Supporting Learning within the Workplace: Device Training in Healthcare

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ABSTRACT

The phrase "lifelong learning" places emphasis on the fact that learning continues beyond the classroom and formal educational environments, though it is often be supported by training within the workplace. Continued professional development is all the more important within the context of healthcare, where technology is constantly evolving and errors run the risk of causing serious harm to patients. This paper considers the case of infusion device training within UK hospitals. Interviews were carried out with staff involved in medical device training and management across seven National Health Service trusts. The analysis indicates the range of training provided by different institutions and highlights important issues that influence how users develop their understanding of these devices. Further, the research indicates that while there is an increasing interest in e-learning as a way to overcome some of the tensions trainers face in relation to time and resources, there are also significant concerns which need to be addressed when considering this approach.

Author Keywords

Device training; Healthcare; E-learning

ACM Classification Keywords

H.5.m. [Information interfaces and presentation] (e.g. HCI): Miscellaneous.

INTRODUCTION

Human error has caused and been implicated in many patient deaths, with the National Institutes of Health report [6] drawing it to widespread attention: fatalities per year from human error in US hospitals exceed car accidents, AIDS and breast cancer combined. In the UK, the Medicines and Healthcare Products Regulatory Agency (MHRA) has noted the growing prevalence of infusion devices within both the home and healthcare context [9].

These devices are used to deliver intravenous (IV) medication to patients. Between 2005 and 2010 the MHRA investigated 1,085 incidents involving infusion pumps; 21% of these were attributed to user error. In 68% of all the cases no clear cause was established so it is possible that the figures relating to user error are much higher. While only a few of these errors will lead to serious patient harm, even those that do not can result in anxiety for staff and patients, and reduce patient confidence in healthcare.

Effective training is vital for ensuring safety and the literature on infusion devices indicates that inadequate medical device training does lead to error [10]. Douglas and colleagues [6] also note that complex devices which were once only used in critical care units have become common place in general wards. The technology continues to evolve with developments such as "smart pumps" (which include software that requires additional information about the patient and medication to be entered so it can perform additional checks to detect possible errors). These developments place even greater demands on training since more and more users are required to become competent in using these increasingly complex devices, regardless of their clinical and technological expertise.

There has been a growing research interest into "lifelong learning" and how individuals and groups continue to learn outside formal educational institutions, e.g. [4][5]. In addition to the emphasis being placed on the need for continued professional development across employment areas, researchers such as Sharples and colleagues [11] note that learning is increasingly being conceptualised as lifelong and ubiquitous. Learning in this sense occurs through social participation where individuals engage in the process of "being active participants in the *practices* of social communities and constructing *identities* in relation to these communities" [12; p.4].

This conceptualization of learning has been reflected in the UK National Health Service (NHS). As part of the drive to modernize in 2001, a framework for lifelong learning in the NHS was produced [5]. The document states that the main aims of the framework are to ensure that NHS staff are equipped with the skills they need to "support changes and improvements in patient care; take advantage of wider career opportunities; and realise their potential". While e-

learning is highlighted as a vital tool for supporting these aims, the document also notes the advances in healthcare technologies that staff will need to be trained to use.

Training has also been identified as an area for further Human Computer Interaction research [9]. From an HCI perspective it is important to understand how users develop their conceptual models of device use and to identify these models in order to ensure device design will support user understanding. A method such as CASSM (Concept-based Analysis of Surface and Structural Misfits) [2] makes it possible to assess how some devices are better able to support users' conceptual models than others.

In this paper we report an exploratory study is that aims to investigate the use of infusion pumps across hospital contexts, and the training provided to users. The following sections outline how the study was conducted and present the findings of a thematic analysis. The paper then concludes with a discussion of implications for training and an outline of future work.

METHOD
Semi-structured interviews were carried out with an opportunity sample of 11 participants (F = 5, M = 6) based at 9 different UK hospitals (within seven different trusts). The participants consisting of medical device managers and staff involved in training and education. Trainers sometimes had multiple roles (e.g. trainer and device manager) and were often responsible for device training across the whole of their organisation so would provide examples from additional hospitals. Out of the nine locations, two were specialist hospitals (coronary care and cancer) and the rest were general hospitals. All were located in cities and towns of various sizes though in order to protect the anonymity of the locations further information cannot be provided. R&D departments were consulted when setting up the interviews at each site. Approval was gained from the evaluation units (e.g. Clinical Effectiveness Units) where required. The study was also granted ethical approval by University College London.

