Nurses' Perspectives on Clinical Alarms

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Background Alarm hazards are a critical issue in patient safety. Of all health care providers, nurses are the ones most directly affected by the multitude of clinical alarms. **Objectives** To qualitatively explore nurses' experiences with clinical alarms. **Methods** The Krippendorff method for content analysis was used to analyze comments provided by 406 nurses in a national survey on perceptions of clinical alarms. **Results** Six interrelated themes emerged: dissonance and desensitization; pollution, panic, and pathology; calling for accountability; calling for authority of nurses; clinical alarm management is crucial but not a panacea; and hope for the future. **Conclusions** Nurses are concerned about the impact of alarm fatigue on nurses and patients, recognize the importance of nurses' role in reducing noise pollution, and offer valuable insight into strategies that can mitigate alarm hazards. (*American Journal of Critical Care.* 2015; 24:387-395)

A larms emanating from a myriad of devices are ubiquitous in hospitals. Alarm fatigue occurs when clinicians become overwhelmed by the sheer number of alarms, many of which are false or require no action. This situation can result in desensitization to alarm signals.[1] Consequently, the response to alarms may be delayed, or alarms may be missed altogether. Alarms were designed to alert clinicians to both patient- and equipment-related problems. As alarm fatigue becomes pervasive among clinicians, the alarm systems that were created to enhance safety have become an urgent concern in patient safety.

In recent years, numerous reports of alarm-related deaths have been in the news. In February 2010, the first of a series of articles on alarm hazards by Liz Kowalczyk appeared in the *Boston Globe*.[2] Kowalczyk noted that "a Massachusetts General Hospital patient died last month after the alarm on a heart monitor was inadvertently left off, delaying the response of nurses and doctors to the patient's medical crisis."

How common are deaths related to alarms? An examination[3] of the Manufacturer and User Facility Device Experience database of the Food and Drug Administration revealed 566 deaths linked to monitor alarms from 2005 to 2008. The sentinel event database of The Joint Commission[4] includes reports of 98 alarm-related events that occurred between 2009 and 2012. Of the 98 reported events, 80 resulted in death, 13 in permanent functional loss, and 5 in unexpected additional care or extended stay. Because of probable underreporting of cases, most likely the number of deaths is far higher. For example, almost 1 in 5 respondents (18%) to a survey[5] of health care providers reported experience with adverse patient events related to alarms in the preceding 2 years. Adverse events also were most likely underreported; 49% of the participants did not know if an adverse event had occurred in their hospital during the preceding 2 years.[5]

Numerous organizations, including the Healthcare Technology Foundation (HTF), the ECRI Institute, the Association for the Advancement of Medical Instrumentation, the American Association of Critical-Care Nurses, and The Joint Commission, have recognized alarm hazards as a critical issue in patient safety. The ECRI Institute, a nonprofit health services research organization, named alarm hazards as No. 1 of the top 10 health technology hazards for the years 2012 through 2014.[1,6,7] The American Association of Critical-Care Nurses has made alarm safety a priority; the organization has produced an online toolbox of evidence-based resources, including a practice alert on alarm management and webinars.[8] The Joint Commission[9] recently established a National Patient Safety Goal on alarm management.

Of all health care providers, nurses are the ones most directly affected by the multitude of clinical alarms. Nurses are constantly exposed to the cacophony of alarms and must attend to, interpret, and act on alarm signals, all while completing their usual patient care duties. Yet, research on nurses' perception of alarms is limited.

In a qualitative study in a Canadian hospital, Varpio et al[10] conducted 14 interviews of nurses on an inpatient pediatric unit. Nurses expressed frustration with the frequent alarms and interruptions of work flow generated by the alarms.

Siebig et al[11] conducted a written survey of 160 physicians and 114 nurses from 185 randomly selected intensive care units (ICUs) in Germany. The respondents estimated that most alarms do not result in clinical consequences. The survey also revealed dissatisfaction with alarm frequency and specificity of current alarm systems.

Under the auspices of the HTF, 3 of us (M.F., J.T.C., and Y.D.) developed and administered national clinical alarms surveys in 2005/2006 and

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2011 and received a total of 5605 responses from a broad range of health care providers. The surveys elicited primarily objective responses, which have been previously reported.[5,12] However, the surveys also included several areas for respondents' comments; the nurse-specific responses of the more than 2000 nurses who participated in the clinical alarms surveys have not been reported or previously analyzed. In this article, we present the analysis of the nurse-specific comments from the 2011 HTF Clinical Alarms Survey.

