

Systemic consequences of an augmented reality mobile paediatric code cart application

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THE WORK IN CONTEXT

Paediatric code carts (crash trolleys) contain equipment, tools and medication required quickly to resuscitate a child. Infrequent use of carts, as paediatric resuscitations are relatively rare, and logistical issues preventing access to stocked carts combine to decrease familiarity with cart contents, delay resuscitation efforts and potentially harm patients. A team of engineers, clinicians and educators developed an augmented reality application for smartphones to increase access to carts and familiarise clinicians with cart contents. Introducing a new technology into a sociotechnical system can have far reaching consequences in both expected and unexpected ways. Using focus groups as part of a larger evaluation project, physicians, physicians-in-training, nurses and nurse educators identified those consequences after using the application. The identified consequences included increasing access to carts, improving familiarity with cart contents, using the application as a clinical study guide, motivating learning, supporting stocking code carts, facilitating accreditation and certification, using the application to locate items during real resuscitations and not double-checking items before use during a real resuscitation. This project will inform the redesign of the application in light of those consequences and the development of the implementation strategy. Broadly, this project exposes clinicians, educators and engineers to principles of sociotechnical system design and influences the development of future educational technologies.

KEYWORDS

Sociotechnical systems, paediatric resuscitation, healthcare education

A brief outline of the work carried out

The combination of infrequent use and limited access to paediatric code carts (crash trolleys), can lead to lack of familiarity with contents, delaying resuscitations and leading to patient harm. Engineers, clinicians and educators developed an augmented reality (AR) mobile application to increase access to carts and familiarise clinicians with paediatric code cart contents (download at <https://jumpsimulation.org/education/applications/code-cart-ar>), but this technology could also have unintended consequences. The objective of this study is to explore the consequences anticipated by users of the AR mobile application following use of the application.

This study is part of a larger project evaluating the efficacy and usability of the AR application with multiple methods at a large academic medical centre in the midwest of the United States. Institutional review board approval was obtained from the institutional review board at the University of Illinois at Urbana-Champaign and the Peoria institutional review board.

We conducted focus groups with six physicians, two physicians-in-training, two nurses, and four nurse educators at the academic medical centre and eight nurses at regional hospitals to gain an in-depth understanding of their experience using the application, the perceived impact of the application, and how to incorporate the application formally in the learning system of the healthcare organisation (focus group guide available at <https://hfss.ise.illinois.edu/files/2019/12/Focus-group-guide.pdf>; average duration = 40 minutes). Two researchers conducted the focus groups, which were audio recorded and transcribed by a professional transcription service. We checked the transcripts for accuracy and removed identifying information before conducting an inductive thematic content analysis to identify expected consequences of the AR application.

Findings/solutions (the outcome)

As expected, the application successfully increased access to the code carts and increased familiarity with cart contents. The application addressed challenges associated with access to the real-life carts, such as availability and processes associated with opening carts. The application helped users know where items were located and what items looked like.

We identified six unintended consequences – positive and negative – of the application. The application could serve as a study guide for physicians-in-training before rotations on paediatric wards. Gamification incorporated in the design of the application (for example leader boards, tracking time to complete, etc.), could motivate learning. The application also could support the work of stocking the real code carts. The application could help demonstrate commitment to quality and learning during accreditation and certification assessments. The application could be used to locate items during real paediatric resuscitations. Finally, the application could lead to overconfidence in the location of medications or equipment, resulting in not double-checking items before use during real paediatric resuscitations.

Impact

This project could have a far-reaching impact on the development of alternative, technology-mediated education in health care. A large body of research has demonstrated that introducing technology can result in intended and unintended consequences in complex sociotechnical systems, for example increasing errors and requiring workarounds. This study shows, unsurprisingly for human factors professionals, that an educational AR technology will impact users (and possibly patients) in intended and unintended ways. The results of the larger project will inform the redesign of the application. The findings will also inform the development of an implementation strategy to integrate the redesigned application in the healthcare system as well as a future, multi-site evaluation.