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ORIGINAL ARTICLE

Exploring nurses' reactions to a novel technology to support acute health care delivery

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Aims and objectives. To explore nurses' reactions to new novel technology for acute health care.

Background. Past failures of technology developers to deliver products that meet nurses' needs have led to resistance and reluctance in the technology adoption process. Thus, involving nurses in a collaborative process from early conceptualisation serves to inform design reflective upon current clinical practice, facilitating the cementing of 'vision' and expectations of the technology.

Design. An exploratory descriptive design to capture nurses' immediate impressions.

Methods. Four focus groups (52 nurses from medical and surgical wards at two hospitals in Australia; one private and one public).

Results. Nursing reactions towards the new technology illustrated a variance in barrier and enabler comments across multiple domains of the Theoretical Domains Framework. Most challenging for nurses were the perceived threat to their clinical skill, and the potential capability of the novel technology to capture their clinical workflow. Enabling reactions included visions that this could help integrate care between departments; help management and support of nursing processes; and coordinating their patients care between clinicians. Nurses' reactions differed across hospital sites, influenced by their experiences of using technology. For example, Site 1 nurses reported wide variability in their distribution of barrier and enabling comments and nurses at Site 2, where technology was prevalent, reported mostly positive responses.

Conclusion. This early involvement offered nursing input and facilitated understanding of the potential capabilities of novel technology to support nursing work, particularly the characteristics seen as potentially beneficial (enabling technology) and those conflicting (barrier technology) with the delivery of both safe and effective patient care.

What does this paper contribute to the wider global clinical community?

- Early involvement enables potential user insight to be gained to more fully understand the potential capabilities of novel interventions or technology
- Application of the initial 12 domains of the theoretical domains framework (TDF) (Michie *et al.* 2005) during analysis was useful to identify potential barriers and enablers to the implementation and uptake of novel technology into nursing practice; pertinent issues perceived to impact the implementation process were illuminated.

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Relevance to clinical practice. Collaborative involvement of nurses from the early conceptualisation of technology development brings benefits that increase the likelihood of successful use of a tool intended to support the delivery of safe and efficient patient care.

Key words: acute care, design science, information systems, nurses' reactions, nursing informatics

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Introduction

Information technology has the potential to significantly improve and streamline nursing practice by merging and integrating key functions and enhancing the immediacy and accuracy of bedside information. Successful application of 'smart' technology however, relies upon user acceptance (Davis 1989, Venkatesh & Davis 2000, Ketikidis *et al.* 2012). Failure to gain acceptance by key end-users can be both organisationally devastating in terms of financial cost, and dangerous in terms of patient safety (Bakken *et al.* 2004). Involving the expected end-users in the early stages of the concept design and gathering feedback and impressions are recognised as a prudent general strategy to increase user acceptance (Davis 1989, Venkatesh & Davis 2000, Ketikidis *et al.* 2012).

Nurses' acceptance of technology solutions is not well understood (Chow *et al.* 2012). In this paper, we report on this critical element of user acceptance through an exploration of nurses' reactions to a specific novel technology solution designed to support nursing care in the acute care environment. The study was undertaken when the technology was in the early design stages so that potential users had the opportunity to make a meaningful contribution to the development process. The findings served to usefully inform and shape a prototype version of the new technology that was envisioned to electronically capture nursing documentation and enhance communication of real-time patient-specific information, which traditionally is communicated verbally or in writing. The aim of the new technology was to replace paper-based nursing documents, to reduce administrative burdens on nurses, remove duplication or double-handling of patient data, and support care planning and other activities to reduce the risk of missed care to improve patient safety. The product now is marketed as SmartWard™. More details on SmartWard can be found at smartward.com.au. The purpose of this paper was to report the first stage of a longitudinal programme of research aligned with the design, development and adoption of the SmartWard™ technology to support nursing work in acute care, from conceptualisation to implementation. The research was conducted by nurse researchers independent of the technology developers. The findings were shared with developers at each stage to inform the next stages of the technology development. In this first phase, a series of focus groups were conducted and the data were analysed using the 12 theoretical domains framework (TDF) and component constructs developed by Michie *et al.*(2005) as a guide. These TDF and associated constructs were used to categorise and analyse data to gain understanding of nurses' initial reactions to a prototype of SmartWard™ designed to support and enhance nursing work.