Methods

The findings reported are the results of a secondary analysis of the HTF survey data in which health care professionals were queried about their experience with clinical alarms. The parent study, which addressed attitudes and practices related to clinical alarms, was conducted via a national online survey by using Survey Monkey from August 8, 2011, to September 10, 2011. The survey started with 4 work-related demographic questions. These were followed by 20 general statements about clinical alarms that prompted respondents to rate the respondents' level of agreement with the statement by choosing 1 of 5 options (strongly agree, agree, neutral, disagree, and strongly disagree). The next section contained 4 questions related to the occurrence of adverse events, use of monitor watchers, alarm improvement initiatives, and new technological solutions to alarm management. The final section contained a list of 9 issues that potentially inhibit effective management of clinical alarms. Respondents ranked the issues on a scale of 1 (most important) to 9 (least important). The survey included space for comments in each section. The methods are described in detail elsewhere.[5]

Nine different national organizations supported the parent study and offered links to the online survey directly on the organizations' respective websites. This article reports the results of an analysis of the responses of registered nurses to open-ended requests for comments. The study was deemed exempt by the human investigations committee at Yale University, New Haven, Connecticut.

A total of 410 nurses (29.0% of the 1414 nurses in the parent study) responded to requests for comments. Comments unrelated to the research were removed, resulting in an analytic sample of the comments of 406 nurses. Almost all nurses who provided comments worked in inpatient hospital settings (98.5%), a majority practiced in ICUs (69.4%), and most had worked for more than 11 years (76.3%).

Content analysis is a qualitative method useful for analyzing comments obtained in open-ended surveys. Krippendorff[13(p24)] defines content analysis as "a research technique for making replicable and valid inferences from texts (or other meaningful matter) to the contexts of their use." He further notes that this research technique "provides new insights, increases a researcher's understanding of particular phenomena, or informs practical actions."[13(p24)] Krippendorff's method was used to identify the repetitive themes of nurses' experience with clinical alarms.

A total of 790 comments were analyzed. The comments ranged in length from 2 words to 268 words, with a mean length of 23 words for a total dataset of 13 544 words. Three of the authors (L.H., M.F., and M.M.) read in entirety each of the comments so that a sense of the whole could be determined and then reread the dataset and inductively coded the comments by selecting passages that related to the respondent's experience with alarms. Inductive coding was used to perform a line-by-line analysis of transcripts. Exact words, phrases, or sentences that the nurses wrote were highlighted; unique comments and recurrent passages were noted; and data that shared characteristics were categorized. Because the data were from a national survey of nurses, inductive coding rather than coding with an a priori framework was deliberately selected to proceed from nurse-specific comments to a larger whole on the phenomenon of alarm fatigue. After independent coding of the data, the 3 authors met to compare coding and selection of categories. The interrater reliability, calculated as the percentage agreement of the total number of categories, was 274/315, or 87.0%.

Using Krippendorff's analytical technique of clustering,[13] the categories we developed that shared characteristics, patterns, or attributes were clustered and collapsed into thematic units. Dendrograms, or treelike diagrams, were used to illustrate how data were collapsed into thematic units (see Table).

To ensure methodological integrity, the first author (L.H.) created an audit trail to record reflections, evidence of consistency in coding, and interpretations of data. Other authors (M.F. and M.M.) reviewed the audit and discussed the selection of key characteristics, relationships, and categories and the development of themes until agreement was reached on the final coding scheme. Numerous comments are included in the following material to enhance the credibility of the findings.

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Results

Content analysis revealed 6 interrelated themes.

Table

Partial dendrogram illustrating how data are collapsed into thematic units for theme "Clinical alarm management is crucial but not a panacea"

Participants' statements	Categories	Theme
We added monitors techs in our PICU a few years ago, and they are definitely an added safeguard. This staff notifies RNs when an alarm is not acknowledged in a prompt time frame, if leads come off, or if someone's tracings aren't on the monitors.	Monitor techs are a safeguard for patient safety	Clinical alarm management is crucial but not a panacea
EKG monitor techs add an element of safety, especially on progressive care units.	Monitor techs are a safeguard	
Clinical alarm management are not capable of making clinical decisions; it is a safety hazard when they reset alarms without notifying RN.	Alarm management personnel inadequately trained (reset alarms without notifying RN)	
Clinical alarm management are overzealous in complaining about staff responsiveness.	Alarm management overzealous in complaining about staff responsiveness, constant interruptions	
Monitor techs call for everything, which causes disrupting/interfering patients' care.	Alarm management calls result in constant interruptions	
Frequently alarms are missed because of inadequate staffing and no monitor tech.	Alarms missed because there are no monitor techs	
If a monitor tech is present, staff tends to ignore the alarms, figures if it was important the tech will tell them.	Presence of monitor techs results in ignoring alarms by staff	

Abbreviations: EKG, electrocardiography; RN, nurse; PICU, pediatric intensive care unit; tech, technician.

