Economic benefits of SmartWard

SmartWard Pty Ltd

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Deloitte Access Economics

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Executive Summary

SmartWard Pty Ltd has developed a health informatics system designed to improve hospital efficiency, patient safety and the job satisfaction of health care professionals by:

- sensing patient and health care professional location;

- applying context to anticipate user needs;

- automating the repetitive aspects of administration; and

- providing reminders and clinical decision support in the right context.

Development has taken 5 years and has incorporated significant clinical and research input.

Deloitte Access Economics was commissioned by SmartWard to develop a report that outlines the potential benefits of implementing SmartWard to healthcare providers, in particular hospitals, their patients and society. The discussion of benefits in this report is based on results from the clinical trial of SmartWard (Botti, 2014) that assessed the impact on nurse workflow, and evaluated the usability, perceived fidelity and reliability of SmartWard.

The trial found that SmartWard reduced the amount of time that nurses spent on documentation, and freed them up to perform more high value tasks such as spending time with patients and undertaking comprehensive discharge planning. Specifically, nurses increased the proportion of time spent at patient bedsides from 32.8% to 48.1%, and increased the amount of time that they spent interacting with patients from 7.9% to 23.6%. Nurses were able to decrease the amount of time spent on process activities (such as assessment, planning, implementation and professional communication) from 30 hours to 18 hours, which was driven mainly by a beneficial decrease in professional communication time, such as handover time between shifts.

Results from the trial indicate that the system was highly usable and that it met design aims. Trials of health informatics systems are not common, which makes the SmartWard trial, and its positive results, noteworthy. The desirability of the system is underlined by the conditions of the trial which required all users to participate voluntarily. Though designed for use by all clinical staff, the trial focused on nurses, as they are the biggest user group, and their engagement is key to the successful adoption of any new point-of-care system.

Participants commented that the system was likely to increase their job satisfaction, by enabling them to interact with patients more and allowing them to focus on high value activities.

The system is enabled by sensor inputs, identifying users and patients and recording their interactions. This feature could enable continuous improvements in efficiency and effectiveness in the healthcare sector.

SmartWard may allow nurses to spend more time with patients, hospitals to have access to better data, and create a better work environment for nurses. These results demonstrate that SmartWard has the potential to improve patient outcomes, which are typically measured by a reduction in the length of stay and readmission rates. Numerous academic

studies have demonstrated the direct impact on patient outcomes that are made possible by the improvements to hospital processes that could be achieved through the use of SmartWard. The trial also demonstrated that SmartWard has successfully addressed the usual afflictions of health informatics implementations, such as staff resistance and increased administration burden.

Another significant barrier to uptake of health informatics systems is cost of ownership. Once implemented, changes necessary to maintain safety and compliance to best practice often create a significant drain on resources, rather than savings. SmartWard, by contrast, has lowered its cost of ownership through the use of a proprietary code generator.

SmartWard is also likely to assist hospitals to achieve compliance with the National Safety and Quality Health Service Standards (NSQHSS) by codifying best practice and by automating the generation of NSQHSS compliant reports with minimal additional administrative burden.

Likely savings to an organisation implementing SmartWard may be up to $85,000 per bed per annum due to increased bed throughput, many times the cost of ownership of SmartWard[1]. Systems that create savings and efficiency must be implemented soon and on a large scale if we are to avoid significant reductions in care in Australia in the medium term.

A competitor landscape of the health informatics market has established that SmartWard is a product that is not offered by any other company.

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[1] Note that this is a simple linear application of time data from SmartWard's clinical trial against the findings of Needleman et al (2002). See section 2.3 for further details.

1 Background

1.1 Scope

Deloitte Access Economics was commissioned by SmartWard to develop a report that outlines the potential benefits of implementing SmartWard to healthcare providers, in particular hospitals, their patients and society.

The discussion of benefits in this report is based on results from the clinical trial of SmartWard (Botti, 2014) that assessed the impact on nurse workflow, and evaluated the usability, perceived fidelity and reliability of SmartWard.

1.1 What is SmartWard?

SmartWard is a health informatics system designed to improve hospital efficiency, patient safety and the job satisfaction of Health Care Professionals by:

- sensing patient and health care professional location;
- applying context to anticipate user needs;
- automating the repetitive aspects of administration; and
- providing reminders and clinical decision support in the right context.

At the most basic level of functionality, SmartWard replaces paper-based clinical records at the patient's bedside. Nurses enter patient information at individual, bedside touchscreen units, which report back to a central unit at the nursing station to assist with monitoring the delivery of care tasks and managing nurse workflow. SmartWard is an add-on to the eMR (electronic Medical Record)[2].

