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Descriptive title:

Implementation of an evidence-based practice nursing handover tool in intensive care using the knowledge-to-action framework.

Short title:

Implementation of an evidence-based practice nursing handover tool

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ABSTRACT

Background

Miscommunication during handover has been linked to adverse patient events and is an international patient safety priority. Despite the development of handover resources, standardised handover tools for nursing team leaders in intensive care are limited.

Aims

The study aim was to implement and evaluate an evidence-based electronic minimum dataset for nursing team leader shift-to-shift handover in the intensive care unit using the knowledge-to-action framework.

Methods

This study was conducted in a 21-bed medical/surgical intensive care unit in Queensland, Australia. Senior registered nurses involved in team leader handover were recruited. Three phases of the knowledge-to-action framework (select, tailor and implement interventions, monitor knowledge use and evaluate outcomes) guided the implementation and evaluation process. A post-implementation practice audit and survey were carried out to determine nursing team leader use and perceptions of the electronic minimum dataset three months after implementation. Results are presented using descriptive statistics (median, IQR, frequency and percentage).

Results

Overall (86%, n=49), team leaders used the electronic minimum dataset for handover and communication regarding patient plan increased. Key content items however were absent from handovers and additional documentation was required alongside the minimum dataset to conduct handover. Of the team leaders surveyed (n=35), those receiving handover perceived the electronic minimum dataset more

positively than team leaders giving handover (n=35). Benefits to using the electronic minimum dataset included the patient content (48%), suitability for short-stay patients (16%), decreased time updating (12%) and printing the tool (12%). Almost half of the participants however, found the minimum dataset contained irrelevant information, reported difficulties navigating and locating relevant information and pertinent information was missing. Suggestions for improvement focused on modifications to the electronic handover interface.

Linking evidence to action

Prior to developing and implementing electronic handover tools, adequate infrastructure is required to support knowledge translation and ensure clinician and organisational needs are met.

Key words: Handover, minimum dataset, nursing, knowledge-to-action, evidence-based practice

INTRODUCTION

Until recently, there have been limited resources available to support nursing handover in the intensive care unit (ICU). Clinical handover is a top five preventable safety issue worldwide leading to adverse patient events and unnecessary healthcare expenditure (Starmer et al., 2013). Although research outlining various aspects of ICU handover is growing, there are limited standardised tools applicable to nursing team leader (TL) handover.

ICU nursing TLs oversee nurses at the bedside and are responsible for coordinating and managing care for multiple critically ill patients with complex healthcare needs. TLs rely on informative handovers to maintain care continuity following shift changes and play a pivotal role in ensuring ICU patients receive optimal care. Our previous work identified the content required in nursing TL handovers and informed the development of an electronic minimum dataset (eMDS) for shift-to-shift handover (Spooner, Aitken, Corley, & Chaboyer, 2017). Recently, electronic handover tools have received attention as a possible strategy to improve communication and reduce handover related incidents (Balka, Tolar, Coates, & Whitehouse, 2013; Staggers, Clark, Blaz, & Kapsandoy, 2011). Many health care areas have developed electronic templates that auto-populate content from multiple sources within the clinical information system (CIS) or are updated manually by clinicians (typing in free text boxes); eliminating handover preparation time (Silvester & Carr, 2009). The introduction of electronic handover tools has increased efficiency, reduced time spent handwriting notes, decreased duration of handover, increased adherence to handover protocols and clinicians have reported finishing work on time (Balka et al., 2013; Li, Ali, Tang, Ghali, & Stelfox, 2013; Ryan, O'Riordan, Tierney, Conlon, & Ridgway, 2011).

