The Perception of Novel Auditory Alarms in a Simulated Intensive Care Unit Environment

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Introduction: Alarms are frequent, inevitable sounds in any intensive care unit (ICU), and play an important role in patient safety. [1] Unfortunately, the current International Electrotechnical Commission (IEC) alarm sounds [2] have been associated with high rates of alarm fatigue, poor alarm recognition, and inability to determine alarm urgency. [3] Novel auditory “Icon” alarms were created that correspond with IEC categories, but are metaphorically nature (for example, a whistling kettle corresponds with abnormal temperature). They have been tested on non-anesthesiology participants in a non-simulation, computer-based setting, and demonstrated significant improvement in learnability over IEC alarms. [4] We hypothesize that in a simulated ICU environment, when compared to IEC alarms, anesthesiology residents and physicians will rate Icon alarms as: less frustrating, less energy to identify, easier to distinguish between, more helpful, and will perceive their performance in identifying the alarms as better.

Methods: MATLAB was used to create novel Icon alarm sounds. Resident and physician anesthesiologists were randomized to either the control (IEC alarms) or experimental group (Icon alarms). An instructional presentation was reviewed in which participants heard alarms for each category. Subsequently, they gave a break to a “physician” in a simulated ICU, during which time alarms intermittently sounded. Participants chose the reason why the alarm was sounding. They underwent an identical experiment about a week later, after which they were asked to complete psychometric questionnaires (including the National Aeronautics and Space Administration Task Load Index (NASA-TLX) and Swedish Occupational Fatigue Inventory (SOFI)).

Results: A total of 20 participants, 17 anesthesia residents and 3 attending physicians, were separated into 2 groups (10 participants in each). When compared with the IEC alarms, the Icon alarms were rated as less frustrating (p < 0.05), less energy consuming (p < 0.05), easier to identify (p < 0.001) and more helpful (p < 0.05). However, IEC participants perceived their performance to be better than those in the Icons group (p < 0.01).
Discussion: Although IEC alarm sounds have been in use for many years, the need for more intuitive, easily identifiable alarm sounds is apparent. [5] The goals of Icon alarms are to reduce alarm fatigue, improve learnability, and in turn, improve patient safety. This study had several limitations, including but not limited to: a small number of participants, single-center trial, potential for response bias, and lack of blinding. Still, given the improved psychometric perception associated with Icon alarms (less frustration, less energy expenditure, greater ease of identification, and greater helpfulness), further investigations should be conducted to study the potential positive impact of these novel alarm sounds in the ICU setting.

Figure 1. NASA-TLX and SOFI questionnaires; Alarms survey: Item 2- Total number of alarms heard, 3- To what extent were you aware of alarms?, 4- How easy was it to figure out what alarms meant?, 5- How easy was it to hear alarms, 6- How helpful did you find the alarms?; *p<0.05, **p<0.01, ***p<0.001.

References:
4. Edworthy, J, Hellier, E, Titchener, K, Naweed, A, & Roels, R. Heterogeneity in auditory alarm sets makes them easier to learn. Int J Ind Ergonom 2011; 41(2);136-146