SmartWard improves patient privacy and security of patient records through a number of methods, such as innovative use of electronic identification tags for nurses and patients, and removing the need to display sensitive patient information near a patient's bed as all information is stored in the system.

1.2 Context

Healthcare expenditure in Australia is growing rapidly as a result of increased utilisation and cost price inflation in healthcare services. The key drivers are well documented and include demographic change (the "ageing population") and increasing prevalence of chronic disease, improvements in medical technology and consumer demand (based on better awareness of treatment and care options, coupled with enhanced capacity to pay through rising incomes) (ABS, 2014).

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[2] electronic Medical Record (eMR) software is widely distributed throughout Australian hospitals. SmartWard aims to enhance these systems through bedside record-keeping that is directly transmitted to the central nurse station and associated with the patient's eMR.

Budget pressure at the Commonwealth and State levels of government heighten the need to address rising costs.

Objectives in addressing increasing demand for healthcare services include:

- measures to manage demand for services – for example by limiting access to those most in need; and
- reorganisation of service delivery to improve efficiency of the existing resources employed in healthcare.

SmartWard aims to contribute to the second objective – by changing the model of delivering care to patients, particularly in hospitals.

The Grattan Institute recently reported on projections by Health Workforce Australia that there will be a shortage of 80,000 registered nurses by 2025. This is due to a combination of several factors: a reduction in the proportion of the population that are of working age, increased demands on hospitals, and high turnover rates among Australian nurses which can be partly attributed to job dissatisfaction (Duckett and Breadon, 2014). **Should projected shortages eventuate, this would significantly heighten the level of risk faced by healthcare providers and patients in Australia.**

Methods need to be found to attract and retain staff within the sector, as burnout rates are high (Duckett and Breadon, 2014). SmartWard's clinical trial showed that less than 10% of a nurse's shift was actually spent with patients prior to the implementation of the system (see Section 1.3 for further detail on tasks performed by nurses before the trial compared to during the trial).

Addressing the projected shortage of nurses may help Australia to avoid the issues that accompany a nursing shortage. At the Stafford Hospital in the United Kingdom (UK) in the late 2000s, nursing staff shortages were a significant driver of mortality rates, which were significantly higher than those experienced across the National Health Service (NHS). The findings of the investigation by the UK Healthcare Commission are summarised below.

> **Stafford Hospital crisis**
>
> An investigation by the UK Healthcare Commission in March 2009 found that for several years the hospital had a high mortality rate compared to other hospitals in the area for patients admitted as emergencies. This high mortality rate was not due to chance, but was found to be due to several systemic factors across the hospital's system of emergency care.
>
> The investigation found that there were deficiencies throughout the entire process of emergency care. Central to these deficiencies were a shortage of trained doctors and nurses, patients waiting too long for nurse-delivered care such as medication, pain relief, wound dressings and antibiotics, and medical wards which were understaffed.
>
> *Source: Healthcare Commission (2009) Investigation into Mid Staffordshire NHS Foundation Trust, Healthcare Commission, UK.*

Healthcare costs in the Australian healthcare system will continue to rise at a faster rate than the funding that will be provided by government, and the supply of nurses will not keep pace with demand. As such, hospitals will need to establish alternative methods for keeping costs under control and for ensuring they have access to a sustainable workforce.

1.3 Outcomes of the clinical trial

In partnership with Deakin University, Epworth Healthcare and the Royal Melbourne Institute of Technology (RMIT), SmartWard has undergone three stages of trials at two campuses of Eastern Health in Melbourne, which culminated in the full integration of SmartWard into the hospitals' care processes in July 2013 to assess the impact on nurse workflow, and evaluate the usability, perceived fidelity and reliability of SmartWard[3]. The final phase of the trial in July 2013 collected data over three days on the location and nature of nurse activity, and this was compared to data from the first stage of the trial In September 2012.

The clinical trial of SmartWard is unusual in that trials of health informatics systems are relatively uncommon. Bates and Gawande (2003) note that "relatively little effort has been targeted at the perfection of operational systems [in healthcare]" (p. 2526), and that financial barriers mean that even companies who have produced useful tools have spent negligible amounts on clinical trials. A lack of involvement in trials by clinicians and policy makers is also cited as a reason for a lack of clinical testing. A recent review of 101 new health technologies in the Startup Health Insights database (Ostrovsky et al, 2014) reached a similar conclusion, and stated that "investment in digital health often occurs independent of evidence" (p. 4).

