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## How safe is our nurse call system?

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### Abstract

System Theoretic Process Analysis (STPA) is a hazard or risk analysis method based on systems thinking, with a top down approach. It focuses the attention on problems that may end up as accidents. We used STPA to assess the hazards of our nurse call system. The analysis resulted in 37 unique safety constraints. For safety to emerge, each of the 37 safety constraints should be enforced. To our judgment eight (22%) of these are consistently applied. The other 29 (78%) are not, or in some cases cannot be enforced.

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### 1. Introduction

This story started when one of our elderly surgical patients became anxious because of an increasing chest pain and tried to call the nurse with the nurse call system. Minutes went by and the chest pain got worse. For quite a while nobody came. The event was reported and the analysis showed there was something wrong with the connector in the unit attached to the wall. The nurse who analyzed the event was aware that there were more reported incidents related to the nurse call system as well as a very high turnover of the patient handsets. So, she started questioning the safety of the nurse call system. To get a better understanding of the safety issues at hand, the director of medical care commissioned a risk analysis.

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## 2. Method

When assessing the safety of a system like the nurse call system, one has several risk analysis methods to choose from. The Dutch hospitals have chosen for the Health Failure Mode and Effect Analysis (HFMEA) as preferred method for risk analyses [1]. The HFMEA is a method developed by the Veteran Affairs National Center for Patient Safety, which is now widely used in healthcare. This is a process-oriented approach, based on a multi-disciplinary brainstorm technique. Like most risk analysis methods, it starts by describing the steps of a process, followed by imagining what could go wrong with each of these steps by means of multidisciplinary brainstorm sessions. It ends by evaluating the level of risk and either;

- 1) accepting the situation as is, or
- 2) designing a better solution, or
- 3) introducing additional safety barriers.

The analysis is focused on failures and based on the idea that improving reliability and redundancy enhances safety. The analysis is loosely structured by following the steps of the process. It usually takes several sessions with a multidisciplinary team of clinicians to complete the analysis.

The HFMEA is based on a couple of assumptions:

1. Up to a certain degree of risks can be successfully treated (this is generic for any risk analysis);
2. The description of the process is a complete and correct representation of the process in practice.
3. An analysis of the separate steps results in an adequate image of the safety of the entire process;
4. Members of the multidisciplinary team performing the analysis have enough knowledge and experience to be able to comprehensively identify the process risks;

It is questionable whether the assumptions the HFMEA is based on, are valid when analyzing the nurse call system. Processes within the domain of human interactions are often characterized by a lot of variation and fuzziness. The order is not so predefined and linear as the process description suggests. The missing elements in the process description might result in missed risks. Furthermore, the nurse call system is made complex by using a computerized communication system. Instead of a linear process, the nurse call system has the characteristics of a control loop. The system is operated by the patient, who uses it to arrange for help when experiencing a need. When so, he presses the button of the nurse call handset. The computerized nurse call system then sends out a signal to the beeper of the nurse. The signal is displayed on the beeper with the patient's room and bed number. The nurse goes to the patient, resets the system and starts providing the requested help.

We have chosen STPA to perform the risk analysis because it fits the system to be analyzed better than any other known method. Leveson claims that STPA is superior over conventional techniques like HFMEA in that it identifies more causal factors and hazardous scenarios, particularly those related to software, system design and human behavior, provides more support in doing the analysis than most other techniques [2]. STPA can be used prospectively on technical and organizational systems.

The STPA method is based on systems theory and the idea, that safety is an emerging property of a system that is well controlled by safety constraints. Because of this, its primary focus is on control flaws and not on failure modes or faults. The analysis starts at system level, addressing the system as a whole.

The STPA method consists of three steps (table 1).

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