

Service ecology: design issues for hospital infection prevention and control training

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Abstract

Training in appropriate infection prevention and control (IPC) measures is crucial in minimising the incidence of hospital-associated infections (HAIs), a growing cause of patient illness and death in hospital. This paper describes the co-development of visualisation tools intended to form part of a digital tablet-based training package for hospital-based staff across a number of roles. It argues that, in a typically hierarchical organisation, taking a cross-cohort approach to developing tools to raise awareness and understanding of IPC and HAIs recognises the complex service ecology of behaviours, relationships, the environment and the organization, and introduces a democratic, open innovation approach to developing IPC training materials.

KEYWORDS: infection prevention and control, in-service training, visualisation tools

Introduction

Staff training is an essential aspect of the development of competence and safe practice in the UK's National Health Service (NHS). One crucial area of training for staff across the hospital setting is in infection prevention and control (IPC) to reduce the incidence of hospital associated infections (HAIs). This is a particularly pertinent issue given the rise in antimicrobial resistance (AMR) 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. This is accompanied by a lack of significant commercial innovation in antimicrobials. While the development of new antimicrobials is an urgent priority, it requires substantial investment and a long-term strategy. The authors describe a complementary approach to tackling HAI through IPC, one which can be progressed and implemented in the shorter term, concerned with the development of visual tools for in-service IPC training for hospital staff.

Current approaches to IPC training

Current staff training practice for IPC varies across NHS boards and regions in the UK. For instance, in one Scottish region staff receive, as part of their induction package, a mandatory annual hand hygiene e-learning course and a three yearly mandatory Standard Infection Control Precautions (SICPs) e-learning course - supported by a workplace content management system (WCMS), and then receive further sessions as and when required. Staff are also directed to online courses supplied by NHS Education for Scotland (NES), such as the Scottish Cleanliness Champions programme which has been influential in advocating an 'all-workforce' approach to educating for good IPC practice (West et al., 2006; Macduff et al., 2009). These online courses represent the national standard. The content of the WCMS modules is essentially text-based information supplemented by visual diagrams and photos, occasionally inviting some interaction. The issue here for the user is how one is guided or elects to navigate through the considerable content. For the health board one issue is in determining the link between the content, an effective means of awareness-raising and learning, and a desired outcome, in this case a reduction in HAIs. Another approach to ICP training is in the form of digital tablet-based training packages. One of the UK's largest suppliers of hospital cleaning products, including wipes and disinfectants containing biocides, provides these to approximately 200 UK hospitals. These include training videos demonstrating evidence-based procedures of how to clean, e.g., hospital ward surfaces using their cleaning products. They also provide incentives to evaluate one's learning through, e.g., interactive games mimicking the video-illustrated cleaning procedures, albeit limited to the surface of the tablet. However, in both the above types of training resource, there are limitations to what can be achieved from self-learning by rote: on the job one has to recall correct procedures perhaps without having an adequate understanding of the nature of the pathogens likely to be present or the consequences of certain protocols not being observed.

Co-developing tools for training: visualising the invisible

In attempting to address the HAI issue, the authors have described findings from a previous programme of research exploring the use of prototype visual methods to help 'see' invisible pathogens in the hospital setting (Macduff et al., 2013) a key outcome of which was the recommendation that the further development of these 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. Loudon et al. (2015), in work being driven by the question '*could more HAIs be prevented if hospital staff could 'see' microscopic pathogens?*', outline the model and methods being used for this - visionOn - study which deploys a co-development approach, utilising data on staff behaviour, e.g., '*who touches what?*', and on the location, abundance and persistence of different pathogens as a result of, e.g., transmission by various means (human and environmental) or as a consequence of cleaning regimens intended to eliminate or mitigate pathogen growth. Using a workshop-based approach, prototype visuals were used to interrogate understanding and awareness across four different hospital staff cohort groups: doctors, nurses, cleaners (domestics) and other - mixed - roles. These prototypes were iteratively developed through three main stages: by the second stage these were interactive tablet-based prototypes designed to raise awareness and understanding of location of pathogens, their survival properties, cleaning and surface recontamination, and their spread and transmission. Further refinement and evaluation enabled their embodiment into a prototype digital tablet-based training package for hospital staff for evaluation by the NHS and the industry partner.

From hierarchy to co-dependency

Clearly differentiated roles within the hospital organization create a hierarchy across the different cohort groups (nurses, doctors, domestic cleaners and visitors): these individuals form a complex service ecosystem (Morelli & Tollestrup, 2007) of interaction and potential transmission of HAIs as they move into, through and around the various spaces and artefacts within the hospital environment as they perform their individual but overlapping roles. Here, there is significant co-dependency: individuals within all cohorts require to observe IPC protocols within the hospital 'ecosystem'. Domestics have their vital role, cleaning certain areas of the ward environment, e.g., floors and toilets, without necessarily having a clear understanding of the specific natures of different pathogens. Nursing staff may be regarded as carrying the most conspicuous burden of IPC through cleaning routines concerning the patient and on various surfaces within the ward environment particularly in and around the patient bedside. Junior doctors are required to handle patient notes as well as examine the patient and may have, e.g., an erroneous perception that not touching the patient diminishes the opportunities for infection transmission. Visitors are another rogue element to consider while the patients are also unwitting sources - as well as reluctant recipients of - infection. In this service ecosystem there is a substantial co-dependency between all individuals: just one transgressor creates serious ramifications for others, most seriously for the patient.