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[3] For the full report, see Botti M (2014) *Evaluation of the fidelity and usability of the SmartWard system in the delivery of acute nursing care*, SmartWard Pty Ltd, Canberra.

1.3.1 Reallocation of nurses' time to high value tasks

Current practice for clinical record keeping in the hospital environment requires nurses to spend a significant amount of time making paper-based notes at patients' bedsides and entering data into eMR and other data collection systems, generally at a centralised nursing station.

Table 1.1 highlights the distribution of nursing activities in the clinical trial compared with a baseline that reflects the standard practice in the trial hospitals. Nurses increased the proportion of their time spent at bedsides from 32.8% to 48.1%, while the proportion of their time spent at nurses stations, in corridors and in medication rooms fell. Less time was spent in the corridor as nurses were able to reduce the amount of time spent walking between patients' rooms and the nurses' station.

Table 1.1: SmartWard trial outcomes – location of nursing activities

Location	Baseline (%)	Trial (%)	Difference (ppt)
Nurses' station	25.9	20.0	- 5.9
Bedside	32.8	48.1	+ 15.3
Corridor	21.0	13.3	- 7.7
Medication room	5.2	2.1	- 3.1
Other	15.2	16.4	+ 1.2
Total	100%	100%	0

Note: totals do not add due to rounding.
Ppt= percentage point.
Source: Botti (2014).

Chart 1.1 demonstrates the overall reduction in nursing process activities that occurred during the trial, from 30 hours to 18 hours. At baseline, 30 hours was spent on nursing process activities, which includes:

- Assessment – recording vital signs and measurements, nutritional and fluid status assessment
- Planning – nursing admission and discharge
- Implementation – general nursing care, medication administration and wound management
- Professional communication – nurse-to-nurse and interdisciplinary communication, handover and family/visitor discussions.

Note that nursing process activities do not include other nursing activities such as transporting patients, cleaning equipment and administrative tasks.

Chart 1.1: Duration of nursing process activities
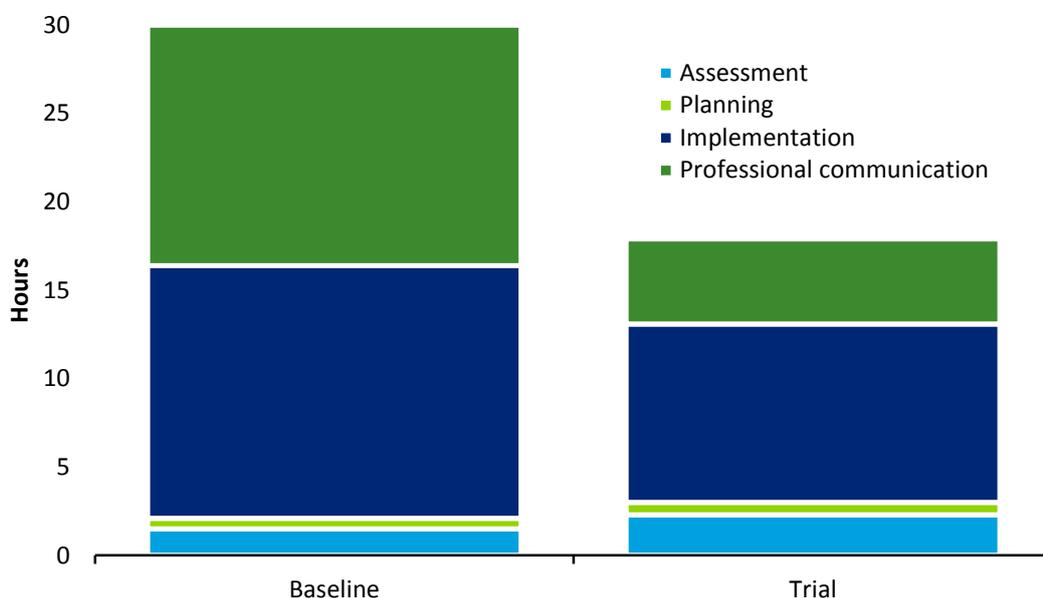
Source: Botti (2014).

The amount of time spent on professional communication decreased significantly (13.6 hours to 4.8 hours, a 65% reduction), while time spent on implementation also decreased (14.3 hours to 10.1 hours, a 27% reduction). There were small increases in the amount of time spent on planning and assessment.

During the trial, nurses spent more time at patients' bedsides. At baseline, nurses on average performed 32.8% of their activities at bedsides, while in the trial the proportion was 48.1%. This increase in time spent at the bedside was partly due to an increase in documentation-related activities that occurred at bedsides: this grew from 24.8% of documentation-related activities to 61.3%. However, the overall duration of time spent on documentation decreased from 6.23 hours to 1.84 hours, which is a reduction of 70%.

