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Online Usability Tool - First Experiences from Testing a Ventilator Interface

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Abstract. Usability tests of medical devices are mainly conducted on-site, but remote tests can also be suitable for quick feedback. Using the online survey tool SoSci Survey and videos of a ventilator interface prototype, a usability test environment was developed which allows participation independent of time and place.

Keywords. Usability Testing; Medical Device; Online Test Environment

1. Introduction

Human-machine interaction is a safety-critical aspect in the use of medical devices such as ventilators. Continuous data and different types of alarms are to be presented in a comprehensible way. Since medical decisions are made on the content presented, an early analysis of the graphic concepts is essential and required by regulation. Usability tests with users are a suitable method for testing medical devices and providing information on safety and hazards during use (1,2). Due to the Covid-19 pandemic, but also for fast, iterative feedback, remote synchronous or asynchronous tests have become more important to evaluate medical devices (3).

In order to be able to guarantee adequate usability, suitable tools must be available for implementing remote tests. Since the devices or prototypes to be tested are not provided on-site, they must be made available to the user via another modality (e.g. simulation or video). The aim of this work is the development of such an online usability test environment for the implementation of asynchronous remote tests using the example of a ventilator interface.

2. Methods

An enhanced UI-design of highlighting “air trapping”, a pathological mechanism of trapping too much air in the lung, in a ventilator interface was developed. This prototype requires a continuous data stream of ventilatory data depending on patient status and ventilator setting for a realistic presentation. This representation does not exist separately from the ventilator device. Therefore, we have included a simulated prototype as a video in a usability testing environment.

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As usability test environment, the open source web application SoSci Survey (https://www.soscisurvey.de/) was used. The functional scope of SoSci Survey includes qualitative and quantitative question types to measure usability and identify potential comprehension problems in human-machine interaction. It is also a comprehensive tool for planning, conducting and evaluating online surveys with a high level of data privacy.

3. Results

The comprehensibility of the representation of different alarm messages as well as highlighting is to be evaluated. Sosci Survey was configured and extended to implement a cross-over study design. Through the randomised presentation of different interfaces, dedicated usability tasks could be tested. An evaluation of the efficiency was not clearly measurable due to interfering factors, e.g. brief interruption of the task. To evaluate the effectiveness, the test persons were asked to write down the recognised ventilation problem. Following the test tasks, the participants' satisfaction with the device interface was assessed by means of open and closed questions (Likert scale). The developed usability test was performed unsupervised online by doctors experienced in ventilating patients. To obtain a first impression regarding the applicability of the tool for usability testing, the users are asked questions about the suitability and comprehensibility of the tool and tool-specific anomalies in the collected data are analysed.

4. Discussion und Conclusion

The online survey tool SoSci Survey was extended to conduct a remote usability test using a prototype of a ventilator interface. The tool allows the integration of classic usability test content to a limited extent. The prototype must be available in a suitable format, which can be integrated via the methods provided. The prototype developed in advance could only be integrated as recorded videos. However, this was sufficient for evaluating the comprehensibility of the displayed content. The flexibility of the test person in terms of time and place goes hand in hand with restrictions in the design of the test. Functionalities of on-site tests such as interaction within a realistic context of use and detailed questions to clarify specific aspects are not possible. Due to these limitations, on-site tests with users cannot be replaced for the described use case. Nevertheless, this form of testing can provide initial results for rapid further development (2,4). The low response rate shows that intensive work is still required in the recruitment of test persons.

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