The integration of evidenced-based strategies into practice, such as an eMDS for nursing TL handover can be challenging. Knowledge translation frameworks provide a structured and systematic approach to translate knowledge into practice, which promotes and sustains practice change (Davison, Ndumbe-Eyoh, & Clement, 2015; Field, Booth, Ilott, & Gerrish, 2014). The knowledge-to-action (KTA) framework is one of the most frequently cited conceptual frameworks used in healthcare settings to support researchers and clinicians implement evidence-base practice (Field et al., 2014). The framework incorporates existing change theories from health, social sciences, education and management fields to provide user-friendly action phases to consider during the knowledge translation process which was utilised in this research. Guided by the KTA, researchers and clinicians engage with end-users to identify gaps in practice, align new knowledge to the local context which informs implementation strategies to embed evidence-based practice (Field et al., 2014; Lockwood, Stephenson, Lizarondo, van Den Hoek, & Harrison, 2016). End-users act as informants throughout the implementation and evaluation process. The KTA comprises of two components: Knowledge Creation is the production of knowledge and consists of three phases – knowledge inquiry, knowledge synthesis and creation of knowledge for best practice (Graham, Tetroe, & K. T. Theories Research Group, 2007; Lockwood et al., 2016). The Action component guides the implementation process for change and sustainability consisting of seven phases - identify the problem; adapt knowledge to the local context; assess barriers to knowledge use; select, tailor and implement interventions; monitor knowledge use; evaluate outcomes; and sustain knowledge use.

Utilising the KTA framework, the study aim was to implement and evaluate an eMDS for ICU nursing TL shift-to-shift handover. This research sought to answer three questions:

1. What strategies should be used to implement an eMDS for handover?
2. To what extent did TLs use an eMDS for handover?
3. What were TL's perceptions of an eMDS for handover?

METHODS

This study was conducted between January and June 2016 in a 21-bed adult medical/surgical ICU, specialising in cardiothoracic surgery at a tertiary referral hospital, in Queensland, Australia. Ethical approval was obtained by the institutional (HREC/10/QPCH/5) and university (NRS/09/13) Human Research Ethics Committee.

Setting

The ICU consists of three areas (ICU 1-cardiac surgical, 2 and 3–general); each area containing up to nine patients coordinated by one TL. There are 180 registered nurses employed in the ICU including 63 senior registered nurses working in TL roles. Handovers occurred at the nurses' station within each area.

Participants

All nursing TLs were invited to participate. All TLs worked across the three ICU areas. Potential participants were told about the study at staff meetings. Written consent was obtained prior to study commencement and confirmed during data collection.

Electronic minimum dataset

An eMDS was built within the MetaVision (*i*MD*soft*®, 2017) CIS over a 6-month period (June-December 2015) in collaboration with the on-site CIS coordinator and Hospital Health Service information technology department. The eMDS was structured using the ISBAR (Identify-Situation-Background-Assessment-Recommendation) mnemonic and additional content items considered pertinent to ICU nursing TL handover, identified in previous research (Spooner et al., 2017). Within the 'Assessment' category of the ISBAR mnemonic, TLs acknowledged and discussed significant detailed information within each body system (i.e., Respiratory system) to provide a thorough overview of the patient. For example, when TLs acknowledged the 'social system', information regarding family or care giver issues and needs were discussed. In addition to ISBAR, TLs mentioned alerts (allergies, infectious status, patient incidents) and patient management strategies (end-of-life plan, investigations). As TLs are also shift coordinators, they handed over managerial information regarding admissions, discharges, skill mix and theatre cases coming to ICU. An eMDS for each patient was generated and information was mostly auto-populated from multiple sources within the CIS. A free text box was provided with each eMDS to add additional information not included in the tool. Wi-Fi was unavailable during the study period; therefore, smart devices were not used. Instead, an eMDS for each patient was printed from the CIS to facilitate bedside handover.

Data collection

The Action cycle from the KTA framework guided knowledge translation. Phase four, five and six informed the implementation and evaluation process for this research.