Background

The complexities associated with the coordination, communication and delivery of health care at the point of care, present particular challenges for the design of information technology (IT) systems. In an Australia-wide qualitative study that examined nurses' experiences of already established Computerised Patient Information Systems (CPIS), Darbyshire (2004) found that nurses commented that these established systems made no 'clinical sense' and were perceived to waste time. Overriding of the system, duplication of documentation and reverting to familiar systems such as paper recording, have all been reported as work-around strategies used to continue delivery of safe and reliable clinical communication and care in the face of technological solutions that do not meet clinicians' needs (Alaszewski 2005, Dowding *et al.* 2009, Lau *et al.* 2010, Viitanen *et al.* 2011). To mitigate such problems, we created an ongoing-collaborative process which engaged both nursing and information technology industries to actively contribute to the development, and sequential implementation, of a novel

technology solution to support nursing work within acute health care settings. Our approach is expected to increase the likelihood of achieving a feasible, viable and crucial solution to product development for healthcare.

Building technology systems suited to support nursing care

Jennings *et al.* (2009) recommended that technology systems need to be designed to meet the full clinical and research needs of the clinical nurse. However, designing a technology system specifically designed to assist the nursing profession, that adequately and appropriately meets the requirements of nursing in terms of design and flexibility, is challenging. Others have suggested that such systems should encompass a set of standard elements directly related to the routine of everyday nursing practice (Yu *et al.* 2009, Yun-Ke *et al.* 2009). Previously, technology systems have addressed some of the needs of nursing care delivery, but fall short of supporting the full scope of nurses' work in complex clinical settings: i.e. *the system doesn't think like a nurse thinks* (Yun-Ke *et al.* 2009).

Cornell *et al.* (2010a) observed more than 98 hours of nurses' workflow patterns and found that nurses were often observed to make important decisions about care delivery quickly and decisively. Their workflow, however, was often sporadic and chaotic in nature incorporating a complex mix of patient and environmental data and clinical experience. They discovered further that workflow patterns of nurses change little after the introduction of technology. Indeed, the technology added an extra task (Cornell *et al.* 2010b).

Disparities between the clinical work of nursing and the effectiveness of technology systems in supporting nursing work are commonly reported. Issues such as responsiveness, reliability and ease of use are often cited problems (Alaszewski 2005, Garg *et al.* 2005, Kawamoto *et al.* 2005, Yun-Ke *et al.* 2009). In addition, difficulties with security, maintenance and confidentiality of patient records are also reported as barriers to the assimilation of new technology into nursing work (Venkatesh *et al.* 2003, Garg *et al.* 2005, Weber *et al.* 2009, Holden 2010, Viitanen *et al.* 2011).

In summary, technology systems have not yet effectively captured the multidimensional aspects of nursing care in a way that promotes efficient and effective nursing workflow. Accordingly, adoption of technological solutions capable of supporting nursing practice, that could potentially improve care delivery and patient safety and outcomes, requires early contribution and buy-in from nurse end-users (van der Meijden *et al.* 2003, Lau *et al.* 2010). van der Meijden *et al.* (2003) suggest that key stakeholders should be *involved during the design of the initial concept to set the 'vision' and continue to be involved on an ongoing basis* (p. 242) throughout the ongoing evolution and development of the software. We applied a qualitative approach to understanding the issue of acceptance of technology by nurses, which allowed for full exploration of the participants' reactions. This was informed by a theoretical framework developed by Michie *et al.* (2005) to explore behaviour change related to the implementation of evidence into practice. Tavender *et al.* (2014) reported use of a similar iterative approach to data analysis, where in keeping with the qualitative nature of the study, they coded findings against the concepts in the TDF to tease out where behaviour change initiatives might be needed. We used a two-stage interpretative approach that enabled us to address two research questions: (1) What were the nurses' initial reactions to the new technology being proposed? (2) What did nurses perceive to be the main barriers and enablers to implementing technology of this nature into nursing practice? Furthermore, it also provided another opportunity to use the TDF in health care practice.

Methods

Design

A qualitative exploratory design was used. Data were collected from four semi-structured focus group interviews involving a convenience sample of 52 nurse participants from two hospitals in metropolitan Melbourne, Australia.

