

Medical Device Safety Training by Using Quick Response Codes and Extended Reality-Based Technologies

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Abstract. This article describes the results of three different study settings where the use of QR codes and XR technologies were tested for medical device training among 132 social and health care professionals. Data from three types of learning events and different contents of training indicated that the professionals considered these novel technologies both beneficial for learning and useful in their working environments for training safe use of medical devices. Based on the collected data, these technologies can be considered prospective options for medical device training.

Keywords. XR technologies, QR code, medical device, training, social and health care, patient safety

1. Introduction

Safe and competent use of medical devices in patient care is of paramount importance to both the patient and the medical staff [1, 2]. Despite an obvious need for training and orientation to improve medical device safety, there are major challenges how to acquire and provide sufficient education [3].

Quick Response (QR) codes are already in use in social and health care in some tasks and their use is increasing. In healthcare education, there are different kinds of learning settings, one of which is for just-in-time learning (need-related training to be readily available exactly when and how it is needed by the learner). According to the literature, the perceptions towards the use of QR codes were generally positive. [4.]

Extended reality (XR technologies; including both Augmented reality (AR) and virtual reality (VR)) based technologies are novel ways of teaching and training.

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Immersive experiences may foster the teaching and learning of complex medical content. XR technologies including a headset or glasses are versatile, low-price, and mobile, and make learning content more accessible and engaging. XR technologies broaden educational impact beyond the classroom and face-to-face teaching and enable a repeated practice to learn complex medical content without adverse effects on the patient. Moreover, disruptive technologies can also prepare medical learners for a highly technologically advanced workplace. [5, 6.]

An EU-funded project (Virtual Platform for Medical Device Training) was initiated in 2021. This project aimed to produce a virtual learning platform solution that certifies and develops health technology and medical device expertise. Some results from this project have been reported previously [7-9].

2. Methods

Three types of learning events of different contents were organized. The aim of these learning events was to provide examples of how QR code, XR technologies, and gamification can be used in training medical devices and to gather information from social and health care professionals on opportunities and potential challenges of these technologies. The tested medical devices were a patient monitor, blood pressure meter, transport respirator, patient lift, wound care product, and PCA pump. Research data were collected from volunteers through questionnaires. Questionnaires consisted of structured and open-ended questions. The study protocols were approved by the participating organizations according to their IRB processes.

Descriptive statistics were analyzed by using the Excel program. The qualitative analysis was carried out with the help of content analysis, utilizing data categorization. In the analysis, there were both inductive and deductive phases. After data transcription, the data were reduced into essential contents, then inductively coded using an interpretive approach, searching for recurrent themes and naming them.

The first setting of learning events tested QR codes as a method for information search on medical devices. Medical device distributors provided educational material approved by the manufacturers. The material was attached to QR codes. Participants consisted of 7 medical doctors, 28 nurses, and 5 other professionals. They were asked to scan the QR codes with their mobile phones. Participants looked through the materials and answered a questionnaire about QR codes as an aid in information search. These events were arranged in the regions of Southwest Finland and Ostrobothnia in May 2022.

The second setting of learning events tested augmented reality (AR). Participants consisted of 5 medical doctors, 11 nurses, and 8 other professionals. They were offered the opportunity to try out AR headsets, and education was given on how AR could be used in medical device training. The participants answered a questionnaire about the usability of AR in medical device training. These events were arranged in the regions of Pirkanmaa, Southwest Finland, and Ostrobothnia in November 2022.

The third setting of the learning events was about XR technologies and gamification. Participants consisted of 6 medical doctors, 35 nurses, and 27 other professionals. They were offered the opportunity to try out AR headsets, virtual reality (VR) headsets, and gamification on a computer. The educational material shown on the medical devices was prepared together with the distributors and approved by the manufacturers. The participants answered a questionnaire about the usability of AR, VR, and gamification

in medical device training. These events were arranged in the regions of Pirkanmaa, Southwest Finland, and Ostrobothnia in March 2023.

3. Results

Forty professionals took part in the QR learning event. Of them, 31 had not used QR codes before in their work. After testing the QR codes, 36 of the participants (90 %) totally agreed or agreed that QR codes are an easy way to search for information. Most of the participants totally agreed or agreed that QR codes are suitable for ensuring medical device competence in their work environments. The participants thought it would be useful if QR codes would contain videos about how to use a device (36 times), a quick manual (34 times), a manual (20 times), and recordings of how to use a device (7 times).

Twenty-four professionals took part in the AR experiment. None of them had used AR technology previously in their work. Twenty of them totally or partly agreed that AR technology supports medical device learning. Of the participants, 23 (96 %) totally or partly agreed that AR technology is suitable for use in their work environment. Participants were asked to explain the circumstances in which they would use AR technology in their work. General training, teaching, and orientation were mentioned, which included also simulations. Training, orientation, and guidance related to both new, old, and rarely used medical devices, as well as maintenance of skills were seen as possible targets for the utilization of AR technology. In addition, general knowledge of operating environments and work was seen to be feasible through the use of AR technology.

Sixty-eight professionals took part in the XR technology experiment. This experiment was held in March, and the analysis is ongoing. The atmosphere of the events was positive towards the use of technology. XR technologies and gamification were seen as being in place in training the use of medical devices. Challenges were also raised, for example, regarding the responsibilities of the production of materials and matters related to the procurement of technologies.

4. Discussion and Conclusion

In three different study settings of learning the use of QR codes or XR technologies for the safe use of medical devices, the participants had an opportunity to try new technologies and expand their knowledge. In the tested learning settings, the participants considered QR and XR technologies suitable and helpful for medical device learning. These technologies allowed professionals to learn more and practice their skills in medical devices regardless of time and place.

The field of social and health care services is challenging and complex, and it is, therefore, necessary to think carefully about how to bring new medical devices and learning methods to social and health care. Resources such as time and money also play an important role in these situations. How to train the entire staff in a high-quality and efficient way?

The manufacturing and use of medical devices are highly regulated. The legislation must be taken into account. For training the health care workers, it is essential to

cooperate with the device manufacturers. Both manufacturers and professionals benefit from new technologies in medical device training.

QR codes are used by some manufacturers, and during this project, one distributor started using them. This study has provided knowledge about what kind of educational information social and health care professionals want to find behind the QR code in connection with the use of medical devices.

QR and XR technologies are useful in medical device training. By using these novel technologies, it is feasible to provide uniform and consistent knowledge and education about medical devices to all professionals. Improving competence reduces risks for medical device incidents and increases patient safety as well as employees' self-confidence and well-being at work.

Nevertheless, there might be difficulties in the introduction of these technologies because they are not yet widely known in social and health care. Furthermore, the costs of XR technologies (headsets, material production, and the accumulation of technological competence) could be an obstacle to wider use.

In summary of findings from all three learning events, the social and health care professionals who took part in the events found these technologies - the use of QR code, XR technologies, and gamification - beneficial for the learning of medical devices.

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