Phase 4: Select, tailor, implement interventions

Our previous work identified the barriers and facilitators to eMDS use (Spooner, Aitken, & Chaboyer, In press). Barriers consisted of knowledge deficits regarding the ICU handover work unit guideline and an eMDS that was not user friendly, time consuming and contained too much information. Facilitators included TL familiarity with most work unit guidelines and a user-friendly eMDS that saves timed and contained relevant information. These findings informed four strategies selected to implement the eMDS into ICU. The investigators selected Interventions from recent systematic reviews and multiple strategies were utilised due to the cumulative and significant effect shown to promote practice change (Effective practice and organisation of care, 2016; Grimshaw, Eccles, Lavis, Hill, & Squires, 2012). First, 30-minute interactive education sessions were used to target knowledge deficits. A video focused on safety issues, the national handover standard, the ICU handover work unit guideline, handover resources and real-life handover scenarios to critique. TLs were also given hands on training using the eMDS (Russell, Cornello, & Wright, 2007). Second, a small group of TLs and nursing management were recruited as 'champions' to be the driving force of change through developing positive relationships with nurses, challenging the barriers, educating and supporting TLs to use the eMDS (Effective practice and organisation of care, 2016). Third, regular reminders regarding the eMDS were placed on posters at handover locations and sent via emails to increase nurses' recall of handover knowledge and further embed the use of the tool (Effective practice and organisation of care, 2016). Instructions and short reference guides were placed on computer desktops fastened to computer monitors to act as prompts. Fourth, ad hoc audit and feedback was used during the first four weeks of eMDS implementation. A clinical research nurse (AS) attended various handovers, seven days a week during night-to-day or day-to-night shift

handover. Consistent with the feedback intervention theory, a behavioural change theory, TLs were given feedback regarding their use of the eMDS and goals were set to redirect their focus of attention during handover to promote behaviour change and efficient use of the eMDS (Kluger & DeNisi, 1996). The research nurse also assisted staff with troubleshooting issues and gained feedback about the eMDS which informed modifications to the ~~tool~~ electronic interface to ensure the eMDS was user friendly and efficient to navigate. This strategy relied on participant involvement to facilitate optimal use of the handover tool.

Phase 5: Monitor knowledge use

Three-months post eMDS implementation, 49 handovers were audited over 25 days (Monday-Friday) to determine the extent of TL use of the eMDS during handover. A random number generator sampled one TL per handover from the three ICU areas during the night-to-day (0700-0730hrs) and day-to-night shift (1900-1930hrs) handover. Handovers were observed if the oncoming and outgoing nurse provided consent to participate and had not been previously observed handing over. Nurses were observed once giving handover and any number of times receiving handover. The audit tool contained three sections 1) demographics, 2) general handover information and 3) adherence to the ISBAR mnemonic and other key content items (Spooner et al., 2017). The audit criteria were either met or not met.

The audit tool was scrutinised by an expert panel of six experienced nurses including two PhD supervisors, a Quality and Safety Clinical Nurse Consultant, Clinical Nurse, Clinical Nurse Teacher and Clinical Nurse Consultant in ICU for face validity. Next

inter-rater reliability was established (≥ 80% agreement) between three auditors and then data collection commenced (Polit & Beck, 2012).

Phase six: Evaluation outcomes

A survey was distributed to all TLs (n=63) three months-post eMDS implementation to assess their perceptions of using the eMDS for handover. Surveys were placed on the ICU central desk along with an opaque envelope to collect completed surveys each day for three weeks. Email reminders were sent each week. The 'Clinical Handover Staff Survey' (O'Connell, Macdonald, & Kelly, 2008), widely used in handover research, was adapted to the ICU setting and consisted of four sections: 1) demographics, 2) TL perceptions of handover (25-items), 3) perceived strengths and limitations of handover and 4) suggestions for improvement. TLs were asked to rate their perceptions related to a series of statements on a 7-point Likert scale ranging from' Strongly Disagree' to 'Strongly Agree' and each item was given a score from 1 to 7. Nurses answered open ended questions relating to the strengths and limitations of the eMDS and made suggestions for improvement.