Nurses were able to approximately double the amount of time spent with patients: at baseline, nurses spent on average 3.15 hours with patients, while in the trial this increased to 9.3 hours[4]. This represents an increase from 7.9% of nurse time to 23.6% of nurse time, which is a significant increase.

Nurses commented favourably on the improved legibility of medical records, and that they didn't need to waste time trying to decipher information. Nurses felt that the increased time that was needed to set up a patient's record on SmartWard was more than outweighed by the reduction in time in not having to look for charts. As SmartWard replaces the paper records which are traditionally left at the end of a patient's bed or at the nurses' station, there is no longer any productivity loss that results from nurses having to search for a patient's chart, or determine who has the chart.

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[4] At baseline, nurses spent 3.15 hours out of a 39.6 period of observation interacting with patients. Under the trial, nurses spent 6.81 hours with patients, based on 28.9 hours of observation. Therefore: 6.81*(39.6/28.9)=9.3.

This represents a significant time saving to nurses, allowing more time to perform high value tasks such as spending time with patients and undertaking comprehensive discharge planning.

1.3.2   Better patient management

Nurses were able to increase the proportion of time spent on planning activities, which includes nursing admission and discharge, from 1.2% to 1.9% of process activity time. Nurses were also able to increase the proportion of process activity time spent on general nursing care, medication administration and wound management from 44.3% to 57.2%. More time was also able to be spent on tasks such as vital signs, nutritional and fluid status measurement, which increased from 5.2% to 9.1%.

The counterbalance to these increased proportions is the reduction in time which was spent on professional communication, which reduced from 49.3% to 33.6% of process activity time. It should be noted that the fall represents the redundant communication, with around a third of process activity time still being spent in (more useful) professional communication.


SmartWard trial outcomes

- Increased time spent at patient bedside, with more clinical nursing activities occurring at bedside, and more time interacting with patients.

- Decreased time spent at nurses' station, in the corridor, in the medication room, and at the drug trolley.

- A beneficial decrease in the time spent on professional communication.

- Nurses commented favourably on the in-built prompts, that the longer time to set up a patient's record was outweighed by time saved in terms of not having to look for charts, improved legibility of records, and the ease of use of the system.

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2 Benefits of SmartWard

Implementing SmartWard into a hospital ward offers the potential for a new model of care, by delivering better information to nurses, hospitals and policy makers, and by creating a better work environment. Together, these may deliver improved patient outcomes, reduced lengths of stay, and a lower readmission rate. Section 2.1 and 2.2 outline the key areas impacted by SmartWard, and Section 2.3 discusses how these impacts translate into improved patient outcomes. Section 2.4 analyses the potential impact on SmartWard on hospitals achieving the National Safety and Quality Health Service Standards. Section 2.5 summarises the potential challenges faced by SmartWard, and how these have been addressed during its development.

Figure 2.1: Overview of benefits
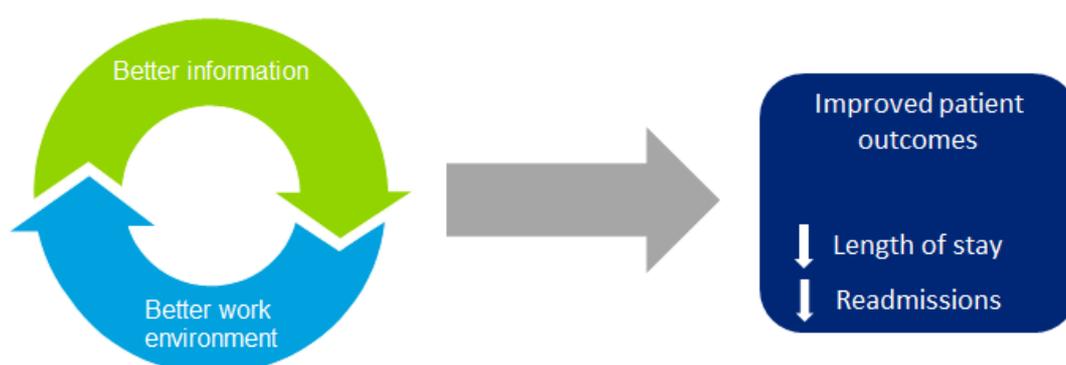
2.1 Better information

The clinical trial of SmartWard suggested that enhanced usability for nurses at the bedside had resulted in a greater likelihood of reporting accurate and timely information. The clinical trial of SmartWard found that this flows through to better fidelity in patient records[5]. This, in turn, has implications for hospital cost-tracking and government datasets.

