PSNet
PATIENT SAFETY NETWORK

Alert Fatigue

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Background

The rapidly increasing computerization of health care has produced benefits for clinicians and patients. Yet the integration of technology into medicine has been anything but smooth, and as newer and more sophisticated devices have been added to the clinical environment, clinicians' workflows have been affected in unanticipated ways. These fundamental shifts have resulted in new threats to patient safety—a cruel irony given that technological solutions have been promoted for many years as the most promising solution to medical errors.

Most health care technologies—be they computerized provider order entry systems (CPOE), smart intravenous infusion pumps, or cardiac monitoring devices—provide auditory or visual warnings to clinicians to prevent or act on unsafe situations. These warnings are well intended and in isolation may be helpful. However, in the highly computerized clinical environment, an individual clinician interacts with many different alert-generating devices—meaning that every day, clinicians are on the receiving end of a staggering number of alerts. A 2014 study found that the physiologic monitors in an academic hospital's 66 adult intensive care unit beds generated more than 2 million alerts in one month, translating to 187 warnings per patient per day. In a study in the Veterans Affairs primary care, clinicians received more than 100 alerts per day.

The term "alert fatigue" describes how busy workers (in the case of health care, clinicians) become desensitized to safety alerts, and as a result ignore or fail to respond appropriately to such warnings. This phenomenon occurs because of the sheer number of alerts, and it is compounded by the fact that the vast majority of alerts generated by CPOE systems (and other health care technologies) are clinically inconsequential—meaning that in most cases, clinicians *should* ignore them. The problem is that clinicians then ignore both the bothersome, clinically meaningless alarms *and* the critical alerts that warn of impending serious patient harm. In essence, a proliferation of alerts that are intended to improve safety

actually results in a paradoxical increase in the chance patients will be harmed. Although rarely discussed prior to the widespread use of electronic health records, alert fatigue is now recognized as a major unintended consequence of the computerization of health care and a significant patient safety hazard.

Effect of alert fatigue on patient safety

Much of the literature on alert fatigue derives from studies of CPOE and clinical decision support (CDS) systems, in which alerts are provided to warn of potentially harmful drug–drug interactions or incorrect medication doses. These studies consistently show three main findings:

- Alerts are only modestly effective at best. A systematic review of computerized reminders found only minor improvements in targeted processes of care, and, while CPOE systems have been shown to markedly decrease prescribing errors, this can largely be ascribed to their ability to standardize drug doses, provide decision support, and eliminate errors from poor handwriting or incorrect transcriptions.
- Alert fatigue is common. Clinicians generally override the vast majority of CPOE warnings, even "critical" alerts that warn of potentially severe harm. There is less literature on other types of warnings, but it is likely that rates of overriding or ignoring warnings in other settings are also high.
- Alert fatigue increases with growing exposure to alerts and heavier use of CPOE systems. This finding is intuitive, but also raises the important implication that without system redesign, the safety consequences of alert fatigue will likely become more serious over time.

Although there are few studies that quantify adverse events related to alert fatigue, this phenomenon has been implicated as a significant cause in several high-profile errors. A 2011 Boston Globe investigation identified more than 200 deaths over a 5-year period attributable to failure to appropriately heed alarms from physiologic monitoring systems. A book by a prominent patient safety leader details how a hospitalized teenager received a 38-fold overdose of an antibiotic, in large part because the ordering physician had been advised by colleagues to "just ignore the alerts."

Current context

Alert fatigue (and the unintended consequences of the computerization of health care) remains a high-profile patient safety issue, with recent research exploring alert fatigue in nursing, intensive care, and pediatric care. The Joint Commission released a sentinel event alert in April 2015 calling for health care organizations to pay close attention to information technology as a safety issue. In order to mitigate these consequences—including alert fatigue—The Joint Commission recommended improving the culture of safety by creating a shared sense of responsibility between users and developers, paying careful attention to safe IT implementation, and engaging leadership to provide oversight of health IT planning, implementation, and evaluation.

There is intense interest in developing specific methods to combat alert fatigue, but as yet, there is no consensus on the optimal approaches. Solving alert fatigue will require use of the principles of human factors engineering as well as those of informatics, as the problem fundamentally arises from both the

technology itself and how busy human beings interact with the technology. The Making Healthcare Safer III report outlines several patient safety practices to address alert fatigue, including fostering a culture of safety and alarm risk assessment. A WebM&M provided several additional suggestions on how to minimize alert fatigue in CPOE systems:

- Increase alert specificity by reducing or eliminating clinically inconsequential alerts.
- Tailor alerts to patient characteristics and critical integrated clusters of physiologic indicators. For example, incorporate renal function test results into the alert system so that alerts for nephrotoxic medications are triggered only for patients at high risk.
- Tier alerts according to severity. Warnings could be presented in different ways, in order to key clinicians to alerts that are more clinically consequential.
- Make only high-level (severe) alerts interruptive.
- Apply human factors principles when designing alerts (e.g., format, content, legibility, and color of alerts).

A quality improvement program in the Veterans Affairs system that incorporated the above principles and provided primary care physicians with education on managing alerts achieved a small but meaningful reduction in alerts.

One limitation to addressing alert fatigue pertains to the legal consequences of removing alerts. A 2016 commentary pointed out that system developers have thus far been reluctant to remove alerts for fear of being held liable if patients were harmed in the absence of a warning. There has been progress toward developing guidelines for high-severity alerts (which warn of significant risk of harm and should be retained) and low-severity alerts (less clinically consequential warnings, which could be made non-interruptive or removed entirely).

In solving the problem of alert fatigue, health care will need to look to examples from other industries. The aviation industry offers a sharp contrast to health care, because cockpit technology is rigorously designed to provide only highly consequential alerts to pilots, minimizing minor alerts in order to allow pilots to maintain situational awareness. This use of human factors engineering and deep attention to the experience of the end-user has thus far been lacking in health care technology design.