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sWafety: A Complementary Low-Threshold Safety Management Process

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ABSTRACT

Established safety management systems (SMS) often have limitations, such as low participation rates or data bias due to influencing factors. In collaboration with Swiss companies from safety critical industries, sWafety was developed to address these shortcomings. It provides a low-threshold process design and app that aim to further engage and motivate employees to participate in data collection, analysis, and feedback. This paper describes an initial use case of the process and app in a Swiss hospital. The findings of an evaluation workshop and a qualitative content analysis imply that concisely worded questions, timely, work-related feedback, and elements that trigger learning or reflection seem to be particularly motivating. However, participants called for a more active role in discussing the results obtained and developing safety measures. Finally, the potential of sWafety can be enhanced through technical developments that focus on flexible interaction using the app and accelerated data analysis.

Keywords: Safety management, Safety process, Reporting systems, App-based continuous measurement, Employee involvement, User-centered design

INTRODUCTION

Effective safety management requires reliable information. However, information provided by current safety management systems (SMS), or safety surveys is often limited because of low participation rates or data being biased (Pfeiffer, Manser and Wehner, 2010; Sujan, 2015). To address these shortcomings, partners from industry and academia cooperated closely in the sWafety project to develop a digitally supported process, which complements current SMS. Mainly two objectives were pursued: (i) Negative influences of situational factors on data quality should be kept as low as possible. Therefore, sWafety offers the possibility to ask employees a few questions every day, which they can answer within seconds. Through this continuous involvement of employees, the sWafety process allows for a longitudinal data collection which is more robust against random situational factors. (ii) Motivation to participate should be kept as high as possible. Hence, sWafety is designed as a low-threshold process, which relies on process elements that meet psychological needs (Peters, Calvo and Ryan, 2018), like giving task-related

feedback (Kluger and DeNisi, 1996) or promoting a sense of competence (Deci and Ryan, 2012). Increasing employee participation through the deliberate integration of such elements is critical to promote learning (Lukic et al., 2013) and improve safety at the workplace as employees have significant explicit and tacit safety-related knowledge (Pedler, 2002). Consequently, sWafety involves employees in data collection, interpretation, and feedback, which has a positive impact on behavior and attitude (Mayo, 2003; Leana, Ahlbrandt and Murell, 1992).

After a brief overview of the sWafety process concept, this paper presents a pilot study that was carried out to learn how the concept can be transferred into practice, how it is evaluated by participants, and what the implications are for its further development.

THE DIGITALLY SUPPORTED SWAFETY PROCESS DESIGN

Applying a human-centered design approach (Norman, 2013) and integrating insights from motivation theory (Deci and Ryan, 2012) and gamification (Zagel and Bodendorf, 2014), a low-threshold process design, and an app prototype for implementing sWafety in organizations were developed.

The sWafety process is designed as a circular structure that ensures closed-loop feedback, which is important for maintaining participation (Sujan, 2015). It comprises five process loops that involve different stakeholders in various stages of safety management (see Table 1). In this study, mainly process loop 2 "data collection and immediate feedback" was tested and evaluated (see below for details).

The sWafety app enables continuous data collection regardless of time and place, and provides immediate feedback to participants. Data collection and feedback presentation are supported by an editable format of questions, selectable responses, and various feedback formats. The latter take into account that feedback is most motivating when it reacts to a specific input or offers learning opportunities (Kluger and DeNisi, 1996), e.g., by providing cues to improve safety. As it is not always possible to provide immediate, content-related feedback, gamification elements such as quizzes can be used and combined with tasks or questions (Tolks et al., 2020). To further support

Table 1. Overview of the five sWafety process loops.

sWafety process	Description
Identification of safety indicators	Definition, operationalisation, and validation of safety indicators
Data collection and immediate feedback	Continuous, short-cycled assessment of safety indicators, followed by instant feedback
Feedback and identifications of areas for improvement	Presentation of detailed results followed by an assessment of where action is needed
Development and mutual coordination of safety measures	Development of specific safety measures and implication
Evaluation of safety measures	Systematic evaluation of the effectiveness of the safety measures implemented

employee participation, the app also provides the possibility for participants to submit comments or notices.

PILOT AND CONCEPT EVALUATION

Since sWafety is a generic process concept, it needs to be adaptable to the specific contexts and safety objectives. We piloted an initial use case in a Swiss hospital to evaluate to what extent the concept is transferable into practice, how the process elements for low threshold are perceived by participants, and which implications can be derived for further improvement of sWafety.

Application Scenario

Together with a subject-matter expert, an application scenario for the work environment of anesthesia was developed, which considered sWafety elements for low-threshold design, participant involvement, and continuous data collection. These are described below.