SmartWard enables nurses to compile better patient records that are more complete and accessible, and that are easily accessible by all relevant staff. This may result in:

- faster shift changeovers, as the new nurses can be quickly brought up to speed on each patient in the ward;

- a reduction in omitted or inaccurate recordings as the in-built system prompts and checks minimise the risk of this occurring;

- reduced interruptions to nurses' documentation time, as more of it occurs at the patient bedside in real time, rather than other locations and/or after time has elapsed where correct recall of patient observations may be compromised; and

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[5] The usability of SmartWard for nurses, who provide care and are increasingly expected to input data to hospital and government datasets, is a key benefit.

- reduced fail-to-rescue situations, as medical personnel can quickly access a complete record of patient care and observations.

Ghabra et al (2007) compared the reliability of three different methods of handover on the amount of information that was retained by the incoming nurse. They found that only 2.5% of patient information was retained using the verbal-only handover method, 85% was retained when nurses were provided with the information verbally and made notes as they listened, while 99% was retained when a printed handout containing all patient information was used. *SmartWard provides the incoming nurse with a written record of all patient observations and treatment records for the patient's entire stay in the hospital. This method of shift hand-over is likely to minimise almost all information that is lost by using typical shift hand-over methods.*

SmartWard delivers **better information to hospitals** as an electronic record of how nurses spend their time is created. Data in the SmartWard system can be interrogated to provide information on what activities have been undertaken, the amount of time spent with each patient, which wards are under the most pressure, and staff members who are routinely required to undertake an excessive volume of tasks in their shift. This information can be used to efficiently allocate resources within the hospital and identify staff shortages before a critical shortage is reached. A study by Wright et al (2006) found that improved models for nurse scheduling and allocation can increase staff satisfaction with the shifts they are assigned, without impacting on wage costs. The study demonstrated that data-driven workforce scheduling models can be used to optimise scheduling of nurses in hospitals. *The data generated by SmartWard may assist with optimising work schedules in hospitals, and allow nurses to be more satisfied with the shifts they are provided with, without increasing wages.*

SmartWard increases the scope for hospitals to use **data mining** techniques to improve patient outcomes and reduce costs. An example of data mining in a hospital is provided in Hachesu et al (2013), which used data mining techniques to determine and predict the length of stay in hospital for cardiac patients. The study found that comorbidities, smoking, and having social security all led to a longer length of stay than other subjects. The authors were able to predict incoming patients' length of stay with 96.4% accuracy. Another example of using data mining to improve patient outcomes is at the New York Presbyterian Hospital, which has used data mining to identify known risk factors in patients. This has reduced the rate of potentially fatal blood clotting in admitted patients from 0.33 incidents per 1,000 patient days, to 0.23 incidents (Robertson, 2012). *The data generated by SmartWard could be used to tailor medical treatment for incoming patients with known risk factors, and forecast resource allocation for each incoming patient. Schneeweiss (2014) identifies prediction of outcomes as a key application of big health data.*

There is potential for **policy makers** to access high quality, complete, accurate and consistent data on patient observations, treatment and outcomes, by drawing on the patient data that is entered into SmartWard by nurses. This has a large range of potential uses, such as:

- Providing data for input to clinical studies, which may seek to investigate links between interventions and outcomes, and establish the efficacy or otherwise of treatments and interventions[6].
- Allowing population health benchmarking of hospital patients, which can be compared intra-hospital, with other hospitals, and with the general population.
- Identifying emerging trends and issues among hospital patients.

The patient data collected across an entire hospital in SmartWard represents a large, accessible and complete data set that may provide insights into decision making to improve health service performance and patient outcomes, by driving practice improvement within the hospital. Hippisley-Cox et al (2003) found that data quality in paperless patient records was of a much higher quality compared with paper-based records. Paperless records were more understandable and legible, and record more pertinent patient information such as diagnosis, notification of advice given to patients, the referrals that had been made and the specialty, and drug use. *SmartWard offers the potential for better quality data to be made available to policy makers, which can be used to drive improvements in public health policy and patient outcomes.*

Continuous improvements in efficiency and effectiveness are needed in the hospital sector. Such improvements are crucially enabled by highly accurate and granular data, such as that produced by SmartWard: authentication measures, time stamping and real-time capture features that may enable a wide variety of studies and improvements to the processes of care, resource utilisation and clinical practice.

