

Improving Alarm Management in Single Room NICUs

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Background:

To notify a caregiver that a patient requires help, patient monitoring alarms are used. In single bay NICU's alarms can be shown on mobile devices. The complex alarm chain can give high risks of alarm fatigue and associated reduced patient safety, as repetitively warned for by ECRI¹.

The **purpose** of our study is to investigate possibilities on improving the alarm chain with focus on:

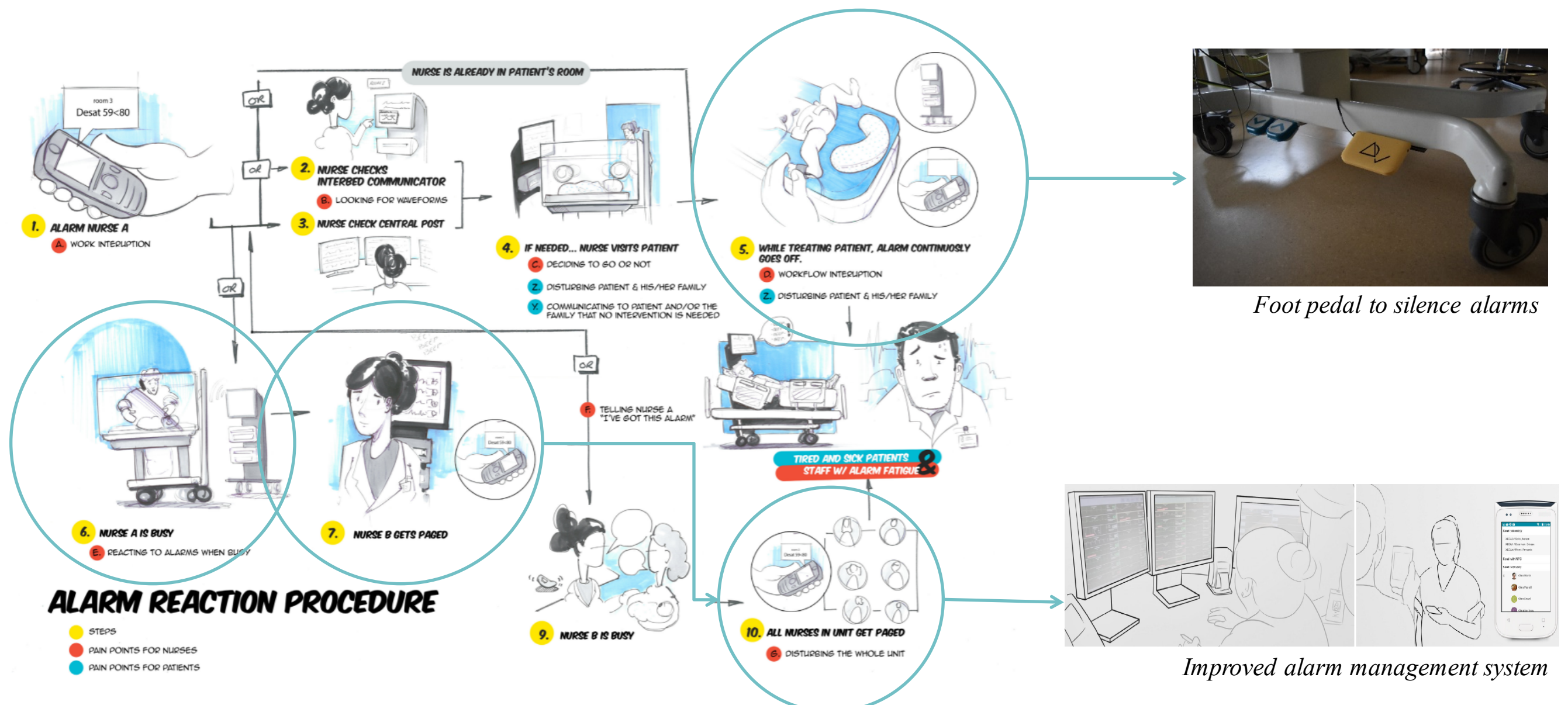
1. Reducing the sound and number of alarms;
2. Increasing alarm safety.

Results:

Technical failure and alarm fatigue pose the biggest risks in alarm handling. The most critical pain points (Figure) are the workflow-interruption that alarms cause, waveforms not being visible in every location and smart decision support is missing.

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.
2. Since many alarms are generated when giving patient care, a **foot pedal** was developed to silence these 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), the risks were assessed and 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. 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 delays are prevented. In addition, nurses consider the additional waveform information useful to determine how to handle an alarm. The risk analysis showed reduction of risks. In addition, it will allow implementation of sound reduction (next phase).
2. Introducing a foot pedal to silence alarms that are generated while taking care of the patient is considered helpful. Nurses found the product 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 user study on the current alarm chain, possible improvements to the alarm handling have been identified and several concepts have been tested. Apart from quick wins in the current alarm flow, 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