Although the survey tool has been previously assessed for face validity, the tool underwent further scrutiny by four expert nurses (two ICU nurses, a PhD student and PhD supervisor). During Phase 5 face validity (readability, understandability, relevance, ease of response) and content validity (clarity, consistency and content) were assessed using a 2-point scale with 'Clear' or 'Unclear'/'Yes' or 'No' responses (Imle & Atwood, 1988). Although the initial content validity index was more than 0.8 (clarity:0.89, consistency:0.89 and content:1.0 Scale-Content Validity Index/Universal Agreement) questions were revised until perfect agreement was

achieved (Polit & Beck, 2012). The survey tool was pilot tested at two different time points by eight TLs in the ICU to establish test-retest reliability (83% of nursing TLs had perfect agreement or 1-point difference in responses at two time points).

Data analysis

Descriptive statistics were used to summarise data from the post eMDS-implementation audit and survey. Data are presented as median, interquartile range, frequency and percentage. Responses to open ended questions and the frequency of recurring responses are summarised.

RESULTS

Phase 5: Monitor knowledge use

Three months following eMDS implementation 49 out of 63 (78%) TLs were observed performing handover (49 nurses giving handover, 49 nurses receiving handover) resulting in 322 patient handovers and a median of seven (IQR 3) patients discussed at each handover. Table 1 provides a summary of these observations. Participants were mostly female, and experienced ICU nurses. Slightly more than half of the handovers were observed from the night-to-day shift. Most handovers were performed using the eMDS to conduct handover, alongside other paper and electronic print-outs.

Table 1 Post-implementation observation participant characteristics (n=49)

Demographics	Frequency (%)	Median	IQR
Gender			
Female	35 (71)		
Male	14 (29)		
Nursing grade			
Nurse grade 6	23 (47)		
Nurse grade 5	26 (53)		
Years nursing		16	11
Years working in ICU		13	10
Years working as TL		6	8
Shift			
Night-day	29 (59)		
Day-night	20 (41)		
Handover time (mins)		29	9
Overtime (mins)	26 (53)	2	10
Handover started late	31 (65)		
Handover location			
Desk	4 (8)		
Bedside	40 (82)		
Missing	5 (10)		
Handover tools used during handover			
eMDS	42 (86)		
Body systems paper handover form	7 (14)		
Ward view (computer program)	6 (12)		
Other	11 (22)		
Own notes	9 (18)		
Medical notes	1 (2)		
Unknown	1 (2)		

Audit findings are detailed in Table 2. Almost two thirds of TLs referred to *unit flow and management* (admissions, discharges, staffing, skill mix and equipment issues) of the ICU. Most TLs structured their handovers using the ISBAR mnemonic. Within the *Identify* category over three quarters of nurses referred to three patient identifiers to discuss patients, however only one patient's medical identification number was mentioned in 322 patient handovers. More than half of the handovers contained information regarding patient diagnosis, reason for admission to ICU and surgical procedure however, only six percent of handovers contained information about

resuscitation plans in the *Situation* category. Patient plan within the *Recommendations* category was the only item routinely discussed during handovers.

Table 2 TLs' use of the eMDS for handover (n=49)