2.2 Better work environment

The clinical trial of SmartWard (see section 1.3) found that three key areas of the service model were impacted:

- nurses spent more time at patients' bedsides;
- reallocation of nurses' time towards high value tasks, by reducing time spent recording patient information in centralised databases, and improving workflow; and
- better patient management, both in-hospital and in discharge planning.

These three areas will potentially create a better work environment for nurses, which will lead to higher job satisfaction, reduced personal leave and lower rates of attrition

SmartWard allows nurses to reallocate how they spend their time, and allows them to spend more time on aspects of their job that they consider to be more critical. In the trial, nurses spent more time on aspects of their job such as patient care and spending time with patients, and decreased the amount of time spent on tasks such as documentation. *This reallocation of time will potentially lead to higher job satisfaction among nurses who use SmartWard, which has the potential to reduce staff turnover.* A study by O'Brien-Pallas et al (2004) identified job satisfaction as a key determinant in predicting nurse turnover, and estimated the average cost of turnover per nurse to be $21,514 (US dollars, 2004). This cost is driven mainly by the costs of hiring temporary replacements, and the lower initial

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[6] See Schneeweiss (2014) for a discussion of the potential for big health care data to generate new knowledge about the effectiveness of treatments.

productivity of new nurses. Other less significant cost components are recruitment and hiring, training, and termination costs.

SmartWard has the potential to even out the distribution of nurse workload through accurate timestamping of treatment and easy prioritisation of tasks. In the absence of SmartWard, treatment administered to patients is typically recorded as having occurred either on the hour or the half hour, regardless of when the treatment actually occurred. When follow-up treatment is required, for example four hours after the first treatment, there is pressure on nurses to perform this task four hours after the timestamp. With SmartWard, nurses simply enter the treatment that has been administered, and the system automatically records the actual time of treatment. This means that nurses avoid the peak work periods on the hour and half hour, and work can be evenly distributed over the course of a shift. SmartWard also allows nurses to easily assess which patient tasks in a ward are the highest priority, which assists them in performing the highest priority tasks first.

A study on nurse burnout and patient satisfaction by Vahey et al (2004) found that nurses who worked in wards that had adequate staff, good administrative support, and good relations between doctors and nurses reported significantly lower burnout. Patients in these wards were more than twice as likely as other patients to report high satisfaction with their care. *Nurses using SmartWard may experience less burnout, which will reduce their levels of turnover and improve patient satisfaction with their care.*

2.3 Better patient outcomes

SmartWard contributes towards a better work environment, and information for nurses, hospital and policy makers that is timely and more accessible. This has the potential to lead to improved patient outcomes, which can be measured through a reduction in patient length of stay and reduced readmission rates. The following clinical studies demonstrate the potential impact that SmartWard could have if implemented in an Australian hospital.

- Duffield et al (2011): Increasing the amount of care provided by nurses leads to lower levels of adverse events, and reduces the rate of negative patient outcomes (see also Aiken et al (2002) and Needleman et al (2002). *SmartWard has been shown to increase the duration of care that nurses provide to patients, which will improve patient outcomes.*

- Friese et al (2008): Improving the nurse practice environment (a nurse-sensitive indicator of quality, measured against the Practice Environment Scale of the Nursing Work Index) could reduce the odds of death and of failure to rescue for hospitalised surgical oncology patients (see also Lake, 2002). *SmartWard improves the nurse practice environment through areas such as quality assurance, up-to-date nursing care plans for all patients, allowing nurses to spend time with their patients, and giving nurses time to discuss patient care problems with other nurses. This can improve patient outcomes through reduced odds of death and failure to rescue.*

- Weingarten et al (1993): Patients who were treated according to best practice guidelines did not have any unexpected life-threatening adverse events in the two week period after hospital discharge. *SmartWard has the potential to improve adherence to National Health and Safety Quality Standards, which may reduce readmission rates.*

- Naylor et al (1999): Nurse-centred discharge planning reduced readmissions among at-risk elderly patients, lengthened the time between discharge and readmission, and decreased the costs of providing health care. *Nurses using SmartWard have more time to spend on high-value tasks such as discharge planning, which is likely to reduce readmission rates and lengthen the time between discharge and readmission for elderly patients.*

- Philips et al (2004): Comprehensive discharge planning with post-discharge support for older patients with congestive heart failure significantly reduced readmission rates. It may also improve health outcomes such as survival and quality of life without increasing costs. *SmartWard allows nurses to spend more time on comprehensive discharge planning. This could include increasing the time discussing discharge with the patient, having access to a complete and accurate record of patient observations and response to treatment, and potentially issuing the patient with electronic data from their file. This may reduce readmission rates, and may also increase survival rates and quality of life in discharged patients, at no extra cost.*

SmartWard also has the potential to reduce errors in hospitals, which may lead to reductions in mortality and decrease the rate of complications that extend hospital stays.