Recognising different learning needs

A significant training challenge within IPC is one of addressing phenomena which are fundamentally invisible, i.e., the occurrence of different kinds of pathogens, each with their 'preferred' locations, abundance and persistence as well as their complex routes of transmission. Consider, then, the differing training needs of the different cohort groups named above. Cleaning staff may not be used to the norms of 'educational' materials such as those found in the online e-learning modules described above, some indeed may have problems with literacy. Nursing staff have, as do junior doctors, a relentless schedule of individual tasks to conduct for each of their patients requiring any new routines to be embodied, along with countless others, in everyday practices and procedures. Visitors are part of the 'world outside' bringing with them unschooled behaviours and unpredictable reservoirs of pathogens. Each of these groups, it could be argued, requires to 'see' and understand the issues in their own particular way.

Cross-cohort training as a service design issue

So what's the relevance of the above for Service Design? Current e-learning materials are largely reliant on text-based or text-derived documents and rote video-based protocols and may not provide the appropriate formats for each and all of the above cohorts. One issue arising in team discussion about the nature of the visualisation tools during their development was if these, and the training package embodying these, should be tailored for each of the separate cohorts. While there may perhaps be an argument for this, such an approach might reinforce a hierarchical as distinct from a co-dependency model. Findings from the first cohort workshop (with doctors, nurses and cleaners) suggested that the same visualisation materials were an effective medium with which to engage all these different

staff, collectively and simultaneously, with the information, helping raise awareness and understanding of specific issues relating to pathogens and IPC. A second workshop was able to refine this view determining that supplementary content might require to be added, tailored to each cohort. However, the visualisation approach enabled communication of key information from normally difficult-to-access research data across the different cohorts, demonstrating its potential to assist in learning new information or reinforcing current knowledge. This 'one-tool-fits-all' visualisation approach provides the opportunity for exploring cross-cohort training, further strengthening the co-dependency model and better reflecting the dynamic service ecology.

Synthesised narratives, embodied data & democratic discourse

Macdonald (in press) argues for the early introduction of visualization prototypes to visualise, probe, elicit, explore and test, arguing can result in specific kinds of service innovation. The visionOn prototypes represent a synthesis of narratives - gleaned from all cohorts and from additional expertise such as that from microbiologists - of experiences, of procedures, of data, contextualised within a ward setting. Using the iterative co-development and workshop-based process, each of the different cohorts attending the workshops has input to the design of the visualization tools while simultaneously witnessing others' responses to the same materials. This iterative and discursive process continually probes and hypothesizes '*what if...?*' in an attempt to better reflect the discourse that needs to be promoted about the dynamic relationships between all actors (human and non-human) in this hospital service ecosystem and their individual agencies, i.e. individuals, pathogens and their lifecycles, and the environment. In this 'open innovation' approach (Chesbrough, 2003), the process of co-developing these visual training tools reflects a collective construction process, disregarding the normal hierarchical and authoritative healthcare structures, generating a political effect through enabling a more democratic form of discourse: a cleaner's input and views in shaping these tools is as vital as a consultant's.

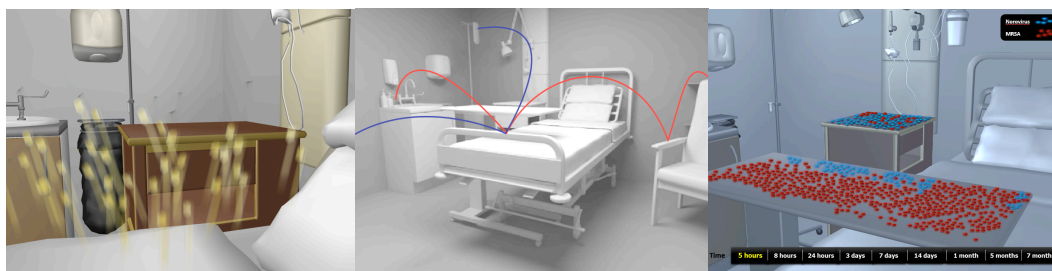


Figure 1: Stills from dynamic visualization prototype sequences: (left) pathogen behaviour - MRSA dispersal; (centre) pathogen transmission - potential complexity of routes; (right) pathogen survival - Norovirus and MRSA.

Conclusion

The discussion above highlights a number of issues (summarized in figure 2): the type of data used and the format in which this data is provided, for - and to - whom, and whether this is privileged (decided by some parties only) or open (decided with the involvement of all); how material is used to develop understanding - and again if this is privileged or open; whether the expected behaviour is through rote instruction or enlightened awareness and

under-standing; how this affects the use of technology (in this case the cleaning products) and the observance of IPC protocols; and, ultimately, how this impacts on the incidence of HAIs.

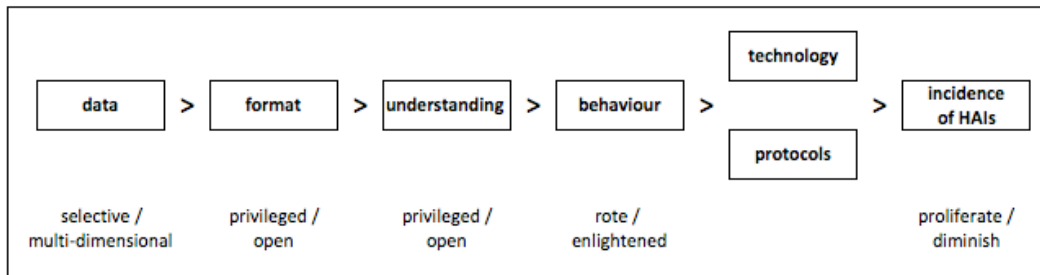


Figure 2: Chain of consequences in development of HAI IPC training materials.

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The research team, advisory group and partners of visionOn: www.visionon.org

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