Category	Subcategory	Frequency (%)
Unit flow & management	Mentioned in handover	31 (63)
	Unit overview template	3 (6)
	Equipment issues	10 (20)
Identify	Name	304 (94)
	Age/date of birth	252 (78)
	Days in intensive care	237 (74)
	Medical identification number	2 (1)
	Bed number	138 (43)
	Admitting doctor	138 (43)
Situation	Diagnosis	186 (58)
	Reason for admission to ICU	239 (74)
	Surgical procedure (if applicable)	236 (73)
	Acute resuscitation plan	18 (6)
	Discharge status	85 (26)
Background	Medical/surgical history	262 (81)
	Patient issues/status	263 (82)
	Management of issues	252 (78)
Assessment		
Central nervous system	[a]Acknowledged	75 (23)
	[b]Observations	283 (88)
Respiratory system	Acknowledged	67 (21)
	Observations	295 (92)
Cardiovascular system	Acknowledged	81 (25)
	Observations	289 (90)
Gastrointestinal system	Acknowledged	24 (7)
	Observations	201 (62)
Renal system	Acknowledged	19 (6)
	Observations	252 (78)
Skin system	Acknowledged	27 (8)
	Observations	98 (30)
Social system	Acknowledged	6 (2)
	Observations	88 (27)
Recommendation	Patient plan	232 (72)
	Chores for next shift	69 (21)
	Consultations	36 (11)
Other	Alerts	82 (25)
	Additional patient updates	56 (17)

[a]Acknowledged - stated the body system before discussing observations
[b]Observations - discussed observations relating to the corresponding body system

Phase six: Evaluation outcomes

Three months following eMDS implementation 35 (56%) nursing TLs completed a survey assessing their perceptions of the eMDS (Table 3). Most respondents were female and had extensive ICU experience.

Table 3 Post-implementation survey respondent characteristics (n=35)

Demographics	Frequency (%)	Median	IQR
Gender			
Male	5 (14)		
Female	24 (69)		
Age			
≤25	1 (3)		
26-35	13 (37)		
36-45	8 (23)		
46-55	10 (29)		
>55	1 (3)		
Nursing grade			
Grade 5 Registered nurse	23 (66)		
Grade 6 Clinical nurse	8 (23)		
Work status			
Full-time	15 (43)	34hrs/week	6
Part-time	19 (54)		
Number of years nursing			
≤5	2 (6)		
6-10	8 (24)		
11-20	10 (29)		
≥21	11 (31)		
Years working in ICU		13	7
Year working as TL		8	5

Although all TLs *giving* handover carried out bedside handover (100%, n=35) and used the eMDS (74%, n=26), enabling them to share the upcoming patient plan and give advice to oncoming TLs, they did not consider handovers were succinct or the forum to include patients or families. TLs *receiving* handover generally perceived handover positively reporting that they felt comfortable asking questions, information was up to date, timely and contained sufficient content (Table 4).

Table 4 TL perceptions of an eMDS for handover (n=35)

Question	Median	IQR
TL receiving handover		
I am able to ask questions about information that has been provided to me at handover	6	1
I am provided with sufficient information about patients at handover	6	0
The format in which information is provided to me at handover is easy to follow	5	3
The information that I receive is up to date	6	1
I am able to remain focused at handover	5	2
I am informed about different aspects of nursing care during handover	6	0
Patient information at handover is provided in a timely fashion	6	1
I feel that important information is not always given to me at handover	4	2
I am given information during handover that is not relevant to patient care	5	2
I can obtain the handover information from the patients' electronic record instead of using the TL handover tool	5	2
I find it beneficial to visualise the patient during handover	5	3
The information that I receive at handover is ambiguous?	3	2
The new handover tool extends the time needed for handover	5	2
TL giving handover		
The new handover tool helps me to deliver a succinct handover	3	3
I feel comfortable handing over confidential information at the bedside	3	3
I use strategies to appropriately discuss sensitive information at handover	6	1
I am often interrupted by colleagues, patients &/or their significant others during handover	5	4
I have the opportunity to debrief with other colleagues at handover when I have a difficult shift	4	4
I have the opportunity to discuss how patient issues were managed during the shift	5	2
I have the opportunity to discuss workload issues at handover	5	3
I share the upcoming plans for patient care during handover	6	0
I give advice to the oncoming TL during handover	6	1
I invite patients to participate in the handover process	2	2
I invite family members to participate in the handover process	2	3
There is enough time for me to deliver handover	4	4

1=Strongly disagree, 2=Disagree, 3=Somewhat disagree, 4=Neither agree/disagree, 5=Somewhat agree, 6=Agree, 7=Strongly agree

TLs described advantages and disadvantages to using the eMDS and suggested improvements. Responses provided three or more times by TLs are reported.