Ethics approval

Approval for the study was provided by the Human Research Ethics Committees of the university and two affiliated hospitals. The project was funded by Sage Health Ltd, who approached the university as a potential collaborator; thus, the researchers had no prior connections to the company or the proposed technology and thus no conflict of interest to declare. The company recognised the need for independent research to be generated that would inform the development of the new technology. This company later changed its name to SmartWard Pty Ltd.

Setting and data collection

The participants were registered (bachelor prepared) or enrolled (diploma prepared) nurses employed at one public and one private health care organisation in metropolitan

Melbourne, Australia. The hospitals were chosen through convenience because access to the workforce, for research purposes, already existed through joint clinical academic appointments. Furthermore, although limited technology was available to nurses to capture clinical activity in the private hospital, the public hospital did not, at that time, have any electronic patient records or any systems that enabled nurses to document patients' care needs and subsequent interventions provided. Both organisations were exploring possible systems to implement to fill this gap.

The nurse participants who volunteered for this study worked on general or specialist medical and surgical wards, and had variable years of clinical experience. The sample included nurses who naturally fell into one of two groups: 'native technology users' who in the main tend to be familiar with the ever-changing technological environment that is apparent in today's society and 'migrant technology users' (Bayne & Ross 2007, Toledo 2007) who were those who needed to adapt, and continue to adapt, to technological changes in their work.

At the start of the focus group interviews, nurses were shown a short video of the proposed technology system prototype SmartWard™, following which they were invited to share their perceptions and initial reactions. Discussion topics were guided where necessary by evidence-informed interview themes. Each of the focus groups was audio-taped and transcribed verbatim; supplementary field notes were also collected to assist analysis.

Data analysis

The deductive analysis plan was based on the TDF (Michie *et al.* 2005). The focus group data were analysed independently by two experienced researchers (BK and MB) in two stages. Stage I: thematic analysis of nurses' reactions to the SmartWard™ technology were categorised into initial theoretical domains that were later aligned to the TDF (Michie *et al.* 2005, Cane *et al.* 2012) (See Table 1). The 12 TDF, derived from consensus of representatives from health theorists in psychology and health research (Michie *et al.* 2005, Cane *et al.* 2012), guided the development of understanding of nurses' perspectives in terms of barriers and enablers to the technology. Stage II: content analysis was used to identify comments in each of the domains that related to likely barriers or enablers to future implementation of the novel technology. Frequencies of these occurrences for both barriers and enablers were then calculated and reported through percentages. Qualitative data were identified that best illustrated the main themes identified.

Results

The findings are reported in line with the two stages of data analysis.

Thematic analysis of reactions according to the TDF

Nurses' comments about barriers and enablers to using the novel technology were distributed throughout each of the 12 TDF domains (Michie *et al.* 2005) (see Table 1). Aspects of the novel technology that made it more or less appealing for nurses emerged. Of primary importance to nurses was that the system did not 'remove' their professional autonomy but rather enhanced their ability to provide quality nursing care for their patients. Thus, in comments that related to the TDF domain of *skill*, nurses made it clear that they did not want the novel technology to hinder their nursing practice.

Content analysis of reactions

The reactions from the nurses were re-examined, following which the number of reactions which fell into each specific domain, either as a barrier to the implementation or an enabler, were calculated. These are represented as percentages for each of the 12 domains and by public and private sector. The distribution of nursing reactions over the 12 TDF domains from Site 1 is captured in Fig. 1. Nurses indicated that they see the potential benefits to the tool, with a high percentage of enabling comments in the domain of *Environmental Context and Resources* (38%). The highest number of barrier comments aligned with the *Beliefs about Capabilities* domain (25%). There were domains identified in which no comments aligned: *Knowledge (0%), Motivation and Goals (0%) and Emotion (0%)*.

The reactions from Site 2 nurses over the TDF domains are presented in Fig. 2, which shows a relatively even distribution across the domains. Noticeably, *Beliefs about Consequences (24%)* was the domain with the most enabling comments and *Skill (24%)* was the domain with the most barrier comments.