- Deans (2005): Medication errors in a hospital are mostly attributed to documentation issues, such as illegible handwriting, misunderstanding abbreviations, misplaced decimal points, misreading and misinterpreting written orders. *SmartWard addresses the usual sources of medication errors, as documentation is recorded on a keyboard, and in-built system checks will reduce the incidence of numbers being entered incorrectly. SmartWard also moves more documentation entry to the bedside (where distraction is reduced and accuracy is enhanced – see Wager et al, 2010), and away from other usual locations such as the corridor and nurses station.*

- Classen (1997): An adverse drug event in hospital is associated with a significantly prolonged length of stay, increased economic burden, and an almost 2-fold increased risk of death. *SmartWard may reduce the risk of adverse drug events through patient records and treatment plans that are more complete and accurate, lowering the risk of providing medication to the wrong patient through improved identification of patients, and by making it easier to assess patient response to administered medication through providing readily-accessible data that is provided in real time.*

The clinical trial of SmartWard demonstrated that SmartWard increased the amount of time that nurses spent with patients from 3.15 hours to 9.3 hours. Needleman et al (2002) estimated that increasing the nurse care provided to patients from 6.3 hours to 9.3 hours resulted in a 5.2% reduction in the average length of stay by patients. A simple linear application of this estimation to the trial results from SmartWard means that SmartWard may deliver an 11.1% reduction in the average length of stay. Using data on the average cost per bed in Australian hospitals[7], this potential reduction in length of stay translates to annual savings in 2014 of:

- $50.8 million to a hospital with 600 beds

- $7.36 billion if employed across the entire hospital system.

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[7] Data was obtained from AIHW (2013): 58,420 available beds in the public health system; 28,380 available beds in the private health system; and 2011-12 expenditure by public hospitals of $40,384 million which was brought forward to 2014 using the health component of CPI.

These calculations merely estimate the impact of SmartWard's potential reduction in average length of stay. The impact of other likely effects, such as reductions in nurse turnover, better adherence to quality standards, and improved utility of data, were not included in the calculation.

2.4 National Safety and Quality Health Service Standards

SmartWard has the potential to positively impact on all ten of the National Safety and Quality Health Service Standards. To meet the guidelines, the ACSQHC[8] recommends that hospitals "standardise routines and processes" and "have systems in place that reduce the risk of harm to patients" (ACSQHC, 2014, page 44). *SmartWard provides a system that assists to standardise procedures and reduce the risk of harm to patients. Through this, it helps hospitals to deliver safe, high quality care.*

The potential impact of SmartWard against each of the ten standards is as follows:

1. *Governance for safety and quality in health service organisations:* SmartWard assists nurses to deliver improved quality of care, which may result in fewer errors and better patient outcomes.

2. *Partnering with consumers:* this may be achieved through improved admission and discharge procedures, and increased time spent with patients will strengthen relationships between patients and staff.

3. *Preventing and controlling health associated infections:* Alerts which are built into the system will remind nurses of patients that are infectious, or who are particularly prone to infection. The alerts could provide information on patient's previous antibiotic resistance profile and any antibiotic resistant infections the patient currently or previously had.

4. *Medication safety:* the records in SmartWard are a more complete record of what medication has been administered, how the patient has responded, and when the patient requires their next dose of medication. Improved identification of patients may reduce the risk of providing medication to the wrong patient.

5. *Patient identification and procedure matching:* The electronic identification wristbands worn by patients will assist in correctly identifying all patients and matching them to their intended treatment.

6. *Clinical handover:* the electronic patient records in SmartWard allow nurses to perform clinical handovers which are more accurate and complete. This results in fewer errors in communication.

7. *Blood and blood products:* SmartWard's patient identification systems and in-built alerts may lead to fewer errors in administering blood and blood products to patients.

8. *Preventing and managing pressure injuries:* the system prompts within SmartWard can remind nurses of which patients need to be moved, and how often, to prevent

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[8] Australian Commission on Safety and Quality in Healthcare.

and manage pressure injuries. This reduces the need for nurses to constantly check patient notes, and so reduces the risk of forgetting to manage pressure injuries.

9. *Recognising and responding to clinical deterioration in acute health care:* system checks that are built into SmartWard will check if patient observations fall within usual clinical boundaries, or whether the observation indicates that a serious adverse event is likely to follow. Also, if a patient's health deteriorates suddenly, their record of treatment is immediately accessible which makes it easier for other medical staff to administer appropriate emergency treatment.