Seventy-one percent (n=35) of respondents surveyed described the advantages to be content (48%), suitability for short-term patients (16%), saves time (12%) and easy to print (12%).

Thirty (86%) respondents surveyed recalled disadvantages to using the eMDS. Almost half of the participants found the tool contained irrelevant information (e.g., number of times dialysis stopped and started), reported difficulties navigating and locating relevant information and missing content because items had not been auto-

populated into the tool. In addition, TLs found the eMDS time consuming (37%), difficult to print (23%), the eMDS relied on medical notes that were often not documented and missing and six (20%) nurses continued to write their handover notes.

Although several strategies were recommended, the most common related to the lay out of the eMDS (24%), using the body systems to structure the tool (14%), incorporating the typed weekly medical summary (14%) and reporting trends in data such as vital signs rather than a snapshot at one point in time (14%).

DISCUSSION

Our study examined the implementation and evaluation of an evidence-based eMDS for ICU nursing TL shift-to-shift handover using the KTA framework. Participants were experienced ICU nurses. Multiple implementation strategies (education, champions, reminders, ad hoc audit and feedback) were employed to overcome the barriers and complement the facilitators identified in previous literature. Three-months post implementation most TLs used the eMDS to conduct handover however key content items were absent and additional documentation was used alongside the eMDS. Nurses receiving handover had more positive perceptions of the eMDS than nurses giving handover and open-ended questions revealed numerous disadvantages relating to the electronic capability of the tool and suggestions for improvement were aimed at modifying the handover interface.

Alongside identified deficiencies with the electronic handover interface, the KTA framework lacked sufficient guidance to troubleshoot issues that arose during the implementation and evaluation process. The KTA is widely used in knowledge translation and is not only a process model (provides steps in the process of

translating research into practice), it is also a determinant framework (identifies the barriers and facilitators to implementation outcomes) that provides an implementation process that proceeds in a step-wise linear fashion (Nilsen, 2015). The implementation process however, is a multifaceted and complex phenomenon and the KTA has been criticised for being too generic, providing limited support during the implementation process.

Although some improvements were seen in nursing TL handover, our findings indicate that there were multiple shortcomings with the implementation of an eMDS in the ICU. In addition to using the KTA to structure the project, strategies informed by other theoretical approaches may have provided the researchers with additional support to resolve unanticipated problems, thereby optimising the knowledge translation process. The incorporation of strategies based on behavioural theories such as the COM-B (Capability, Opportunity, Motivation and Behaviour) which focuses on altering components of the behaviour system to promote change (Michie, van Stralen, & West, 2011) or the Transformation theory whereby clinicians learn how their experiences, perceptions and values lead to subsequent actions by using critical reflection and discourse (Matthew-Maich, Ploeg, Jack, & Dobbins, 2010) may have been a beneficial adjunct. Addressing emotions, attitudes and beliefs toward an intervention may have motivated nurses to embrace and sustain a new handover procedure.

Despite limitations of the KTA, several factors relating to the CIS may have also contributed to inadequate communication of content items during TL handover. For instance, most TLs printed additional documentation to accompany the printed eMDS as important information was absent either because medical staff had not

updated the electronic record (e.g. admission notes) or because the CIS was unable to integrate information (x-ray and magnetic resonance imaging results) from external sources. A survey conducted by the Healthcare Information and Management Systems Society reported that more than 90% of hospitals used six or more types of medical devices/databases and approximately a third integrated them with one another or the electronic medical record (Healthcare information and management systems society, 2010). Furthermore, nurses were forced to print the eMDS for each patient as Wi-Fi was unavailable to accommodate portable devices. Nurses reported delays of up to two hours to upload and print eMDSs. Similar findings were identified in an examination of the use of an electronic handover tool to improve doctors' weekend patient handovers (Govier & Medcalf, 2012).

