2015-10

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Damkliang, J

10.1016/j.ienj.2015.04.004
International Emergency Nursing
Elsevier BV

International Emergency Nursing 23 (2015) 299–305

Contents lists available at ScienceDirect

International Emergency Nursing

journal homepage: www.elsevier.com/locate/aaen

Nurses' perceptions of using an evidence-based care bundle for initial emergency nursing management of patients with severe traumatic brain injury: A qualitative study

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ARTICLE INFO

Article history:
Received 14 December 2014
Received in revised form 13 April 2015
Accepted 27 April 2015

Keywords:
Emergency nursing
Brain injury
Trauma
Neurotrauma
Evidence-based practice
Care bundle
Thailand

ABSTRACT

Evidence to guide initial emergency nursing care of patients with severe traumatic brain injury (TBI) in Thailand is currently not available in a useable form. A care bundle was used to summarise an evidence-based approach to the initial emergency nursing management of patients with severe TBI and was implemented in one Thai emergency department. The aim of this study was to describe Thai emergency nurses' perceptions of care bundle use. A descriptive qualitative study was used to describe emergency nurses' perceptions of care bundle use during the implementation phase (Phase-One) and then post-implementation (Phase-Two). Ten emergency nurses participated in Phase-One, while 12 nurses participated in Phase-Two. In Phase-One, there were five important factors identified in relation to use of the care bundle including quality of care, competing priorities, inadequate equipment, agitated patients, and teamwork. In Phase Two, participants perceived that using the care bundle helped them to improve quality of care, increased nurses' knowledge, skills, and confidence. Care bundles are one strategy to increase integration of research evidence into clinical practice and facilitate healthcare providers to deliver optimal patient care in busy environments with limited resources.

1. Introduction

Care bundles are one solution to introduce evidence into clinical practice and optimise the care provided by healthcare providers (Resar et al., 2012). A care bundle is defined as "a small set of evidence-based interventions for a defined patient segment/population and care setting that, when implemented together, will result in significantly better outcomes than when implemented individually" (Resar et al., 2012, p. 2). The care bundle approach has been developed and used more widely in Western countries, particularly in intensive care units (Litch, 2007; Morris et al., 2011; Rello et al., 2010; Sedwick et al., 2012). Use of care bundles in intensive care not only improved clinical outcomes (Litch, 2007; Morris et al., 2011; Sedwick et al., 2012), decreased the length of hospital stay (Litch, 2007; Rello et al., 2010), and reduced the healthcare costs (Sedwick et al., 2012), but also increased knowledge among healthcare providers (Dumont and Wakeman, 2010; Subramanian et al., 2013).

Care bundles are being used in emergency care to improve the care of patients with stroke and transient ischaemic attack (NICS, 2009; Weeraratne et al., 2010), sepsis (Kuan et al., 2013; Nguyen et al., 2011; Tromp et al., 2010), cardiac arrest (Nolan and Soar, 2008), chronic obstructive pulmonary disease (McCarthy et al., 2013), and acute asthma (McCreanor et al., 2012). Implementation of care bundles in emergency care has been shown to improve clinical outcomes (McCarthy et al., 2013; Tromp et al., 2010; Weeraratne et al., 2010). Although the development and implementation of care bundles in Western countries have been shown to improve patient outcomes and reduce healthcare costs, care bundle use in low-income and middle-income countries, where backgrounds, facilities, and resources are very different, is just beginning to occur (Apisarnthanarak et al., 2010; Liu et al., 2013; Subramanian et al., 2013; Unahalekhaka et al., 2007; Wu et al., 2012). In this paper, the particular focus will be on the use of a care bundle approach for management of patients with severe TBI in the Thai context.

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http://dx.doi.org/10.1016/j.ienj.2015.04.004
1755-599X/

2. Background

Severe TBI is a global problem (Crowe et al., 2010; Faul et al., 2010; Tagliaferri et al., 2006) and it is a major and increasing problem in Thailand (Bureau of Policy and Strategy [BOPS], Ministry of Public Health, Thailand, 2011; Ratanalert et al., 2007). Thai emergency nurses play a vital role in caring for patients with severe TBI, particularly during initial emergency care and resuscitation in the emergency department (ED). However, little is known about the evidence-based management of severe TBI in Thailand, where specifically ED management of TBI is poorly understood. Research has shown variation in Thai nurses' knowledge and clinical care regarding best available evidence for management of patients with severe TBI (Damkliang et al., 2013). Lack of clear evidence for the initial emergency nursing management of patients with severe TBI may lead to variation in care, and place patients at risk of harm from increased intracranial pressure and secondary brain injury (Damkliang et al., 2013; LaPlaca and Irons, 2011; O'Phelan, 2011).

