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USE PREFERENCES FOR CONTINUOUS CARDIAC AND RESPIRATORY MONITORING SYSTEMS IN HOSPITALS: A SURVEY OF PATIENTS AND FAMILY CAREGIVERS

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Abstract

The overarching objective of this research is to reduce the burden of ‘alert fatigue’ on patients and family caregivers who stay overnight in hospitals on units that provide continuous monitoring of cardiac and respiratory systems. When a patient develops respiratory compromise on the medical-surgical units of the hospital, the mortality rate is 29 times higher. Alarms require nurses to quickly respond, even when it is likely a false alarm. An anonymous survey was distributed to patients and family caregivers with 72 responses. Alarm sounds were judged most helpful to detect a high heart rate or unusual rhythm, and less helpful to detect a patient exiting from bed. The expectation was for an immediate response to an alarm, and that it would be annoying to have an alarm go off for hours. There was strong agreement with wanting alarm sounds to go to the nurse, but not be heard in the hospital room by patients or caregivers. Implications of these findings are discussed.

BACKGROUND

The overarching objective of this research is to reduce the burden of ‘alert fatigue’ (Curry & Jungquist, 2014) on patients and family caregivers who stay overnight in hospitals on units that provide continuous monitoring of cardiac and respiratory systems. For monitoring the heart, there are sensors placed on the chest (so-called ‘leads’) that monitor the heart rate and the rhythms. For monitoring the lungs, there is a sensor (so-called ‘pulse ox’) placed on the finger that monitors the oxygen level. When the heart rate is too high or the oxygen level is too low, an alarm sound goes off and a nurse will come to the room to assess how the patient

is doing. In the set of hospitals in which this research was conducted, there is also an alarm that sounds every time the patient tries to get out of bed (so-called ‘bed exit’). Usually this is only used for patients who are at risk of falling and need assistance getting to the bathroom (so-called ‘high fall risk’ patients).

Respiratory compromise occurs in approximately 1 in 14 of Medicare patients (Curry & Jungquist, 2014). When a patient develops respiratory compromise on the medical-surgical units of the hospital, the mortality rate is 29 times higher (Kelley et al., 2012). As one explanation, when a patient’s brain does not receive enough oxygen for several minutes, severe and irreversible brain damage (called cerebral hypoxia) can occur in the next 24 hours. The human eye is poor at detecting cerebral hypoxia, even when a nurse is staring at the patient with no distractions.

On the other hand, the associated alarm (called the pulse ox) is the least accurate in the hospital, and thus the one that is ignored most often by nurses. A recent review by Paine and colleagues (2016) found that a range of less than one percent to 26% of physiologic alarms in hospitals were considered actionable in a recent 32 article systematic review. In two of the reviewed studies (Bonafide et al., 2015; Voepel-Lewis et al., 2013), a higher overall number of alarms was associated with slower response times by nursing personnel. Reasons for false alarms include the sensor falling off of the patient’s finger, when the oxygenation level is hovering around the threshold and so goes off several hundred times in an hour for being one percent below the threshold (e.g., 88-alarm, 89, 90, 89, 88-alarm, 89, 88-alarm, 89, etc., when the threshold is set to the 89% oxygenation level).

In addition, alarms require nurses to stop what they are currently doing in order to quickly respond to a potentially time-sensitive, critical alarm, even when historical false alarm rates suggest that a false alarm was likely. Nursing care in the hospital is complex, characterized by time pressure, uncertain information, conflicting goals, interruptions, and often stressful conditions (Ebright et al., 2003); this situation makes it a challenging environment for continuously responding to potentially, but unlikely to be, consequential alarms. Therefore, nurses request decreasing the overall number of alarms, including by removing monitoring from patients who do not obviously require the monitoring and by setting threshold crossings as far away from the normal range as possible to reduce the occurrence of non-actionable auditory alarms per patient. An open question is how these strategies would be perceived by patients and family caregivers in hospital settings, particularly with respect to their satisfaction with care as measured by required patient satisfaction (HCAHPS) surveys for Medicare reimbursement (CMS, 2016).