Discussion

This exploratory study was undertaken to better understand nurses' initial reactions to a proposed technology solution, i.e. SmartWard™. The early involvement of nurses as part of the development of this novel technology appears to have been extremely valuable as it provided evidence to indicate implementation feasibility for the technology to

Table 1 Barrier and enabler reactions according to the TDF (Michie *et al.* 2005)

Domain	TDF domain explanation	Example of nursing behaviour (barrier comments)	Example of nursing behaviour (enabling comments)
Skill	Nurses' understanding of how the technology will impact on clinical skill	FG 4 I mean that's my biggest fear, is that the technology is taking away the basic nursing skills … Where is the family support or the psychological care? Is there a spot you can just tick for that? RN 2 FG 3 You'll see someone and their blood pressure will flash up and it will say 110 over 60. Patient looks unwell and he's sweaty can't breathe, whatever. Then you take a manual (BP) and it says 80. And they say but the automatic says 110 so it's fine … People need to be able to rely on their practical skills to be able to get them through as well. EN 1	FG 2 I know one our warfarin orders. Often it's nice to have a prompt if someone's on warfarin. It's sometimes in the evening before you realise you haven't got the INR done. Probably vital signs and medications would be the main prompts. RN 9
Social Professional Role Identity	How nurses perceive themselves and the technology working in their environment	FG 3 But I just find - it almost doesn't trust the nurse. RN 4	FG 4 And then you could adapt it. The team leader or the nurses for each patient could adapt that care plan. RN 3
Knowledge	How the technology will impact on their clinical knowledge	FG 1 Well you know it's telling you what you need to get for your dressing step by step, and, I mean, it's not like you've got to think about it, you just go well, that's what the computer screen's telling me to do, that's what I need to do … RN 3	FG 3 I think it could be useful as well for the likes of – not taking away the thought process for wound care, but wound care is notoriously done quite badly. But if we had a system where it had an input of what is available, such as what [unclear] we keep in the hospital, and some sort, if you put in what the wound looks like and it gives you an idea of where it is and that sort of thing. RN 9

Table 1 (continued)

Domain	TDF domain explanation	Example of nursing behaviour (barrier comments)	Example of nursing behaviour (enabling comments)
Beliefs about Consequences	What would be the outcome / impact of the introduction of the technology in the clinical area or nursing work?	FG 2 . . . but with this technology stuff like that we'd definitely have a power shortage. Then if – or there was some type of computer glitch . . . I think if I was falling behind that day and I knew the things that were important . . . I would get frustrated.. swiping on and all these alerts coming up to tell me all the priorities things I haven't done . . . I don't know if that would be a very friendly system in that way. RN 3	FG 2 My first reaction was – just in relation to the medication and all of that – is I think I can see it automatically helping a lot of areas which would be extremely welcomed in terms of also bringing up – probably a lot easier to manage with plans and things like that. I think that it makes people more accountable and maybe it helps – it will help with rolling out all the new things that we're trying to at the moment in terms of . . . (sic). RN 7 FG 4 I think there'd be some accountability, because if people signed off on what they'd done . . . RN 5
Memory, attention and decision-making	Would the technology impact on their attention and decision-making processes?	FG 1 Well yeah because I can go from one end of the ward to the other, being in charge, and I think I could be asked 19 different things en-route and try and do one thing. NUM 1	FG 2 It's really about these guys (nurses) having the no use to know what needs to be done next without having to be told (by the NUM). We know that there are times when you do have to be reminded that this needs to be done. NUM 1
Social Influences	What would other nurses think about the introduction of technology?	FG 1 I think also we've had a lot of change over a short period of time, that it probably wouldn't help, this coming in. If we probably hadn't had so much change it may have been received better. RN 6	FG 1 at the moment we've got to link these ideas with the new obs charts and things - in terms of linking them is the system and code system which the data meets feeds criteria, then obviously that will raise an alert? RN 8
Behavioural Regulation	Would the technology expect nurses to behave in a planned and consistent – predetermined manner?	FG 3 . . . there'll be nine staff on our ward in the morning and none of us will have to talk to each other, because we'll just be walking around like automated robots with things prompting us. I think it's almost inhumane in nature, especially in the role that we do. RN 3	FG 3 If you had a patient whose temperature was 38 and we did nothing about it you could go back to the nurse and say well, you documented the tem pat 38 degrees, what did you do about it? RN 3

Table 1 (continued)