Theme 1: Dissonance and Desensitization

A preponderance of comments related to the auditory dissonance faced by nurses daily that results in aural desensitization. As technology has evolved and proliferated in acute care institutions, so has the number of alarms. Nurses described the sounds by using a myriad of terms, including "noxious," "unnerving," "ominous," and "strident." The "constant" auditory dissonance leads nurses to fear for the impact on young nurses' hearing, calling the "constant white noise" an "occupational hazard." Nurses become desensitized to the "shrill" alarms that are "a part of the everyday sound of the unit." They ponder why alarms on intravenous devices, feeding pumps, chairs or beds, mattresses, and sequential compression devices all must make a sound as if the alarms are "proclaiming life or death." Nurses complain that the various mechanical technologies "all sound the same" when an alarm goes off because no standards for alarm sounds exist; the devices are "too sensitive to patient movement" and "too noisy, too complex to shut them up once and for all."

Not only do the barrage of alarms and lack of tone standardization lead to an inability to identify which alarm is sounding, but the number of "spurious" alarms leads to an "anesthetized" response to the alarms. One nurse's comment illustrates this belief: "The monitors are so very sensitive. One little patient movement and they are alarming. All the false alarms lead to lack of response for real alarms." As a result, nurses note that they "disassociate," "discount," and become "numb" to alarms as a means of "self-preservation." As one nurse noted:

> It seems that when an issue arises regarding a patient, the solution is always to add another alarm or to increase the volume of existing alarms. We are absolutely inundated with alarms, every piece of equipment that we use in critical care has a distinctive and often louder alarm which frequently go off for nuisance events. This is stressful for patients, family members, and staff and makes it very easy to "tune out" alarms as a means of self-preservation.

Participants compared the specious alarms to a "cry wolf" situation in which they no longer "trust" the alarms. As a result of this "alarm fatigue and alarm exhaustion," they "tune out" the "disruptive" ubiquitous noises that are habitual in their environment.

Theme 2: Pollution, Panic and Pathology

The "noise pollution" customary to health care professionals causes undue panic in patients, patients' family members, and visitors. Nurses' comments suggest that noise pollution is associated with comorbid conditions such as "increased patient anxiety," "sleep deprivation," "ICU psychosis," and "delirium" in patients.

Nurses noted that patients and patients' visitors often complain about the "constant alarming"

with little impact of the alarms seen in the hospital environment. The continual alarms are described as "distracting," "annoying," "upsetting," and "frightening" to patients and visitors and are causing them to feel unnecessary "panic." One nurse described the public response to alarms:

> The alarm problem is so horrible, and equipment manufacturers and hospitals are so alarm gung ho, I can't imagine this will ever get fixed. Our patients suffer greatly by the constant alarms 24/7. Wouldn't you? And the families think we are crazy because we don't view the each alarm as a crisis like they do.

Nurses are concerned that noise pollution is associated with the comorbid conditions previously described, along with nervousness and fear, which complicate patients' already unstable status.

Theme 3: Calling for Accountability

A call for accountability was noted in the comments across 3 domains: the personal-professional, the institution, and national organizations. On the personal-professional level, nurses call for vigilance in answering alarms and note that "everyone on the unit needs to be proactive in responding to alarms. We cannot become complacent and just silence, silence, silence." The attitude of "not my patient, not my responsibility" must end. The respondents noted wide variability in nurses' responsiveness: from "deaf nurses" to those that "wait for the primary nurse to answer alarms," and nurses that "turn alarms off or down when they alarm with every movement of the patient and then don't even look when someone else asks them to check out the patient. Scary!" Many nurses called for "changing the culture to never shutting alarms off" and preventing the resetting of alarms without direct observation of the patient in institutions that have central alarm systems. Collaboration, integrity, and teamwork are suggested in making inroads into this important problem. Additionally, alarms on intravenous infusion pumps appear to be particularly troublesome, especially on medical-surgical units. One simple cost-effective solution is to ensure that the equipment's battery is charged. Ultimately, participants suggest that all frontline health care workers should foster an attitude of teamwork to improve patient care. As one nurse noted, "Make every patient's care a team effort. . . .If you hear an alarm respond—whether it's your patient or not."