Currently, there is much interest in addressing the ‘alarm problem’ in hospitals for cardiac and respiratory alarms. At this time, there is a gap in the literature regarding the perspectives of patients and family members. With the increased use of middleware systems that send alarms to nurses’ cellphones (Jahrsdoerfer & McAlpine, 2015), additional opportunities and challenges arise with respect to designing the auditory environment in the hospital room. With this paper, we begin to address the gap in the literature by obtaining and assessing empirical data about the perceptions of patients and family caregivers on respiratory, cardiac, and bed exit alarms used in the hospital setting.

METHODS

This research was approved by the Institutional Review Board. An anonymous survey was distributed to a Patient Advisory group of volunteers at the Wexner Ohio Medical Center in August 23, 2017 and October 4, 2017. The survey link was also distributed with personal networks via social media of members of the research team.

RESULTS

72 responses were received, with 34 responses on some individual survey questions. In Figure 1, the roles represented by these respondents are displayed, with many of the respondents having experience with more than one role.

Visitors and patients were the most frequent categories. Two respondents were also registered nurse employees in hospitals, and four served as volunteers in the hospital. Forty-six were female and 18 were male. The age range was 19 to 76, with an average of 47.8 years and a standard deviation of 19.8. Thirty-three required a wheelchair while in the hospital, 29 required a walker, and 7 required a cane.

There was strong agreement with several statements. This included Figure 2 responses to “I feel that it is helpful when an alarm sounds when there is a high heart rate or an unusual heart rhythm.” There was somewhat less strong agreement regarding a low oxygen level, perhaps indicating that some patients are aware that there tends to be a higher false alarm rate for oxygen level. Alternatively, it is possible that patients experiencing shortness of breath is more common than patients experiencing cardiac issues. In addition, some patients with lung disease might consistently have an oxygenation level that is always low enough to constantly trigger alarms, and therefore the meaning of the alarm, even when not false, is less meaningful to them or the nursing and respiratory staff.

Responses to “I feel that it is helpful when an alarm sounds when the patient gets out of bed” indicate that the ‘bed exit’ alarm is viewed as less useful, although there were still more who agreed that it was useful as opposed to not useful. Nevertheless, quite a few respondents disagreed with the statement. One possible explanation for disagreement is that, while some family members recognized a risk of the patient falling, the actual patients perhaps lacked insight into their fall risk, particularly if it’s a new risk due to a recent change in health status or following a surgical procedure with anesthesia. In addition, frustration with the bed exit alarm might be correlated with frustration about not being allowed to go to the bathroom without waiting for staff assistance.

Responses to “I feel that it is safest when only patients that really need it have monitoring” are in Figure 4. The responses display a polarized perspective on the need for monitoring. This polarization might be surprising to people with little experience with the use of alarms in the hospital setting. Some might perceive that it is safest to monitor all patients regardless of health status to increase patient safety without truly understanding the costs of this approach.

Responses to “I feel that it is safest when nurses check on me: (please select the best option)” are in Figure 5. The most frequent response is once an hour, although there is variation on this expectation. This variation suggests possibilities for staff to clarify expectations with staff and/or to modify the frequency of check-ins based upon patient preferences in order to increase patient satisfaction.

Responses to “I feel annoyed when nurses do not come within a few minutes when an alarm sounds” in Figure 6 demonstrate an opportunity to better calibrate expectations for timeliness of nurse response times on the basis of the content of the alarm sounds. Likely because patients cannot differentiate which alarms are high priority and which are lower priority, they expect that all alarms will immediately be responded to in general.

In Figure 7, the largest agreement in the survey was for the statement “I feel annoyed when alarm sounds stay on for hours.” This is a clear area of opportunity for improving patient, family, and visitor satisfaction.

In Figure 8, there was more agreement with the option of turning alarm sounds off in the room and instead having them only heard by the nurse than with turning down the volume, turning off alarms, or having bed alarms off when a patient is with a caregiver. It is noteworthy that this option is not approved by the Food and Drug Administration, which regulates the bedside monitoring devices for cardiac and respiratory monitoring. The survey question was “I want to be able to turn the alarm sounds off in my room, but have the nurses receive the alarm sounds.”

The survey respondents were given a series of vignettes and asked about their preferences for use of monitoring. The results are currently being analyzed. The preliminary suggests that the preference for use depends on specific patient factors, but also that there is a balanced perspective of polarized beliefs regarding use for individual vignettes where there is not a clear trade-off of risks and benefits.