Domain	TDF domain explanation	Example of nursing behaviour (barrier comments)	Example of nursing behaviour (enabling comments)
Beliefs about Capabilities	What is the potential of the system in the nursing work area?	FG 2 I just had 15 admissions in the space of a few hours. Who is loading on all that care? RN 6 FG 2 Like you get patients – well, the other day, there was three different patients in one bed, in/out, in/out. Who's, as soon as they get there, putting – sitting there doing the whole plan for them? RN 6	FG 4 You've got to take into a fact that it might say when the daily dressing and it might flash up at 7:00am saying this is your priority. You've done your meds and you've meds and you know to do this dressing. Or is it going to take into the fact that nursing is a 24 hr job? RN 5
Motivation and Goals	Nurses drive to use the system and expectations of the technology	FG 1 We don't want to be walking more than we already are. RN 8	FG 3 It's right there. You can see all your trends, even your - if they prompt you to do your skin risk assessment, that's more paperwork, but your touching four buttons and its done. RN 2
Environment Context and resources	How would the technology be physically integrated in the clinical area? How would it be integrated with other existing technology systems?	FG 2 You would have to put it through different wards as well. You couldn't just have it for one because what happens if neuro is completely different that happens in cardio or ICU. RN 7 FG 1 I mean you have to know 500 different passwords for every different system, that's all going around and it's got to be all linked. RN 12	FG 2 I can see it being useful in the respect that we go around and do – populate your care plan and we write it all down. Instead of walking round with your pen and paper, you'd be walking around with a laptop on your trolley perhaps and doing – populating your plan that way. Because everybody does – we all start off with a plan. RN 4
Nature of Behaviour	How would the technology influence and structure nursing behaviours or break behaviours? Identifying strategies of change process	FG 1 Speaking of emergency things, like cardiac arrest, you're not going to stop and look at the computer screen. RN 4	FG 4 But if something goes wrong with one of their patients while they're on lunch, if that can be alerted to that other staff member . . . which isn't always easy as them knowing what's going on in the other rooms - because she's in a single room. RN 8

Table 1 (continued)

Domain	TDF domain explanation	Example of nursing behaviour (barrier comments)	Example of nursing behaviour (enabling comments)
Emotion	Does the proposed technology evoke an emotional response? Does the emotional response hinder or help the implementation	FG 3 I think one of the frustrating things with such a system will be that if I knew I was falling behind that day and I knew the things that were important, I would be jacked off that I hadn't had lunch … might not even go on that system and just do what I felt I needed to do rather than getting frustrated swiping on an all these alerts coming up to tell me the priorities things I haven't done. RN 10	FG 1 I think stock wise and all that, that's fantastic. RN 11

support nurses working in the clinical setting. It also served to facilitate a sense of contribution to the design process for these nurses, which allowed them to explore key barriers and enablers useful to inform the next stage of development. Supportive literature, such as van der Meijden *et al.* (2003), suggests that such a collaborative process, which starts at the initial conceptualisation of the idea and continues on throughout the design process, can promote alignment in perspectives across both health and technology industries. They recommend that, in the ideal situation, such collaboration should continue on an ongoing basis.

Participants' comments indicated that involving them as potential users of the technology early in the design process engendered their sense of external respect for their professional contribution and control over the development of the new technology (van der Meijden *et al.* 2003). Furthermore, studies have similarly found that greater user satisfaction arises from early input into tool design (van der Meijden *et al.* 2003, Yun-Ke *et al.* 2009, Kowitlawakul 2011).

The nurse participants in this study revealed reactions indicating that such a system could be valuable in clinical settings; however, their acceptance of the technology would require further nursing input, particularly in relation to design around the nursing workflow patterns and the tool's flexibility to accommodate a variety of different clinical nursing activities. This finding reinforces earlier literature, which suggest that to 'value add' from the nursing perspective, the tool needs to capture real nursing work, be relevant to patient care and illustrate meaningful clinical outcomes (Darbyshire 2004, Lang 2006, Asaro & Boxerman 2008, Cornell *et al.* 2010a, Chow *et al.* 2012).

