Improving Alarm Management in Single Room NICUs

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This study is funded by NWO-TTW

Background:

Alarms are used to notify a caregiver that a patient requires attending. In **single family room NICUs**, alarm management is more challenging and often alarms are communicated to medical staff using mobile devices. The complex alarm chain can give high risks of alarm fatigue and associated reduced patient safety, as repetitively warned for by ECRI¹.

Aim of the study is to improve the alarm chain, focusing on:

1. Reducing the sound and number of alarms;
2. Increasing patient safety.

Results:

Technical failure, delays in alarm handling and alarm fatigue pose the biggest risks in the alarm management. The most critical pain points (Figure, blue and red bullets) are the workflow-interruption that alarms cause, alarm sound and stress to patient and family, waveforms not being visible in every location and the lack of smart decision support.

Of all ideas generated in this project, several concepts to improve the alarm chain were tested or even implemented in clinical practice:

1. A **new alarm system** was implemented to overcome current problems in alarm handling and missing waveform information. On the new mobile devices more information is displayed, on vital sign values and waveforms of the patient.
2. Since many alarms are generated when giving patient care, a **foot pedal** was developed to silence alarms at the incubator.

Methods:

First, a multi-disciplinary **risk analysis** was performed using an HFMEA methodology, similar to our previous study². All possible failure modes in the current system were determined and scored with respect to frequency of occurrence, severity of effect and possibility of detection. Next, for one of the implemented improvements (1), risk reduction was determined.

Additionally, to evaluate how current alarm management is perceived, a **user study** was performed to determine the drawbacks of the current system.

Finally, **user-centered design methods** were used to generate and evaluate solutions for improving alarm handling (2). Concepts were generated using multiple sessions with stakeholders and evaluated on a difficulty versus impact diagram. Quick wins as well as long-term adjustments were identified.

Implementation results:

1. Using more advanced alarm handling and redirecting alarms when busy, alarm handling delays are prevented. In addition, the provision of **waveform information on mobile devices** is considered useful to determine how to handle an alarm. The risk analysis showed reduction of risks.
2. Introducing a **foot pedal** to silence alarms that are generated while taking care of the patient is considered helpful. Nurses found the prototype to be useful as it allowed them to give uninterrupted care to the patient without having to remove their hand out of the incubator every three minutes to silence alarms.

Conclusion

By conducting a risk assessment and user study on the current alarm chain, possible improvements to the alarm handling have been identified. **Two improvements have been tested and found useful.** However, advanced solutions are needed to reduce alarms using nurse tracking and alarm relevance detection.

¹ ECRI www.ecri.org - Top 10 Health Technology Hazards for 2018
² Pul et al; Safe patient monitoring is challenging but still feasible in a neonatal intensive care unit with single family rooms. Acta Paediatr 2015;104:e247-54