Transfer Into Practice

The process of data collection and immediate feedback was adapted to anesthesia staff working in an operating room as follows: During an eight-day period seven anesthesia physicians and nurses answered the same 12 questions about patient safety at the end of their shifts. These questions referred to safety indicators such as *availability of resources*, *adaptability*, *team support*, *self-confidence*, and *subjective wellbeing* and were selected, and adapted in wording and content to the specific context. An example of these questions is "Today's circumstances require to violate my personal safety principles". Answers could be given on a 7-point Likert scale. Since the focus was on piloting sWafety, the psychometric quality of the questions was not examined. Finally, data was extracted from the sWafety database and transferred to SPSS for data analysis.

For immediate feedback, various elements supported by the app were selected. Every day, alternate feedback was provided, either instantly after the participants had responded to a particular question or after they had answered all questions. At irregular intervals, questions were followed by a comment field where participants could provide additional information or observations. The questions were randomized for daily presentation.

Implemented Low-Threshold Design

To support sustained participation during the pilot, the questions were short and concisely formulated. Also, only one question at the time was presented. As the app did not yet provide the ability to present immediate results (e.g., means, trends) related to specific questions, immediate feedback was designed using elements of gamification. These were namely reference tags on participation rates (see Figure 1, No. 1), informative posts on *speaking up for safety* or similar error prevention practices (see Figure 1, No. 2), and text or images expressing appreciation (see Figure 1, No. 3). The random arrangement of the questions and the alternating presentation of immediate feedback in terms of content and timing created variety for participants, even though the same questions were asked every day.

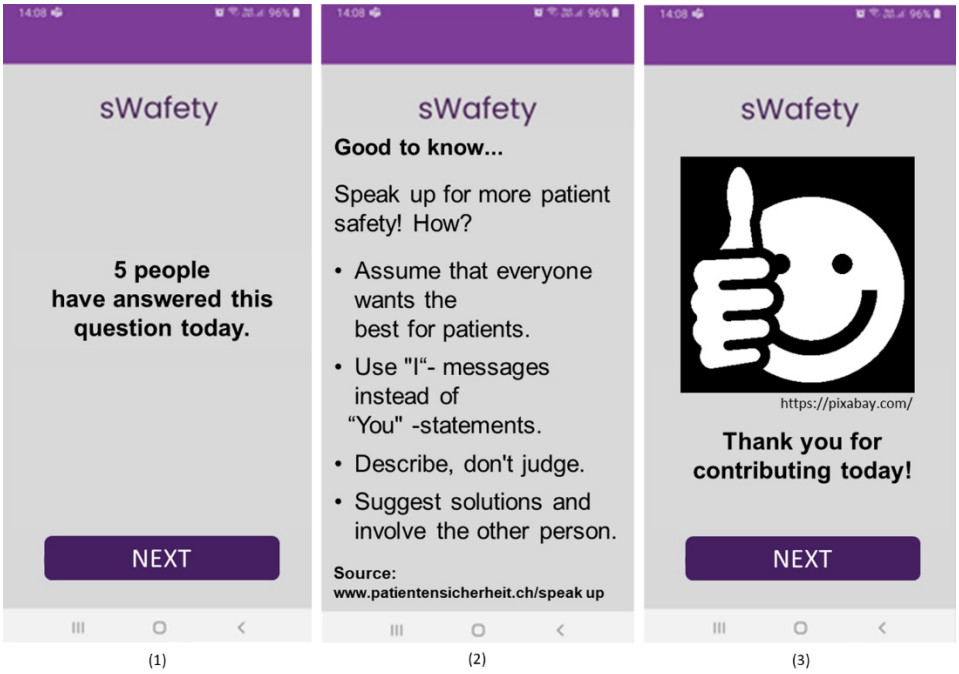

Figure 1: Examples of instant app-based feedback used in pilot (adapted from sWafety app).

Implemented Involvement Channels

In order to involve the participants even more in the process, for some questions the participants were not given direct feedback but the possibility to enter information in the form of an open text. The opportunities for participants to engage differed in their purpose. It was specified whether the participants had the option to provide additional information on a specific question ("Did you notice anything special today related to this question (positive, negative, neutral)?") or the option to give their perception of patient safety in general ("Did you observe anything else you'd like to share about today's patient safety (positive, negative, neutral)?"). To further increase participants' involvement, they received detailed feedback on the assessed aspects of patient safety at the end of the pilot when the findings were discussed in a facilitated workshop.

Continuous Data Collection

To simulate continuous data collection through the app during the relatively short pilot, participants were asked the same 12 questions every day. This was to test the functionality of sWafety to collect time series data, which serves to account for daily contextual factors as well as to identify changes or trends over time.