International evidence-based guidelines for the management of patients with severe TBI were reviewed and it was established that they were either derived from Western countries with well-developed trauma care systems and emergency care facilities or, if relevant to the Asian content, were directed at physician care (Damkliang et al., 2014). Further, due to the different contexts, currently available evidence cannot be directly implemented into the Thai ED context, and specifically, the Thai emergency nursing context, without considerable adaptation. Thus, to address this significant gap in the evidence base for care, a care bundle for the initial emergency nursing management of patients with severe TBI was developed and implemented.

2.1. Theoretical framework

This study was guided by rigorous conceptual and theoretical frameworks, namely, the Knowledge to Action Framework (Graham et al., 2006) and seven theoretical steps for care bundle development by Fulbrook and Mooney (2003). The Knowledge to Action Framework (Graham et al., 2006) provided rigorous processes to develop and implement the care bundle in a particular context, while the seven theoretical steps for care bundle development by Fulbrook and Mooney (2003) guided the process of developing the care bundle. Details of the care bundle development process have been published elsewhere (Damkliang et al., 2014). The care bundle was developed specifically for implementation in one Thai ED including consideration of the structure, staffing, processes and resources of the emergency healthcare system, and more specifically the ED setting (Table 1). It is critical to identify the barriers and facilitators to knowledge use specific to the knowledge translation intervention (Graham et al., 2006). The term knowledge translation is commonly used in Canada to describe the process of putting knowledge into action (Straus et al., 2009). Monitoring use of the knowledge is also important to determine how and the extent to which the knowledge has been diffused throughout the end-users (Graham et al., 2006). Thus, in this study, interviews with emergency nurses were conducted to understand emergency nurses' perspectives on the implementation and subsequent use of the care bundle as well as to identify barriers and facilitators to care bundle use.

2.2. Aims

The aim of this study was to describe nurses' perceptions of the use of an evidence-based care bundle for initial nursing management of patients with severe TBI. Specific objectives were to investigate barriers and facilitators to care bundle use and to explore nurses' perspectives of the implementation and subsequent use of the care bundle in clinical practice.

3. Methods

3.1. Study design

A descriptive qualitative approach using interviews to collect study data was used. The interviews were conducted in two phases:

Table 1
Initial emergency nursing management of adult patients with severe TBI.

Airway and C-spine protection	**1. Establish a secure airway along with c-spine protection** • Apply a jaw thrust maneuverer to open and clear airway • Apply bag-valve-mask with oxygen >10 l/min before intubation • Apply manual inline stabilisation during assist in ETT intubation • Apply an appropriate size of cervical collar and proper application
Oxygenation and ventilation	**2. Maintain adequacy of oxygenation and ventilation** • Monitor oxygen saturation, keep SpO_2 > 90% and record every 15 minutes • Monitor ventilation using capnography, keeping $ETCO_2$ of 35–40 mmHg and record every 15 minutes • Monitor respiratory rate and record every 15 minutes
Circulation	**3. Maintain circulation and fluid balance** • Administer normal saline solution (NSS) or other solutions as prescribed • Keep systolic blood pressure (SBP) > 90 mmHg and record every 15 minutes • Monitor pulse rate/heart rate and record every 15 minutes
Disability and intracranial pressure management	**4. Regular monitoring of the GCS score, and pupillary size and reactivity** • Monitor GCS score, pupillary size and reactivity and record every 15 minutes • Notify the physician or the neurosurgeon if any changes of the following are identified: - A GCS score drop - Dilated or asymmetric pupils - Sluggish or unreactive pupils **5. Maintain cerebral venous outflow** • Keep head and neck in neutral alignment • Keep 30° head of bed elevated (unless contraindicated) • Ensure using appropriate size of cervical collar **6. Management of pain, agitation, and irritability** • Administer sedatives and analgesics as prescribed • Splinting of limb fractures • Urinary catheterisation **7. Administer for urgent CT brain imaging** • CT brain as soon as possible after ABCs are stabilised • Contact CT staff • Safe transfer: SBP > 90 mmHg, SpO_2 > 90%, $ETCO_2$ 35–40 mmHg

during implementation of the care bundle (Phase-One) and two months after implementation of the care bundle (Phase-Two). In Phase-One, interviews were undertaken to understand emergency nurses' perspectives of the implementation of the care bundle as well as identify barriers and facilitators to care bundle use. In Phase-Two, interviews were conducted to establish a deeper understanding of nurses' experiences of the implementation and subsequent use of the care bundle in clinical practice and their thoughts related to the impact of the care bundle.

3.2. Setting

The study was conducted in the ED at a regional hospital in Southern Thailand. The ED manages over 54,000 attendances per year; of these approximately 300 patients have severe TBI. The ED at the study site uses a three category triage scale; emergent, urgent, and non-urgent. The adult patient with severe TBI will usually be triaged as 'emergent' and transferred to one of two adult resuscitation bays in the emergency or resuscitation zone. The adult resuscitation bays have the capacity to continuously monitor oxygen saturation, cardiac rhythm, heart rate, and blood pressure (non-invasive). Each resuscitation bay has one ParaPac® transport ventilator. One end-tidal carbon dioxide monitor is available for the whole ED.