Institutionally, a majority of the nurses called for "monitor watchers," particularly in "densely populated units" where patient to nurse ratios are high, visibility of patients is decreased, and locating the source of alarms is difficult. Older, larger units appear to be particularly difficult for identifying the source and location of some alarms; however, new units are not without issues: "The newness of the hospital affects the recognition of the location of an IV machine alarm. The alarm seems to bounce off the wall or door so the location of the alarm is not accurate." The nurses' comments indicate concern about patient safety in institutions that have unattended central alarm monitors; additionally, the nurses call for standards of competencies for monitor watchers and note that if institutions do employ monitor watchers, in many instances they are untrained.

Nurses' comments suggest that the staffing ratio also influences patient safety: "Frequently alarms are missed because of inadequate staffing and no monitor tech." Working short-staffed and with high-acuity patients influences nurses' response time to alarms. Although the nurses recognize that newer technology is available that may decrease nuisance alarms, the nurses' "units and facilities are not always able to replace outdated, or outmoded equipment due to budgetary constraints." Many nurses noted that "with the state of health care today, upgrading is not an option due to finances," and in the rare comments from nurses in hospitals that employ monitor watchers, nurses were concerned that these positions would be eliminated "for cost savings."

Educational institutions also have a role in alarm management according to participants, who suggest that "alarm safety should begin in nursing school." Curricula should include differentiating nuisance alarms from important alarms, troubleshooting alarms, and recognizing that alarms are an addition to clinical observation rather than a primary source of information. Additionally, participants suggested requiring annual competency training related to alarms, with particular emphasis on resetting alarm parameters specific to each patient's condition, and auditory pattern recognition of alarms.

> **Alarm pollution can be decreased when nurses have authority to alter alarm settings.**

Finally, some participants suggested calling on national organizations to implement protective structures that improve patient safety and noted that the current standard "did not help at all—only confusing." One nurse wrote the following:

> Maybe falls have decreased, but other patients' not getting nursing attention is an adverse event in my opinion. How would I know if alarms have been missed? I would have not been able to hear them. Let's hire more people to take care of sick people. Why doesn't The Joint Commission require that?

The call for national commitment to solving problems with clinical alarms is a shared charge among nurses, health care institutions, and national organizations.

Theme 4: Calling for Authority of Nurses

Participants' statements suggest that alarm pollution can be decreased when nurses have authority to alter alarm settings; however, in some institutions, only physicians can change the alarm settings. The following is an excerpt from a nurse's comment:

> Clinical alarm policies are atrocious in my unit. Parameters are set by physician order, not nurse, and are required to exactly reflect call-for parameters. Alarms should be within reasonable range of call-for parameters, but exact limits should be determined by nurse at bedside. Alarms should not be set unless actionable. . . . If no nurse action is necessary, the alarm is not necessary. . . . Physicians are severely undereducated regarding the detrimental effects of nuisance alarms and sometimes order alarm parameters based on "hemodynamic goals" that they are aware are significantly different than current patient condition, resulting in constant "panic" alarms which the nurse is prohibited from changing per policy. It is difficult to obtain a physician order to change a parameter on the night shift . . . , resulting in entire nights where patient, nurse and rest of unit must listen to high-alert alarms that serve no purpose.

Many comments specified 2 clinical situations often associated with alarm pollution: chronic atrial fibrillation and do-not-resuscitate orders. These situations are ones in which the alarms are continuous and easily attended to by, respectively, turning off the irregular heart rhythm and altering heart rate and blood pressure parameters. However, the inability to alter parameters limits nurses' interventions. Thus, "so much time is wasted addressing alarms that do not provide any useful information."

Other nurses noted that although their institutions allow altering alarm parameters, many nurses are "reluctant to 'tweak' alarms." The hesitancy to alter alarm parameters has been associated with issues of liability for nurses. The following statements illustrate this clinical conundrum of altering alarm parameters to decrease nuisance alarms vs perceived increased liability when standard parameters are changed:

> I hope nurses have more control of their patients' alarm settings based on patients' condition, history, etc, without concern about potential liability.