FORMATIVE PROCESS EVALUATION

The sWafety pilot was evaluated in a workshop with some participants ($n = 5$). The aim was to evaluate the extent to which the core concepts of

sWafety are transferable to practice, how implemented sWafety process elements are perceived and what implications derive for further improvement. Group discussions along the starfish-retrospective (e.g., Rice-Khouri and Yerbury, 2015) focused on questions related to defined evaluation criteria as described below:

- *Transfer:* Successfully implemented elements for continuous data collection, feedback, and involvement as well as the perceived integration into practice.
- *Low-threshold design:* Perception of implemented elements, participation rate, and subjective motivation to participate.
- *Involvement*: Noticed opportunities for participation (commentary functions to provide additional information), actual use of opportunities, perceived adequacy.
- *Continuous data collection:* Subjective judgments, perceived adequacy.

A brief quantitative survey including items from the Intrinsic Motivation Inventory (Ostrow and Heffernan, 2018) was used to assess motivation for integrating sWafety into daily work routines. The workshop results were transferred into MAXQDA for qualitative content analysis (Rädiker and Kuckartz, 2019) following the evaluation criteria.

RESULTS

The formative evaluation showed that the prototypical elements of low-threshold process design and continuous data collection can be transferred to organizational practice. In general, participants accepted using the app on their smartphone. Potential was seen especially in the stimulation of reflection and the support of learning (e.g., due to the content of questions) as well as for providing an information basis for safety initiatives. Based on subjective assessments, information was obtained on the potential of the prototypical low-threshold elements to promote motivation for participation in ongoing data collection processes.

Transfer Into Practice

The application scenario with a randomized presentation of questions and immediate, app-based feedback was implemented as planned and ran stably, with no major technical problems. It was only reported that an accidental logout or an interruption of the answering process blocked any further participation and thus the answering of all questions. Nevertheless, participants found it quite easy to integrate sWafety into their daily workflow.

Low-Threshold Design

Most participants took about five minutes per day to answer all safety questions, which was considered reasonable. However, participants missed variety in the questions and suggested fewer questions (e.g., 1 to 2 per day) for the benefit of more focus and precision. They also pointed out that a clear relation of the content (question items, tasks, information, feedback) to their work is essential for motivation. However, a decline in daily participation

rate was observed. Shift work could be a possible explanation for this. Participants also reported forgetting to report observations or events when this did not happen immediately (e.g., when they didn't have their smartphone with them). Thus, it was emphasized that allowing more flexible data entry as close as possible to a happening would lower thresholds. Questions or informative feedback that prompted reflection (e.g., "Are there guidelines for this situation?") or learning were rated as particularly motivating. However, participants missed transparency about data processing (e.g., purpose of the survey, participation activity) or specific outcomes (e.g., lessons learned resulting from sWafety). Such transparency would foster motivation to continuously provide safety-related data. On the other hand, the evaluation showed that instant feedback using generic images (e.g., to express appreciation, comics for a positive user experience) should be avoided. Most participants perceived no benefit in these elements, as they offered no informational value. Participants particularly discouraged the use of humor as a gamification feature because it is perceived as devaluing their work. There was general agreement that gamification elements should be used judiciously so as not to distract from the actual purpose of sWafety as a professional safety tool.

Involvement

In general, the elements for involvement (opportunity to submit input) were positively evaluated. Participants requested more such options, especially for communicating observations and suggestions for improvement. However, usability needs to be improved. This is also reflected by the fact that opportunities for involvement were noticed by participants but only sporadically used. Furthermore, participants wish to be more involved in interpreting data, evaluating results, and developing safety measures. Physical settings that allow for face-to-face discussion were mentioned as appropriate methods for this purpose.

Continuous Data Collection

It was possible to collect continuous data on patient safety. Although data analysis was limited to descriptive methods (frequency, mean) because of the small sample size and short application period. Even though there is need for further technical improvement, as the configuration of the app and the data analysis still require considerable effort, it can be assumed, that the sWafety process provides meaningful data, which supports appropriate methodological requirements.

CONCLUSION

The sWafety pilot showed, that the generic sWafety process is adaptable to the specifics of organizations. Concise questions and feedback with reference to work contexts and target groups support participation. Feedback has high potential to increase motivation to participate. Therefore, companies should implement feedback into their communication. Immediate app-based

feedback seems to be effective if it triggers reflection and learning, while providing transparency of the sWafety process itself (e.g., aim of assessment, data processing status, resulting consequences) further increases motivation. Gamification, on the other hand, should be used sparingly. Furthermore, employees wish to be involved in discussing results of assessments and developing safety measures. Settings such as workshops or focus groups should be established, since the need for face to face exchange is emphasized. For involving employees via the app, appropriate formats must be designed. Technical improvements must focus on enabling more flexible data collection and interaction regardless of time and place, as well as efficient data analysis to shorten feedback loops. Nevertheless, the results imply that the sWafety concept for low-threshold involvement and continuous data collection is adaptable to the conditions of professional practice and provides a sound basis for improving established SMS.

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