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Research paper

Evaluation of a visual tool co-developed for training hospital staff on the prevention and control of the spread of healthcare associated infections

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Received 15 March 2017; received in revised form 19 May 2017; accepted 4 June 2017

KEYWORDS

Hospitals;
Training;
Healthcare
associated infections;
Staff training;
Visual tool

Abstract *Background:* Staff training in infection prevention and control (IPC) across hospital settings has a crucial role in reducing the incidence of healthcare associated infections (HAIs). However the application of dynamic visualisation approaches in this context is under-developed, with very few in-depth evaluation studies of related processes and impacts.

Methods: A prototype training tablet app for hospital staff, using interactive visuals was developed and evaluated. To demonstrate different pathogen behaviour, dynamic visualisations of norovirus, *Clostridium difficile*, and MRSA were developed in relation to location, survival and transmission within a virtual hospital ward model using evidence-based microbiological and staff behavioural data. A three-stage evaluation process was designed, involving a mixed sample of UK National Health Service staff (doctors, nurses and domestic staff, n = 150).

Results: Participants reported improved awareness and understanding of the pathogens responsible for HAI, the types of information relevant for different staff cohorts, those aspects of the visualisations which worked well and those which were prone to cause misunderstandings, and suggestions for further development and improvement. The tool appeared to offer staff a new perspective on pathogens, being able to 'see' them contextualised in the virtual ward, making them seem more real.

Conclusion: Results showed the benefits of a detailed co-development process and a more contextualised understanding of the potential for visual apps to be used in IPC training.

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<http://dx.doi.org/10.1016/j.idh.2017.06.002>

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Highlights

- Staff training has a crucial role in reducing the incidence of healthcare associated infections (HAIs).
- The study adds value by examining the impacts achieved using dynamic visualisation approaches within a training package.
- Development benefitted from involving end users, highlighting related trade-offs and tensions for designers in this field.
- Greater contextualised understanding and awareness of different pathogens, location, spread and transmission were reported.
- Potential for further development of visual apps and in-depth studies of what works and why is highlighted.

Introduction

Antimicrobial resistance (AMR) is recognised as one of the most important global issues for human and animal health due to the increasing numbers of resistant infections leading to many existing antimicrobials becoming less effective [1,2]. Appropriate infection prevention and control (IPC) measures across hospital settings have a crucial role in mitigating the consequences of AMR and reducing the incidence of healthcare associated infections (HAIs) [3]. Within this ambit, effective, meaningful and appropriate education and training are essential.

The hospital setting can be described as a complex service ecosystem with three categories of principal interacting actors: pathogens; the environment or setting; and, not least, people. A key challenge is to find a means of training staff which: (i) raises contextualised awareness and understanding about the invisible pathogens that cause HAIs (ii) explains how the spread of pathogens and HAIs can be prevented and controlled in the hospital environment through IPC procedures, and (iii) is effective within and across different job roles. Gauging the extent to which this challenge is being successfully met within and across different countries is difficult. Educational programmes vary widely in aims, content, form and scope, as do evaluations of their effectiveness [4]. Moreover inter-country variation in contextual and structural factors [5] also complicates comparisons.

However, drawing on our experience of reviewing a number of educational packages, and descriptions and evaluations of such programmes in relevant academic literature, it is possible to offer brief observations on the above three components. Taking the role issue first, there appears to be a spectrum of practice with some tension between meeting job-specific needs (e.g. Ref. [6]) and meeting the needs of whole service communities (e.g. Ref. [7]). The challenge of educating on IPC procedures has seen more accord, with Standardised Infection Control Precautions such as the chain of infection, hand hygiene, use of personal protective equipment, and maintenance of a clean healthcare environment forming the core content of many programmes (e.g. Ref. [8]). Arguably, achieving understanding about relevant pathogens in a way that is contextualised to practice is the component that has received least attention in education and training. Part of

the issue here is the invisibility of pathogens under normal circumstances and Prieto [9] highlights the related “need to find more creative ways to visualise micro-organisms and demonstrate risk”.

The present paper engages with all three components of the challenge outlined above by presenting an evaluation of a prototype interactive tablet-based tool using visualisation techniques developed for in-service IPC training for hospital staff. The focus on visualisation is supported by a growing evidence-base that creative visual-based interventions can be a powerful medium for influencing behaviour within healthcare [10]. Within IPC there seems much scope for development using more engaging and visually dynamic approaches that harness staff expertise, new data and information technology. Indeed in a recent survey of Australia’s infection prevention and control professionals, on-line learning packages and enhanced IT emerged as the two top priorities for additional resource [11].

The study described here took a participatory co-development approach [12] involving healthcare staff, while exploiting the researchers’ expertise in visualisation techniques, to raise awareness and understanding of how the interplay between pathogens, people and settings contribute to the incidence of HAIs. This was informed by the authors’ earlier work which explored the extent to which healthcare staff actively envisage pathogens in “the mind’s eye” [13] and which developed related prototype computer generated visualisations that aimed to help visualise the invisible. One of the recommendations from this work was that “*further development of the concept prototypes for staff training would be beneficial if the visualisations could be augmented with specific training information and scenarios centred around the prevention of HAIs.*” Given the proliferation in the availability and use of tablet computers in recent years, it was reasoned that these provided a promising medium for an interactive training tool.

Methods

Design

A three-stage process was designed, involving staff from two NHS Scotland boards over a 12-month period. This

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