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Bags, batteries and boxes: A qualitative interview study to understand how syringe drivers are adapted and used by healthcare staff

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ABSTRACT

Syringe drivers are medical devices that are critical for end of life care. They deliver continuous medication over extended periods of time. Their design contributes to the quality of experience for both patients and healthcare professionals. Little research has been published about the factors that influence the usability of this type of equipment for frontline users (i.e. those in direct contact with patients) and how equipment gets introduced. Understanding how syringe drivers are used in practice can help improve the design of equipment. 27 semi-structured interviews were conducted across acute hospitals, community hospitals and hospices (4 organisations in total). All participating organisations used the same type of syringe driver. It was found that frontline staff needed to adapt this equipment to fit the circumstances of use. The analysis provided examples of this happening for aspects relating to the appearance of the device (bags), accessories (batteries) and security (the lockable box).

1. Introduction

Syringe drivers are widely used for palliative care. These devices are compact boxes that are typically powered by a battery and can be left unattended by healthcare staff. Although patients rely on the effective functioning of these devices for pain relief and have to integrate them into their lives, and although the devices are often left running without professional oversight, there have been no prior studies of how they are used, or of how professionals adapt the devices to address their patients' needs and to remain safe. This paper reports on a study of how equipment gets adapted (e.g. the reconfigurations that occur to support use) and relates this to the process of introducing equipment (purchasing). This builds on a previous paper that reports how those involved in purchasing syringe drivers go about evaluating usability, the challenges that arise, and opportunities for improvement (Vincent and Blandford, 2017).

1.1. The replacement of older types of ambulatory syringe driver

Across the UK, most palliative care providers use the same type of syringe driver (for a history see (Graham and Clark, 2005)). The device is used to treat patients when they cannot take oral medication. It can be used to control symptoms and provide pain relief. Palliative care commonly involves the use of an ambulatory syringe driver. This is because patients may be mobile whilst using the device. The current ambulatory device replaced an older piece of equipment (reviewed in (Oliver, 1988)) that was withdrawn due to concerns about a lack of control, difficulty in use and potential for error. The replacement followed the release of a Rapid Response Report (RRR), detailing the potential for confusion to arise when setting the rate.

> *"While the majority of syringe drivers and pumps used in healthcare have rate settings in millilitres (ml), some older types of ambulatory syringe drivers have rate settings in millimetres (mm) of syringe plunger travel. This is not intuitive for many users and not easy to check."* (NPSA, 2010)

Although there was a need to replace the old equipment, there was a limited choice in the marketplace; some trusts reported that they had little choice but to use a single type of technology. The focus of this study is on the ways in which the equipment was adapted for use across multiple settings (acute hospitals, community hospitals, hospices and homes), and how this relates to the original process of introducing it. The circumstances surrounding the introduction of this equipment provide an opportunity to learn

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how the needs of multiple local organisations could have been met, based on the capabilities of a generic piece of technology.

1.2. Equipment replacement and socio-technical systems (STS)

The syringe driver was provided with an agreed default configuration (as recommended in NPSA, 2004). This means that the functionality and appearance of the device is the same regardless of where the device is being used. However, in this domain the nature of work is characterised by relatively small groups of individuals acting independently, in different ways, across different settings (see Table 1). The nurses set up, activate and replenish the drivers individually but are part of a larger team that develops a shared view on practice. For example if a syringe driver is used outdoors then protection may be added to keep the device dry. If a large volume of solution is required then two devices may be used. If the device is used with children, a parent may be asked to perform similar checks to a clinician (e.g. checking that the device is running).

In this way teams find their own ways of working in order to promote efficiency and job satisfaction. Optimisation occurs beyond the level of the individual but within the level of the team (Trist and Bamforth, 1951; Trist et al., 1963). This topic is very relevant for healthcare as there is a debate relating to the benefits that customisation provides (Obradovich and Woods, 1996), and little attention has been paid to how well the practices of customising fit with wider processes and controls, for example the medical device regulations that seek to define normal conditions of use which remain constant over time (Randell, 2003).