Exposing the nurses to the 'prototype' of SmartWard™, through the use of video, allowed them to explore a vision for the novel technology in relation to their current practice. Understanding the process of '*vision creation*', and their reactions through comments about barriers and enablers enabled greater exploration of the more complex cognitive processes of nursing care delivery and the circuitous nature in which nurses think, plan and manage their care delivery (Cornell *et al.* 2010a). A tool designed to meet these needs, and support practitioners to deliver safe, high-quality care in this multidimensional clinical environment, may also assist with supporting effective use of the technology in the clinical setting.

Nurses in this study envisaged the SmartWard™ prototype to be both reactive and interactive within the chaotic nature of their clinical environments. This is supportive of other literature, which reflects this approach for design of technology (Chow *et al.* 2012).

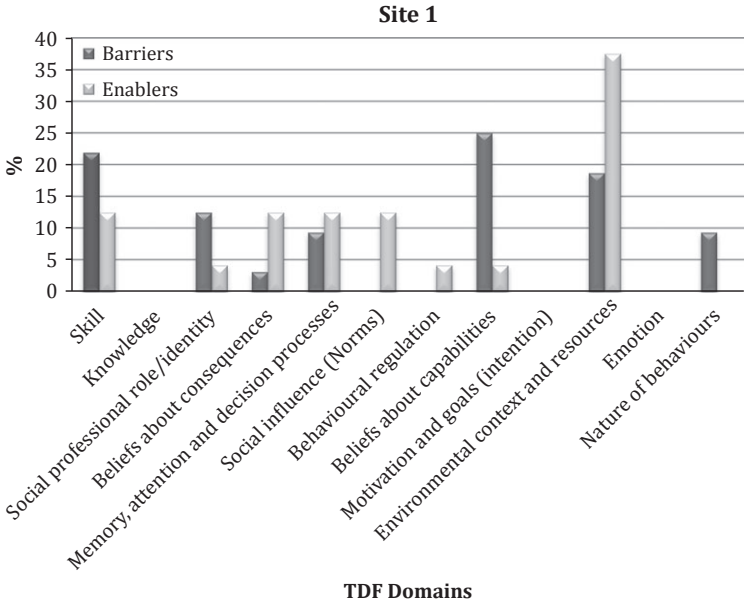

Figure 1 Frequency of Nursing Reactions at Site 1 aligned with the theoretical domains framework (Michie *et al.* 2005).

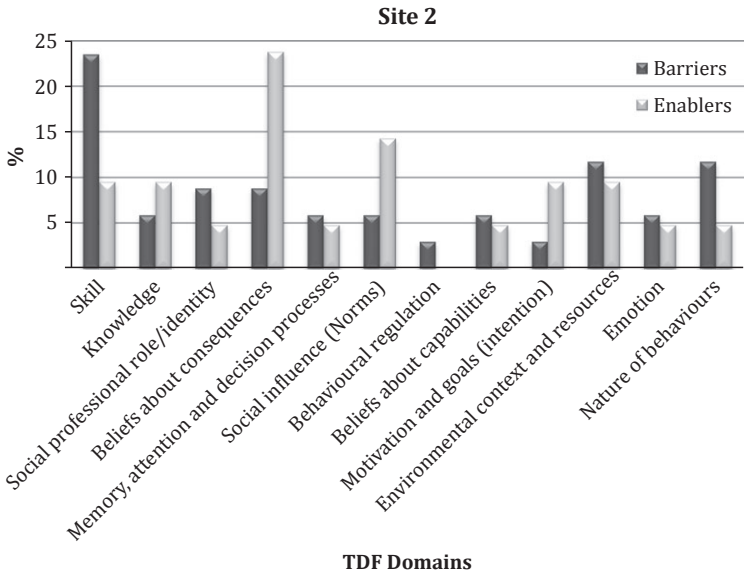

Figure 2 Frequency of Nursing Reactions at Site 2 aligned with the theoretical domains framework (Michie *et al.* 2005).

While the nurse participants were only able to comment after viewing a short video of SmartWard™ prototype, they did appear to react favourably towards the system. Reactions became more favourable after they had time to explore their opinions and envisage its ultimate application to their clinical setting. Nurses from Site 2, however, appeared to be more optimistic about using the technology; comments about enablers were more frequent from this group. Similar findings are reported by Chow *et al.* (2012) who suggested that such reactions might be reflective of those exposed to other 'smart technology' ideas in their workplace, and as such, greater familiarity with the potential and capabilities of the novel SmartWard™ (Bayne & Ross 2007).