The open-ended responses to multiple questions were grouped together and analyzed for common themes. The results are presented in Table 1. Each response was uniquely categorized into a theme, with some exceptions where responses were divided and then uniquely categorized into one theme. A subtheme for the second theme about the volume being loud and sounds of alarms being unpleasant was for all or some alarms to be sent solely to nurses, such as at the central monitoring station, rather than have them go off in the patient room.

The questions were “During past hospital stays, either as a patient, family member, or visitor, did anything make you angry or surprise you regarding alarm sounds? Please explain.”, and “Is there anything else that you would like to tell us about alarms?”

Overall, these findings suggest that patient education regarding the purpose, meaning, and importance of different alarms would likely be useful for reducing stress and anxiety for patients and family members. In the event of family members and patients aiding staff with correctly calling attention to critical alarms, education might possibly improve outcomes as well. Even though this survey was focused on continuous cardiac and respiratory monitoring

and bed exit alarms, many of the responses related to infusion pump alarms, indicating that patients and family members do not understand the distinction as all of them sound the same from their perspective. Therefore, an integrated educational packet describing “What does it mean when there is an alarm in your room?” which differentiates the types of alarms, why they go off, what to do in response, and when to worry when there is a delay in staff responding could be highly beneficial for patient satisfaction and potentially patient outcomes such as mortality. Alternatively, some of the alarms could be routed solely to clinical nursing staff and removed from educational initiatives because they would then not be experienced in the room.

Based on these findings, there is strong consensus from patients and family members to have the personal capability of turning off and turning down the volume of alarms in the hospital room, as long as they are assured that nursing staff are reliably receiving them. At this time, many hospitals are likely to hesitate to provide this capability given the many safety and liability risks associated with turning off alarms, as well as concerns with relying on middleware technology which has not been FDA approved to alert nursing staff to alarms. As a compromise position moving forward, it might be possible to identify critical alarms that need to be alarmed in hospital patient rooms (ventricular tachycardia, ventricular fibrillation, asystole) and at central monitoring stations on a medical-surgical unit as well as alarms that can be sent via middleware to nurses’ hospital-provided devices.

In future work, we anticipate exploring the ability to customize settings on central monitoring stations, smartphones (as opposed to cellphones with limited display space and more issues with having dropped alarms when multiple alarms are received at once on the device), customizing auditory tone sounds, improving the sensitivity of alarm settings by taking advantage of area under the curve rather than simple threshold crossings, and auditing capabilities from captured data. Finally, we will explore how we can take advantage of new capabilities to prioritize alarms which arrive within seconds of each other or simultaneously on the smartphone as well as to time stamp who has acknowledged, viewed, or escalated alarms using the smartphone and stored in a separate tab for later access.

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Figure 1.
Roles of survey participants

Figure 2.
Responses to 'Helpful to have heart rate and rhythm alarm'

Figure 3.
Responses to 'Helpful to have alarm when patient gets out of bed'

Figure 4.
Responses to whether only patients who really need it are monitored

Figure 5.
Responses to ideal frequency for patient being checked on by their nurse

Figure 6.
Responses to expectation of immediate response to an alarm by a nurse

Figure 7.
Responses to 'alarm sounds are annoying when they go off for hours'

Figure 8.
Responses to 'Have alarm sounds go to the nurse but not go off in the room'

Table 1

Themes in open-ended survey responses

Theme	No.	Representative Quote
Patients want nurses to respond more quickly to alarms	17	I'm always surprised at how staff seem to ignore them
The volume is loud and the sound of the alarms is unpleasant	11	The sounds of the alarms in monitors can be modified to have a more pleasant sound...
Patients and family members want to understand why alarms go off and what they mean	7	How is a patient supposed to know if an alarm sound is important or not? Patient has no way of knowing what a particular sound might be...
Alarms are necessary for patient safety	7	Alarms are there for safety of the patient. It tells the patient that something is wrong and that it is necessary that a nurse or doctor come into the room...
Alarms make it difficult for patients to rest	6	They are anxiety provoking and do not allow the patient to rest...
The decision of whether to monitor individual patients should be based on their health status	3	They should generally only be used for at risk groups or life threatening situations otherwise it creates a stressful environment for the patient...