Interviews lasted between 45-80 minutes and were audio-recorded and transcribed for analysis. The majority of interviews were one-on-one but two sessions involved two participants. Participants were asked about the context of infusion device use, who uses these devices, how devices are managed and about the training provided.

FINDINGS
The transcripts were coded using *Thematic Analysis* [3], where an iterative approach is adopted in order to develop themes that cut "across a data set... to find repeated patterns of meaning" (p. 86). The following subsections outline how infusion devices are used and managed within a clinical context; how people are trained to use the devices; and the issues that surround the provision of training and safe use of infusion devices (where themes are indicated in italics).

Device users and management
The interviews indicated that the primary users of infusion devices are nurses and anaesthetists also use specialist pumps. Doctors were mentioned as occasional users and there were some references to pumps being used for research purposes. Infusion devices are used across hospital areas though certain wards (e.g. critical care areas) typically contain more technology than others. Further, nurses who work within these areas are more likely to used advanced functionality such as smart pump technology. Infusion devices are stored in a centralised medical equipment library and/or within individual ward areas.

Forms of training
Users are usually expected to be declared competent before being allowed to use an infusion device. Competency forms are completed after undergoing induction and training, whether this is in the form of formal sessions (usually off-ward) and/or link training on the ward. Formal sessions ranged from lasting all day (including a range of other medical devices and components on IV therapy) to half hour sessions on a particular device (with 5-20 participants in each session). Trainers provided by manufacturers are often used to train link trainers who are then responsible for cascading training throughout their ward areas.

Out of the nine hospitals, one relied only on formal sessions, three used only link trainers, and the remaining five used a mix of both. A certain amount of informal learning was also expected to occur whilst nurses are on the ward – e.g., where more senior staff provide advice to newly registered nurses. E-learning was also mentioned several times as a possible addition to device training packages, usually as a way to overcome the difficulty of finding time to fit training into the standard work shift. At the time of interview, none of the trusts had included an e-learning component in their infusion device training however. A few other tools were also mentioned, including pump simulations, training videos/DVDs and interactive workbooks, though these were not major components.

Themes concerning the safe use of infusion devices and the provision of training
In terms of safe device use, participants discussed concerns that they had about the *complexity* of devices. Participant C (Location 2) expressed a desire to "dumb down the whole lot" of infusion devices as "you'd reduce incidents, I'm almost sure of it". In addition, menu options have become more complex, requiring further button presses: "well initially in the [new pump] roll out there was an awful lot of resistance to the number of buttons they have to press, the fact they've got to lean over and they're hurting their back when they're pressing the button so many times, and they always overshoot" (Participant E, Location 4). There were also concerns that users sometimes exhibited an *over-reliance* on technology. It was suggested for instance, that once nurses start an infusion they often rely on alarms to tell them if something is wrong, rather than checking the

device as they would a gravity feed: "Done, start, button push, off you go. And then when it bips, but with a gravity set you have to go back and check." (Participant L, Location 9). While infusions are generally supposed to be checked twice, normally by a second nurse, this was not always the case. Participant K (Location 8) for example, explains how the device is supposed to be checked at regular intervals (within 15 minutes of a starting an infusion, after an hour, after four hours depending on the length of treatment) and describes a strategy that was implemented to ensure that this occurs: "the latest development is that we've got clocks hanging on the drip stands so that we then put it to the time that they are next due to do a check."

With regard to training, the analysis indicated that there was an overall *emphasis on safety* (e.g. "We want to reduce risk by reducing incidents"; Participant A, Location 1). A lack of training was also seen as a cause of incidents, e.g. "a lot of the incidents that happen, if we look at it, its user error, reason? Training, simple." (Participant B, Location 1) though participants noted that they faced a challenge in training users who differ in terms of their relationship with technology. This relationship appeared dependent upon which *clinical area* users work in, how *confident* they are with technology and how *familiar* users are with a specific infusion device or particular brand of pump. For example, Participant H (Location 6) highlights the role of clinical area and confidence, "You find people who work in critical care areas, they are a lot more susceptible to change in devices because technology has moved on really quickly within theatres and intensive care and coronary care and things like that". Further, Participant F (Location 5) notes how familiarity with a device can influence the adoption of a new technology, "they were offered the new pumps and the charge nurse at the time refused to go with it 'cos his staff knew the pumps they had well, they were happy with them and he wouldn't budge on that".