For example (as in this case), the equipment may be introduced in a very generic way (e.g. mandated by an overarching body); however, socio-technical systems theory (STS) suggests that there may be benefits in smaller groups adapting and taking responsibility for it (e.g. the principle of responsible autonomy (Amble, 2013)). In the homecare environment this could involve customising the device to make it look discreet (O'Kane et al., 2015). In the hospital context equipment could be modified beyond the original design intent, as per accounts relating to barcoding systems (Koppel et al., 2008), alarm settings (Watson et al., 2004), physiological monitors (Cook and Woods, 1996) infusion pumps (Obradovich and Woods, 1996) and glucometers (Furniss et al., 2015).

In domains other than healthcare (e.g. software), the literature generally paints a positive picture regarding the role of adaptation and customisation. Adaptation can be broken down into three categories. Users can change the structure of work to accommodate new technology [*fitting*], they can *workaround* what they see as misalignments; and they can *augment* work in light of new technology (Gasser, 1986). These behaviours are seen as a vehicle for improving practice and confronting the problems that can arise over time (Mackay, 1990; Rogers, 1994). Changes can be acknowledged, fed into design and used to inform future generations of technology.

Research is required to understand the process of "mutual adaptation between tool and context" (Bikson and Eveland, 1996) as findings affect how equipment is managed (e.g. embracing customisation or seeking to avoid it) and the general approach to introduction. For example, some of these behaviours might create additional risks. Obradovich and Woods (1996) state that when considered in a broader context adaptations may be brittle, produce unanticipated side effects or create new paths to failure. A more positive account is provided by Cook and Woods (1996) – e.g. "system tailoring clearly enhances some aspects of performance"; however, there remains uncertainty around the benefit that customisation provides and how it should be managed.

This situation is complicated by the different types of modification that can occur. Randell (2003) gives examples of different types of medical device customisation, including: those aiming to overcome limitations (e.g. short term solutions such as resetting a device); those aiming to provide for ease of use (pen and paper adaptations); and those that change procedures around technology. The different types of adaptation can result in varying benefits, integrate with existing processes to varying degrees and may or may not be productive.

There is therefore a degree of uncertainty about how adaptation occurs and what benefit it provides. For palliative care, there have been no accounts of this type of behaviour. This study complements existing understanding regarding the safe and efficient use of syringe drivers (Costello et al., 2008; Cruickshank et al., 2010; McCormack et al., 2001; West, 2014); it can also inform the approach to the future introduction of technology. For example, investigation focused on a specific type of technology can be used to build theories outlining the relationship between user-device interactions and system wide consequences (for example technology acceptance) as in (Sharples et al., 2012). If we understand the types of modification that occur to support productivity we can design, integrate and manage technology in a way that supports patients and healthcare staff. A holistic view (understanding interactions between people, technology, tasks, organisations and environment) helps provide a safer and more productive workplace (Smith and Carayon, 1989) and frameworks such as SEIPS (the Systems Engineering Initiative for Patient Safety) show the benefit of such an approach (Carayon, 2009; Carayon et al., 2006, 2014; Carayon and Smith, 2000).

In the context of this study, understanding these broader relationships potentially impacts on the theories that underpin the design of medical technology with the consequence that better tools can be provided.

Table 1
Different environments of use.

Environment	Use of device	Customisation
Home	Nurse visits home to set-up/replenish device. Device kept in a lockbox. Device left unattended. Nurse needs to travel to attend to patient or device.	Device used with lockbox. Device sometimes used with bag. Staff need to check the level of power in the battery and keep spares. The appearance of the device should reflect the home environment.
Community Hospital	In this study the community hospital was used as a hub for the nurses working in patient homes.	N/A
Hospice	Nurse checks pump on a regular basis. Device kept in a lockbox. Device may or may not be attended.	Device used with lockbox. Device may be positioned under a bed or under a pillow. The device may be used with a docking station/external power supply. The device needs to support regular checks/monitoring.
Acute Hospital	Nurse checks pump on a regular basis. Device kept in a lockbox. Device may be substituted with another type. Device training provided by training staff working in the hospital.	Device used with lockbox. Device is part of a centrally managed equipment library. Device positioned at bedside. The device may be used with a docking station/external power supply. The device needs to support regular checks/monitoring.