Documentation of alarms is more geared toward covering the hospital if the preset parameters are changed. If a parameter is changed, there is no required documentation to justify the reason. It makes the nurse feel unprotected. Conversely, not individualizing alarms puts the patient and nurse at risk for alarm fatigue and failing to recognize and respond to true changes in patient condition.

> We remain in the infancy of monitoring, but we have put the bar or responsibility very high, so a lot of frontline staff feel thrown under the bus when things go wrong.

Many comments noted that the ultimate responsibility and authority for clinical alarms must rest with the bedside clinician, who has the "awareness/judgment/experience of most appropriate settings for patient clinical pictures and changing alarm settings as the patient's condition changes." But when that autonomy is balanced against legal liability, many nurses commented that the alarms are not altered from the standard parameters because the nurses "are afraid they'll miss something."

Theme 5: Clinical Alarm Management Is Crucial but Not a Panacea

The nurses' comments suggest that patient safety would be improved by having a trained monitor watcher observe the clinical parameters. Many nurses wrote that they are working "short-staffed," at a "hectic pace" with outdated equipment that does not allow for observation of multiple patient alarms when caring for another patient; thus, the nurses think monitor watchers "safeguard patient care," and are considered a second set of eyes on patients. However, some nurses who have a designated central monitoring person expressed that it is not a panacea because the monitor watchers increase interruptions to the nurses' daily routine when alarms are observed. And a few nurses provided examples of potential safety hazards when clinical alarms were reset without notifying the primary nurse. The nurses suggested that a collaborative approach is essential, with a nurse assuming primary responsibility and alarm staff providing secondary surveillance.

Within the comments from the 406 nurses who participated in this study, 1 sentinel event was detailed and 6 potential events were noted. None of the comments (on the sentinel event or the 6 near-miss events) indicated whether or not the institutions had trained monitor watchers available. The following is the description of the sentinel event: "A patient actually died at a facility I worked because the nurses did not pay attention to the

alarms—patient was in V-tach/v-fib for 10 minutes before someone noticed." The 6 potential events included inability of a medical technician to recognize and respond when a patient's rhythm changed from "NSR to a junctional rhythm and then VT to coarse V fib," instances when bilevel positive airway pressure alarms "have been cut off and the patient has developed acute distress," not recognizing a "lead-off" alarm when "the patient had taken himself off the monitor, tore out his IV, and then got out of bed and fell," lack of recognizing "pulseless electrical activity—rhythm looked good, no pulse only found by checking the patient," and 2 instances in which "red alarms" were missed.

The majority of participants did not work with monitor watchers but thought that monitor watchers were an important element in patient protection and expressed that it is "a very dangerous practice" that staff are "not watching the monitors for periods of time." One nurse whose institution hired monitor technicians commented, "We added monitor techs in our PICU a few years ago and they are definitely an added safeguard. This staff notifies RNs when an alarm is not acknowledged in a prompt time frame, if leads come off, or if someone's tracings aren't on the monitors."

Theme 6: Hope for the Future

The nurses' future aspirations include technological development, expanding nurses' influence, and development of monitoring guidelines. Specifically, the nurses suggested that monitor technology that recognizes trends in values will decrease nuisance alarms. For example, for patients with atrial fibrillation, the technology would recognize the irregular rhythm and alter parameters accordingly, or with "transient labile Spo_2 varying with movement, cough, etc, if the drop . . . recovers within 15-30 seconds, it would be nice if this either didn't trigger an alarm at all or would result in automatic modification of parameters." The nurses recommended enlarging the monitoring screens in patients' rooms to allow for display of any high-priority alarms on other patients. Because the participants in the survey are concerned that the cacophony of alarms might be an occupational hazard, they would like ranges in alarm volume. They suggest that older nurses with hearing impairment could benefit from a higher volume, whereas younger nurses could decrease the volume. Better sound differentiation that will aid in identification of which device is sounding an alarm is essential; the nurses noted that achieving this change requires that manufacturers of devices be aware of the concerns of bedside nurses. The nurses request that they be involved in evaluating and purchasing equipment for their units.

Nurses also expect their voices to be heard interprofessionally. They suggested that nurses and physicians should make rounds together to decide what monitoring should be continued and to determine monitoring parameters, and they noted that the current practice of keeping monitoring "in place for extended periods of time thereby confounds the situation." In particular, the nurses suggested that continuous monitoring of oxygen saturation is especially difficult and a primary source for nuisance alarms.

