigate the level of nurses' competence in mechanical ventilation alarm in Critical Care unit. Although physiologic monitor alarms have received great attention during the previous five years, little work has been reported regarding it [(1) (8)]. Among the European Credit Research Institutes, the top 10 health technology hazards for 2017, ventilator alarm management was listed and reported as the third greatest hazard attributable to the unique challenges that ventilators pose to the healthcare team[(9)].

Methods

This descriptive cross sectional, hospital based study was carried out in Critical Care Units in three main governmental hospitals, located in Khartoum State. The targeted populations were all nurses of both genders, working in Critical Care Units during the study period and willing to participate in the study. A designed structured, self-administered close ended questionnaire was used to collect the data from the study subjects. The rating scale used was (good, satisfied and poor knowledge). Two third or more equals 75%, inadequate knowledge equals 50% and poor knowledge accounted for less than 50% [(11)]. The tool was examined by expertise in the field of study and his comments about content and context was considered. Piloting was done among 12 nurses and Alpha Cronbach's test was 87.7%. Data was analyzed using statistical package of social sciences program (SPSS) version (26). P value was considered significant at (0.05). The researcher respecting the rights of participants. Consent was obtained from all participants after explanation.

ResultsTable (1) study group demographic data (n=100)

Causes	**Level of knowledge**				
	Good	**Satisfied**	**Poor**	**Mean± (Std)**	**Total**
High airway ventilator pressures Alarms	22(22%)	26(26%)	52(52%)	2.30±(.810)	100 (100%)
Low airway ventilator pressures alarms	13(13%)	27(27%)	60(60%)	2.47±(.717)	
High and low rate alarms	21(21%)	21(21%)	58(58%)	2.37±(.812)	
High and low expiratory volume alarms	18(18.0%)	32(32%)	50(50%)	2.32±(.763)	
High and low inspiratory volume alarms	17(17.0%)	23(23%)	60(60%)	2.43±(.768)	
Minute volume high ventilator Alarm	13(13%)	18(18.0%)	69(69%)	2.56±(.715)	
Minute volume alarm related to set too low/ little volume	10(10%)	28(28%)	62(62%)	2.52±(.673)	
Low power alarm	29(29%)	24(24%)	47(47%)	1.93±(.934)	

Table (2) Nurses level of knowledge about causes of ventilator alarms

ITEM	Frequency	Percentage
Gender		
Male	23	23.0%
Female	77	77.0%
Qualification		
Diploma	21	21.0%
Bachlorea	76	76.0%
Master	3	3.0%
Years of experience		
6 month-one year	45	45.0%
1-2 years	22	22.0%
3-5years	21	21.0%
>5years	12	12.0%
Training courses		
Never	36	36.05%
Once	39	39.0%
Twice	18	18.0%
>3 times	7	7.0%
Total	**100**	**100%**

Table 3: study group knowledge about causes of ventilator alarms and their role

Nurses role related to	Level of knowledge				
	Good	Satisfied	Poor	Mean± (Std)	Total
Messages alarms	20(20.0%)	18(18.0%)	62(62.0%)	2.42 ±.(806)	100 (100%)
Manage high pressure alarm	18(18.0%)	24(24%)	58(58%)	2.40±(.778)	
Low airway Ventilator pressures Alarms	20(20.0%)	21(21%)	59(59%)	2.39±(.802)	
High and low rate alarms	22(22%)	25(25%)	53(53%)	2.31±(.812)	
and low expiratory volume alarm	25(25%)	23(23%)	52(52%)	2.27±(.839)	
High and low aspiratory volume alarms	29(29%)	21(21%)	50(50%)	2.21±(.868)	
Minute volume high Ventilator	16(16%)	15(15%)	69(69%)	2.53±(.758)	
o low little volume	14(14%)	35(35%)	50(50%)	2.66±(3.14)	
Decreasing Spo2alarm	15(15%)	30(30%)	55(55%)	2.4±(.738)	
Low power Alarm	47(47%)	13(13%)	40(40%)	2.18±(.857)	

Table (4): total knowledge of study group

Item	Mean	Std. Deviation	Percentiles	
			(Median)	Level of knowledge
Causes of high airway ventilator pressures Alarms	2.3000	.81029	3.0000	Poor
The nursing role to manage high pressure alarm	2.4000	.77850	3.0000	Poor
The causes of low airway ventilator pressures alarms:	2.4700	.71711	3.0000	Poor
nursing role g related to low airway Ventilator pressures Alarms	2.3900	.80271	3.0000	Poor
causes of high and low rate alarms	2.3700	.81222	3.0000	Poor
nursing role g related to high and low rate	2.3100	.81271	3.0000	Poor

Causes of high and low expiratory volume alarms	2.3200	.76383	2.5000	Satisfied
nurses role related to high and low expiratory volume alarms	2.2700	.83913	3.0000	Poor
Causes of high and low inspiratory volume alarms	2.4300	.76877	3.0000	Poor
’s role during high and low aspiratory volume s.	2.2100	.86801	2.5000	Satisfied
causes of minute volume high ventilator Alarm :	2.5600	.71520	3.0000	Poor
nurse’s role related to minute volume high Ventilator:	2.5300	.75819	3.0000	Poor
Causes of alarm related to set too low/ little volume alarm	2.5200	.67390	3.0000	Poor
nurses role related to set too low little volume	2.3600	.71802	2.5000	Satisfied
nurses role related to decreasing Spo2alarm:	2.4000	.73855	3.0000	Poor
cause of low power alarm	2.1800	.85729	2.0000	Satisfied
nurses role related to low power Alarm:	1.9300	.93479	2.0000	Satisfied

Discussion

The present study reveled that most of nurses were females (97%) and they have Bachelor degree (76%), while their years of experience is less than half; experience range form (6-1) years and two third of them were exposed to training courses about management of patients on mechanical ventilators.

Regarding the group level of knowledge about ventilator alarms, it was found that it was poor. The output of their experience was in nurses’ role during high and low aspiratory volume alarms, nurses’ role related to set too low little volume, low power alarm and nurses’ role related to decreasing Spo2alarm. More than half of the nurses don’t have enough information or knowledge about causes of ventilator alarm. One third of them have satisfied knowledge about high and low expiratory volume alarms (32%) mean 2.32 ± (0.763), this finding was in agreement with a study done in University of Nairobi Kenyatta National Hospital to assess the nurses' interventions when managing clinical alarms.

According to the results, the study group level of knowledge of the causes of ventilator alarms will direct after their response and skills to manage alarm which may result on patient conditions and out com and may present patient to compliance

In spite of their poor knowledge about causes of ventilator alarms and their results towards knowledge about ventilator alarms, they have good response to ventilator alarm assessment. More than two thirds of them were responsive to the assessment of causes of alarm (83%) and assessment of the patient (77%), but only (3%) were not responsive to the alarm. This result corresponds with a study done in Nairobi in which the response percentage was about 10%. Nurses respond to alarms for different reasons, not just the fact that the alarm sounds [14]. Furthermore it was revealed that the total practices of the study group was satisfied 58% with mean 1.58± (.496). This may be due to the exposure of the participants to their colleagues’ experience.

Conclusion

Total mean level of the participants’ knowledge regarding ventilator alarm was poor, except regarding causes of alarm and nurse’s role was gratified.

Recommendation:

Filling the gaps in knowledge and competencies needed for practitioners, qualified nursing staff, for responding to mechanical ventilation alarms with standardized guideline protocols.

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