10. *Preventing falls and harm from falls:* hospital staff can make a record on a patient's electronic record that they are at risk of falls and harms from falls. This reminder will be displayed to nurses each time they access the patient's record, and the nurse is required to acknowledge that they have read the reminder.

A system of administration support, such as SmartWard, could be a useful tool for assisting in fulfilling the audit requirements of these new standards.

2.5 Potential challenges faced by SmartWard

Change management is a significant challenge to any paradigm shift in operations in any sector. SmartWard requires users to wear system detectable tokens for many of its benefits to be realised. The risk that some users will refuse to be monitored in this way is significant, however the research underpinning the system has suggested that this aspect is accepted by users because it provides a 'safety net' rather than an accountability measure (Botti, 2014). The volunteer rate (96%) that enabled the system to be trialled supports the assessment that the impact of this risk would be high, but the likelihood appears low.

Studies such as Boonstra and Broekhuis (2010) and Smelcer et al (2009) found that data entry into electronic medical records is time consuming, resulting in nurses entering data after they have provided care to the patient, when they are no longer at the bedside. In addition, many nurses reported that using conventional electronic medical records actually decreased their productivity. *The difference with SmartWard is that information is entered as tasks are completed in an intuitive and touch screen mode that nurses are able to define appropriate to their needs, thus greatly enhancing the accuracy of data entered into the system while reducing repetition. As outlined in section 1, nurses also found that SmartWard has increased their productivity, rather than decreased it.*

Early adopters face the risk that the system benefits may not be scalable and the cost of ownership may be higher than anticipated, as the system is untried in an institution-wide deployment. However, results from the clinical trial of SmartWard suggest that this risk is low, as 57 changes relating to physical, interface and functionality improvements were able to be delivered within only 25 days (Botti, 2014). SmartWard's software development uses a model driven development life cycle, which allows changes to be made to the model and then consistently applied via the generator into the executable code. This approach reduces the time needed to make changes to the software, which will allow changes to be made at a lower cost and thus drive down the cost of ownership.

Safety-critical technologies and development techniques have also been used, pointing to a significant range of future productivity and safety gains, such as the attachment of online monitors to all patients to detect deterioration earlier and the medium and longer term

potential of the system to deliver further gains seems high. A long-term study in an initial deployment is needed to test and measure these potentials.

Conclusion

SmartWard is a clinical software package that aims to provide better information to health care professionals, hospital administrators and policy makers. Such information should enable improvements in resource utilisation, create a better work environment in hospitals and improve patient outcomes.

A clinical trial found that SmartWard led to improvements in nurse time spent with patients. This was due to a reduction in the amount of time for documentation, which allowed nurses to spend time caring for patients and other high value tasks. There is a clear correlation in the literature between increased time spent with patients and improved clinical outcomes, reductions in duration of patient stays and decreases in readmission rates.

The clinical decision support features are likely to assist nurses to provide care that adheres to the National Safety and Quality Health Service Standards. The reporting features are likely to decrease the resource impacts of compliance to National Safety and Quality Health Service Standards audit requirements.

There is potential to deliver better information to hospitals, make it easier for hospitals to undertake data mining, reduce the level of errors in hospitals, and reduce nurse attrition rates. These will contribute to improved patient outcomes and increase patient satisfaction with the services that they receive.

The improved information may assist hospital management to allocate resources in the most cost-effective way, and ensure that the hospital has the highest level of bed availability resulting from a balanced complement of resources.

SmartWard may also help to alleviate looming shortages in the nursing workforce, by increasing the productivity of the existing workforce and reducing attrition rates in the industry. SmartWard does not aim to reduce the number of nurses that are employed in hospitals around Australia. Rather, it is an enabler of a new model of care that will assist healthcare providers to maintain a workforce that focuses on the high value tasks that they are trained to perform, and a workforce that derives more satisfaction from its work. This may lead to:

- lower attrition rates, which leads to reduced on-boarding costs;
- an improved balance of the experience and knowledge which is required to provide an appropriate level of care; and
- lower levels of stress among nurses with subsequently higher levels of personal health.

The savings we can extrapolate if the system were deployed nationally are in the order of $7 billion. In the face of mounting health expenditure costs by government, SmartWard's potential impact on patient outcomes and enabling of continuous improvement through more comprehensive and reliable data may assist governments to balance a sustainable level of health expenditure with quality outcomes for the community. It could achieve this by improving patient outcomes, which has been shown to reduce the costs associated with prolonged stays in hospital and the costs incurred by patients being readmitted to hospital.

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