Discussion

Although alarms were designed to alert hospital staff to potentially life-threatening events, our findings reveal the need for restructuring, reassessing, and streamlining the use of alarms. As technology has advanced, so has the use of multiple alarm systems that nurses described as "constant," "noxious," and "a nuisance." Although alarms are meant to serve patients' welfare, nursing staff, patients, and patients' families seem to be subjected to excessive and continual noise pollution, angst, and distraction, which may result in fear, panic, and sentinel events.

Nurses describe alarms as a constant auditory dissonance leading to desensitization, supporting the 2014 ECRI Institute's designation of "alarm hazards" as the leading health technology hazard.[7] Clearly, patient safety is affected if nurses become fatigued and numbed to the incessant sounds and thus may not readily respond to alarms that signify true emergencies. The Food and Drug Administration reported that 566 patients within 4 years died as a result of alarm-related events[3]; however, this number most likely represents significant underreporting. Research[14-20] has indicated that 72% to 99% of alarms are false or require no action. In the end, patients

> **The cacophony of alarms may be an occupational hazard.**

may suffer, not only because of sleep deprivation and delirium caused by constant stimulation but also because of the resulting serious safety issues.

Accountability in answering alarms is also a concern. The participants in our study thought that every nurse, not just a patient's assigned nurse, must be attentive to alarms. MedStar Washington Hospital Center, Washington, DC, has implemented a "no pass" policy that dictates that if an employee (from housekeepers to hospital administrators) passes a patient's room and hears an alarm, the employee must ascertain that the patient is breathing and call for help if necessary.[21]

Nurses were resolute in support for monitor watchers, particularly in step-down and densely populated units. Although they thought that monitor watchers provided a safety net, nurses expressed

concerns about weak or nonexistent competency standards. Nurses were disturbed about delays in answering alarms and in silencing alarms without direct observation of a patient's condition. Poorly trained monitor watchers who could not differentiate false from true alarms interfered with patient care because the nurses were contending with potentially even more false alarms. Although 53% of all respondents to the 2011 survey thought monitor watchers were helpful,[5] little evidence supports their use. The results of single-site studies[22,23] published in 1997 indicated that monitor watchers were not associated with lower rates of most adverse outcomes. Multisite studies are needed to determine the impact of monitor watchers on patient outcomes. As some nurses indicated, middleware (software that enables communication and management of data between systems) that incorporates smart phones may be more effective in enhancing alarm safety than are monitor watchers for ancillary notification of alarm signals.

Nurses also suggested several ways in which manufacturers could improve devices to minimize alarm fatigue. In an observational study published in 2014, Drew et al[20] found that more than 2.5 million unique monitor alarms in 5 ICUs sounded during a period of 31 days. Nurse scientists annotated 12 671 of these alarms and found that 88.8% of them were false or clinically irrelevant. Drew et al[20] proposed a number of solutions that manufacturers could incorporate into monitors that would be helpful for nurses, including use of all available electrocardiographic leads to identify leads without artifact and those with adequate QRS amplitude, prompts to help in tailoring alarm settings, and delays for certain parameters before alarms are triggered. As nurses pointed out in our study, upgrading to the latest monitoring systems has marked financial implications, but perhaps upgrades should be a priority if they can reduce alarm fatigue and enhance patient safety.

Nurses advocated for improved staffing ratios because insufficient staffing can lead to missed high-priority alarms. Although nurses realized that they, not the alarm systems, are ultimately responsible for patient safety, they thought that sufficient staffing might make nurses less dependent on alarms.

Alarm parameters determined by physicians without input from nurses that result in alarms that require no action were yet another cause for frustration. Although nurses agreed that physicians should set reasonable parameters, they also thought that the bedside nurse should set limits appropriate to the individual patient. The results of other studies[24-26] support the notion that nurses should have the authority and the responsibility to individualize alarm settings.

The participants in our study proposed changes to reduce nuisance alarms. The changes included use of larger screens to display high-priority alarms, the ability to adjust alarm volume, having physicians and nurses make rounds together to determine alarm parameters, discontinuing monitoring when it is no longer necessary, and nurses' involvement in evaluating and purchasing new equipment with alarms.

Our results indicate a clear need for nurses' involvement in reforming current policy and restructuring alarm systems with the ultimate goal of improving patient safety. In their unique role at the bedside, nurses are the most directly affected by the multitude of alarms and can provide creative and effective solutions to the hazard that alarms have become. Perhaps if the experiences and ideas of nurses are heard, hospitals can be transformed into safer environments.

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