

EDITORIALS

Alarm Fatigue: Clearing the Air

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Alarm fatigue is not a new issue for hospitals. In a commentary written over 3 decades ago, Kerr and Hayes described what they saw as an "alarming" issue developing in intensive care units.¹ Recently multiple organizations, including The Joint Commission and the Emergency Care Research Institute have called out alarm fatigue as a patient safety problem,²⁻⁴ and organizations such as the American Academy of Pediatrics and the American Heart Association are backing away from recommendations for continuous monitoring.^{5,6} Hospitals are in a scramble to set up alarm committees and address alarms locally as recommended by The Joint Commission.² In this issue of the *Journal of Hospital Medicine*, Paine and colleagues set out to review the small but growing body of literature addressing physiologic monitor alarms and interventions that have tried to address alarm fatigue.⁷

After searching through 4629 titles, the authors found 32 articles addressing their key questions: What proportion of alarms are actionable? What is the relationship between clinicians' alarm exposure and response time? Which interventions are effective for reducing alarm rates? The majority of studies identified were observational, with only 8 studies addressing interventions to reduce alarms. Many of the identified studies occurred in units taking care of adults, though 10 descriptive studies and 1 intervention study occurred in pediatric settings. Perhaps the most concerning finding of all, though not surprising to those who work in the hospital setting, was that somewhere between <1% and 26% of alarms across all studies were considered actionable. Although only specifically addressed in 2 studies, the issue of alarm fatigue (i.e., more alarms leading to slower and sometimes absent clinician response) was supported in both, with nurses having slower responses when exposed to a higher numbers of alarms.^{8,9}

The authors note several limitations of their work, one of which is the modest body of literature on the topic. Although several interventions, including widening alarm parameters, increasing alarm delays, and using disposable leads or daily lead changes, have early evidence of success in safely reducing unnecessary alarms, the heterogeneity of this literature precluded a meta-analysis. Further, the lack of standard definitions and the variety of methods of determining alarm validity make comparison across studies challenging. For this reason, the authors note that they did not distinguish nuisance alarms (i.e., alarms that accurately reflect the patient condition but do not require any intervention) from invalid alarms (i.e., alarms that do not correctly reflect the patient condition). This is relevant because it is likely that interventions to reduce invalid alarms (e.g., frequent lead changes) may be distinct from those that will successfully address nuisance alarms (e.g., widening alarm limits). It is also important to note that although patient safety is of paramount importance, there were other negative consequences of alarms that the authors did not address in this systemic review. Moreover, although avoiding unrecognized deterioration should be a primary goal of any program to reduce alarm fatigue, death remains uncommon compared to the number of patients, families, and healthcare workers exposed to high numbers of alarms during hospitalization. The high number of nonactionable alarms suggests that part of the burden of this problem may lie in more difficult to quantify outcomes such as sleep quality,¹⁰⁻¹² patient and parent quality of life during hospitalization,^{13,14} and interrupted tasks and cognitive work of healthcare providers.¹⁵

Paine and colleagues' review has some certain and some less certain implications for the future of alarm research. First, there is an imminent need for researchers and improvers to develop a consensus around terminology and metrics. We need to agree on what is and is not an actionable alarm, and we need valid and sensitive metrics to better understand the consequences of not monitoring a patient who should be on monitors. Second, hospitals addressing alarm fatigue need benchmarks. As hospitals rush to comply with The Joint Commission National Patient Safety Goals for alarm management,² it is safe to say that our goal should not be zero alarms, but how low do you go?

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Received: November 4, 2015; Accepted: November 5, 2015

2015 Society of Hospital Medicine DOI 10.1002/jhm.2521

Published online in Wiley Online Library (Wileyonlinelibrary.com).

What can we consider a “safe” number of alarms in our hospitals? Smart alarms hold tremendous potential to improve the sensitivity and positive predictive value of alarms. However, their ultimate success is dependent on engineers in industry to develop the technology as well as researchers in the hospital setting to validate the technology’s performance in clinical care. Additionally, hospitals need to know which interventions are most effective to implement and how to reliably implement these in daily practice. What seems less certain is what type of research is best suited to address this need. The authors recommend randomized trials as an immediate next step, and certainly trials are the gold standard in determining efficacy. However, trials may overstate effectiveness as complex bundled interventions play out in complex and dynamic hospital systems. Quasiexperimental study designs, including time series and step-wedge designs, would allow for further scientific discovery, such as which interventions are most effective in certain patient populations, while describing reliable implementation of effective methods that lead to lower alarms rates. In both classical randomized controlled trials and quasiexperiments, factorial designs^{16,17} could give us a better understanding of both the comparative effect and any interaction between interventions.

Alarm fatigue is a widespread problem that has negative effects for patients, families, nurses, and physicians. This review demonstrates that the great majority of alarms do not help clinicians and likely contribute to alarm fatigue. The opportunity to improve care is unquestionably vast, and attention from The Joint Commission and the lay press ensures change will occur. What is critical now is for hospitalists, intensivists, nurses, researchers, and hospital administrators to find the right combination of scientific discovery, thoughtful collaboration with industry, and quality improvement that will inform the literature on which interventions worked, how, and in what setting, and ultimately lead to safer (and quieter) hospitals.

Disclosures: Dr. Brady is supported by the Agency for Healthcare Research and Quality under award number K08HS023827. The content is solely the responsibility of the authors and does not necessarily repre-

sent the official views of the Agency for Healthcare Research and Quality. Dr. Landrigan is supported in part by the Children’s Hospital Association for his work as an executive council member of the Pediatric Research in Inpatient Settings network. Dr. Landrigan serves as a consultant to Virgin Pulse regarding sleep, safety, and health. In addition, Dr. Landrigan has received monetary awards, honoraria, and travel reimbursement from multiple academic and professional organizations for delivering lectures on sleep deprivation, physician performance, handoffs, and patient safety, and has served as an expert witness in cases regarding patient safety. The authors report no other funding, financial relationships, or conflicts of interest.

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