Additionally, tensions were expressed in relation to training and *nursing practice*, the *time and resources* available, and the *type of learning* required. There were a small number of instances where there was a clash between what nurses do in practice and what they are taught. For example, Participant A (Location 1) refers to a training session where nurses said they would read values from the scale on the syringe instead of navigating through the device options: "they were reading the remainder of fluid from the syringe? <sharp intake of breath> You can't get a good accurate reading from the syringe scale really, only a guide". In addition, certain infusion device related activities were seen as being potentially risky and more difficult to carry out than others e.g., carrying out drug calculations, setting up multiple infusions and using advanced functionality e.g. being able to ramp up and taper infusions. However, these activities were not covered as part of the basic device training delivered to all staff. They were usually referred to as being included within infusion therapy training (delivered by clinical staff) or as aspects of practice that would be learnt whilst working on the ward.

Regarding time and resources, high staff turnover was given as a reason for not using dedicated link trainers on each ward. Instead, alternative solutions were sought such as relying on a larger number of formal sessions or using a team of practice educators to areas they were needed. In general, trainers faced a challenge with respect to finding time to train nurses not just on infusion devices but on all the devices they would be expected to use. This was especially true with respect to formal sessions off-the-ward. Further, in the following example, Participant J (Location 7) notes that while there may be a push from management towards e-learning as a way to overcome the issues of finding time and space for training "it's not easier to do e-learning, some people can't do the things with e-learning because they don't like e-learning packages. Access to computers in some areas is very good, in other areas they have two computers, one in the sister's office, one on the front desk and they're always in use so you can't get at those." There were also concerns about implementing meaningful online assessments so that situations can be avoided where users "just click to the end and it shows up as completed" on their training record (Participant C, Location 2). In addition, regarding the type of learning: "I think I've resisted pressure to try and make things as e-learning, because I think you and I [referring to Person F] both feel that it is a very kinetic type of learning" (Person G, Location 5). Participant J also discussed the type of learning required and when arguing that there should be "a blended look at training" that combines online modules with hands-on experience.

DISCUSSION

This research aimed to investigate how users are trained to use infusion devices and to explore the issues which surround infusion device use and training. The emphasis that the NHS places on training staff to use these devices is clear though the challenges trainers face mean that in practice there are a range of different ways in which staff are trained. Further, while some organisations do provide official training in the form of formal sessions, it appears that much of nursing practice involving the use of these devices is learnt more informally whilst nurses are on the ward. Given the hands-on nature of the tasks involved this is hardly surprising but this does raise some issues in relation to the drive towards incorporating e-learning into infusion device training.

Supporting training through e-learning?

Medical device trainers face a significant challenge in terms of being able to find the time and resources to carry out the training that is necessary to enable nurses from a range of clinical areas to become competent users of increasingly complex infusion devices. E-learning has been proposed by management as a potential solution to this challenge but the

findings indicate there are particular issues that would impact the success of this approach. Firstly, staff currently struggle to find time to attend formal training sessions and/or get in-depth training on the ward. Secondly, many hospital contexts only contain a small number of computers which are used for a range of different tasks. Thirdly, using an infusion device requires procedural as well as conceptual knowledge. Finally, there is a risk that online assessments could be rather shallow. Given these issues it is far from clear when and where staff will be able to dedicate time for e-learning. Further, questions remain as to how to effectively incorporate e-learning into training and how online components should be assessed.

Possible solutions mentioned in the interviews include adopting a blended approach, where online components are combined with some form of hands-on training; and enabling bite-sized components that are easily interruptible and that can be bookmarked (e.g. in case a nurse is called back to the ward). Care also needs to be taken when designing meaningful assessments so that any online modules are not reduced to box ticking exercises.

Future Work
The issues raised are highlighted as areas to be considered in relation to training. Given the importance of clinical area in relation to the functionality required and user's confidence with technology, further interviews are currently being carried out with nurses from different wards in order to elicit their conceptual models. These models are important as they can form the basis for studies that compare learners who have been trained face-to-face and those who are trained online. Further research is required in order to develop and evaluate effective online training tools. This should also include a consideration of how learning is to be assessed.

CONCLUSION
This study focused on a healthcare context but the findings indicate that while the boundaries between work and education are becoming increasingly blurred, it is important to consider the type of learning that is required to ensure continued development and the context within which it will take place. Training tools such as e-learning packages can provide more accessible learning materials and assessments but should also be used in conjunction with face-to-face components for more practical tasks (such as delivering infusion therapy). Wenger [12] describes training as developing "competence in a specific practice" but in order to fully support lifelong learning, training needs to be considered as part of a wider "transformative" education (p. 263) where individuals will be able to develop their identities and become fully fledged members of a community of practice.

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