Aspects of the novel technology that made it more or less appealing for nursing staff emerged. Of primary importance to nurses was that the system did not 'remove' their professional autonomy but rather enhanced their ability to provide quality nursing care for their patients. This was reflected in comments that related to the TDF (Michie *et al.* 2005) domain of *Skill*, where nurses made clear that they did not want the novel technology to hinder their nursing practice by telling them what to do, but rather that it should support their clinical practice through reminders and to manage and plan care. Nurses gave examples of specific areas where the tool could be useful, and suggested areas, such as wound care where pictures could give other

nurses in the team clear frames of references, medication administration and the coordination of the care between different clinical areas.

Clearly, defining nurses' work is challenging and measuring the care provided by nurses is particularly difficult. Few technology systems have tried to capture the essential components of nursing work and model software on the nurses' needs and requirements (Randell *et al.* 2007). Instead, systems have tended to 'dictate' to the nurse the tasks that need to be done, consequently eliminating or demeaning nurses' clinical thinking, reasoning skills and judgement critical for patient safety. Nurses in this study made it clear they did not want technology to remove their autonomy in decision-making from their practice or provide 'tick box' solutions for their nursing tasks. In preference, they expressed a desire for tools that will provide them with access to information that will inform and support their decisions and care processes. The utility of novel technology for issues related to clinical patient safety is an aspect of practice that requires further exploration in the future stages of testing. However, the literature suggests there is a perceived increase in patient safety in the clinical environment following the implementation of technology to the clinical area (Bakken *et al.* 2004, Van de Castle *et al.* 2004).

The nurses' vision for the tool was to provide a clearly traceable avenue for accountability and responsibility for practice. Nurses' comments surrounding documentation processes emphasised the importance of behaviours in response to problems in care; the example used was that of a patient with a temperature of *38 degrees Celsius – so what did the nurse do about it?* Clear transparent practices of assessment, planning, interventions and evaluation, or the nursing process, can be reflected in the tool leading to greater and more effective planning and coordination of patient care. Furthermore, real-time documentation is being requested and the use of novel technology to assist with this was supported by the nurses.

The ultimate goal for the novel SmartWard™ technology is to capture and operate *how a nurse thinks*. Our initial findings serve to provide some useful insights that can be generalised to the adoption of technology solutions in nursing contexts. Such a tool needs to be sophisticated, flexible and adaptable to support nurses to deliver high quality and safe patient care.

Limitations

Convenience sampling was used, which imposes restrictions on the wider applicability of the findings. The small sample of volunteer nurses from medical and surgical wards at public and private hospitals may not be representative of the broader nursing population, hence limiting the application of the findings to other settings. Furthermore, previous experiences with technology, together with daily use of current clinically related software programs may have impacted on the nurses' lived experiences and their reactions to the SmartWard™ prototype.

Conclusion

Our study clearly showed the benefit of drawing upon multiple sources to inform understanding. So in this case, we drew on behavioural theories related to evidence implementation, design science ideas, management theories and the nursing informatics literature, to develop a rich theoretical lens from which the full picture of the potential interactions and impacts of a technology solution in a nursing context can be studied. This process has the added benefit of promoting end-user acceptance of the new technology, a concept to be tested in the next stage of this research.

Recommendations

Further study is now needed to engage clinical nurses and test the evolving design of the novel SmartWard™ technology and its relativity to the clinical environment, the discipline of nursing and the benefits to patient care. A pragmatic approach needs to be taken using pre- and post-clinical trials.

Relevance to clinical practice

- Nurses' initial reactions to a new technology provide understanding of their perceptions and their needs critical to guide development and implementation;
- This unique insight into the requirements of the user is a critical step that contributes to ultimate end-user acceptance;
- Engaging nurses to inform the design can support subsequent compliance with use of technology solutions through building familiarity and ownership and identifying opportunity to tailor the system and implementation to suit complex acute clinical settings.

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Contributions

Study design: BK, MB, NT, BR; Data collection and analysis: BK, NT, BR, MB; Manuscript preparation: BK, NT, BR, MB, NW, HM, LN.

Conflicts of interest

Nil declared.

Professional issues

Nil declared.

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