Several benefits of incorporating information technology into handovers have been described however, our findings were not consistent with the literature. Although the content of the eMDS was based on an earlier phase of this work, the CIS was not able to accommodate some items into the handover interface such as trends in vital signs and specific therapies the patient received. Instead, the eMDS contained a snapshot of vital signs at one point in time and contained all therapies the patient received including unnecessary details such as the number of times a dialysis machine was stopped and started. Consequently, TLs navigated through pages of information to locate pertinent items to discuss. A major limitation of current ICU CIS is the inability to perform basic analyses (e.g., report trends in vital signs) and future CIS will need to be able to synthesize and translate data into meaningful, actionable information (De Georgia, Kaffashi, Jacono, & Loparo, 2015). The eMDS did not

include patient and family educational needs as this was conveyed by the bedside nurse. TLs discussed educational needs if related to managerial issues.

LINKING EVIDENCE TO ACTION

- Researchers and clinicians should consider using an overarching theoretical framework such as the KTA to embed knowledge into practice as it articulates a systematic approach.
- When implementing new practices, those leading the change should draw on multiples theories to challenge engrained attitudes and behaviours and to troubleshoot unanticipated issues which may assist to embed evidence-based practice into clinical settings.
- Prior to introducing evidence-based practices, healthcare settings need to ensure adequate infrastructure is in place to support and optimise the knowledge translation process.
- While paperless teams are the way of the future, managers and directors need to ensure that clinical information systems meet user needs, fulfil safety and quality standards and optimise patient care.

Recommendations for practice

Several key considerations for the development of electronic handover tools within CISs were identified in this study. Despite close collaboration between the researchers and CIS coordinator to resolve issues with the handover interface, the infrastructure was inadequate to support the establishment of a handover tool that could meet end-user needs. Vendor support was critical to resolving the technological issues however would have required additional funding that was not attainable or feasible for this research study. Similar issues were highlighted in Saleem et al's study (2015) that evaluated commercial CIS for ICUs. The investigators suggested that efficient technical support is needed to positively support the application's reliability and end-user satisfaction (Saleem et al., 2015). Purchasing regional CIS that contain local or on-site technological support may provide ongoing and timely assistance rather than enterprise level CISs, where

support is provided off-site, is either delayed or unavailable and frequently expensive to obtain.

When purchasing a CIS, organisations need to ensure that the system can integrate data from multiple sources, the architecture facilitates complex data mining and analysis (to make sense of patient data), incorporates a user friendly, visual display and an interface that will promote informed decisions about patient care and the delivery of quality care to patients (De Georgia et al., 2015). When developing and implementing electronic handover tools it is vital to work with a skilled information technology team to build a flexible interface that can be modified to accommodate user needs and meet national and local standards.

Limitations of the study

The study was conducted in one ICU therefore the results may not be generalizable but may be used to inform the development of electronic handover tools in other ICUs, especially given Australian ICUs are posited for wide spread use of MetaVision. It is possible nurses may have changed their behaviour during observational audits of handover but several observations of nursing handovers have been conducted previously in the ICU for research and hospital-wide auditing and the investigators believe that nurses appeared comfortable being observed.

CONCLUSION

Our research examined the implementation and evaluation of an eMDS for nursing TL handover in the ICU. The KTA framework provided a structure to implement and evaluate an evidence-based eMDS for nursing TL shift-to-shift handover. The incorporation of theories to challenge engrained attitudes and behaviours may assist researchers and clinicians with embedding evidence into clinical settings such as the

ICU. While interest in eMDSs is gaining momentum in healthcare facilities, adequate infrastructure is required prior to developing electronic interfaces in healthcare settings. Electronic handover interfaces need to be flexible, modifiable, easy to navigate, contain content that promotes succinct and informative handovers of ICU patients to maintain continuity of care and improved patient outcomes.

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