3.3. Participants

Emergency nurses who had experienced caring for the patients with severe TBI during implementation of the care bundle were invited to participate in the interviews. All 37 emergency nurses working in the ED were eligible to be included in the study; 10 emergency nurses participated in Phase-One and 12 nurses participated in Phase-Two. Of the ten nurses who participated in Phase-One, five nurses (50%) also participated in the interviews in Phase-Two.

3.4. Ethical considerations

The study was approved by the Human Research and Ethics Committee (HREC) at Deakin University and the Research Committee at the study site. All nurses gave written informed consent. Patient consent was waived by HREC.

3.5. Data collection

Individual semi-structured interviews were conducted in April 2013 during implementation of the care bundle and then in June 2013 two months after implementation of the care bundle. The interviews were conducted by one researcher (JD).

3.6. Data analysis

The interview data were transcribed verbatim by the researcher who conducted the interviews. The accuracy of the Thai transcripts was checked carefully after the initial transcription by the researcher (JD). Then, the transcripts in Thai version were translated into English by a professional translator. After translation, the accuracy and consistency of the transcripts between English and Thai versions was approved by the researcher (JD), particularly clinical terms. Then, the consistency of the English and Thai transcripts was verified by a Thai nursing educator who held a PhD in Nursing (written in English).

The interview data were analysed to establish the themes that emerged during implementation of the care bundle and post-implementation of the care bundle using thematic analysis outlined by Braun and Clarke (2006). The data were read carefully line by line and keywords were highlighted in different colours to create initial codes. Potential themes from the codes were then generated. All data relevant to each potential theme were grouped together, and the themes were reviewed. Subsequently, the themes were checked and major themes and subthemes were confirmed with the research team. Quotations from the transcripts were used as evidence to support major themes and subthemes, which were then defined and named.

4. Results

4.1. Phase-one

Ten emergency nurses participated in the interviews in Phase-One. Of the ten emergency nurses who participated in this phase of the study, 80% were female, and the median age was 33 years. All ten nurses were Bachelor degree prepared, and the median years of emergency nursing experience was eight years. Eighty percent of the participants had undertaken specific training in trauma care.

Thematic analysis identified five major themes: (i) quality of care, (ii) competing priorities, (iii) inadequate equipment, (iv) agitated patients, and (v) teamwork, each with a number of subthemes (Table 2). Findings from these five themes will be presented in the sections to follow.

4.1.1. Quality of care

Participants reported that use of this care bundle helped to improve quality of care for patients with severe TBI. The participants stated that if all elements of the care bundle are implemented together, the patients would receive optimal care and risks related to severe TBI would be reduced. Most participants indicated that the guidelines in this care bundle promote specific nursing interventions that nurses had not attended to previously.

> *It's drawn our attention to some things we had neglected such as measurement of CO_2 levels and inspection of the collar size whether it's correctly fitted or not. We now pay more attention to these.* (Nurse 1; 8 years ED experience)

Nurse participants reported that use of the care bundle improved their knowledge of care for patients with severe TBI. Further, a number of nurses mentioned that they had developed a better understanding of care of patients with severe TBI from the education sessions during care bundle implementation, which was beneficial for the patients with severe TBI.

> *We have developed better understanding [of care delivered to patients with severe TBI] and this is really beneficial for the patients.* (Nurse 6; 1 year ED experience)

Although most participants felt that use of the care bundle helps to improve quality of care for patients with severe TBI, they also reported that they did not always follow all elements of the care bundle when caring for patients with severe TBI.

Table 2
Themes and subthemes emerged in Phase-One: implementation of the care bundle.

Major themes	Subthemes
Quality of care	Improved quality of care
	Increased nurses' awareness of care
	Use as a standard of care
	Improved nurses' knowledge and understanding of care
Competing priorities	Complexity of the patient's condition
	Multiple patients in resuscitation area
Inadequate equipment	Inadequate equipment: capnography, cervical collars, and patient trolleys
Agitated patients	The challenges of caring for agitated patients
Teamwork	Teamwork among emergency nurses
	Teamwork between nurses and ED physicians
	Teamwork among different healthcare providers

We sometimes don't follow all the steps suggested because we have to handle several trauma cases as well as other patients, all at the same time so we may forget some steps, like elevating the patient's head or monitoring vital signs every 15 minutes. (Nurse 5; 15 years ED experience)

Further exploration of why nurses did not always follow all elements of the care bundle when caring for patients with severe TBI revealed several factors.

4.1.2. Competing priorities

Nurses reported that they sometimes did not follow all interventions recommended in the care bundle because of the complexity of the patient's condition, which gave rise to competing priorities. Participants described that caring for patients with severe TBI and multiple other injuries was more complex than caring for patients with isolated TBI.

When there are multiple injuries, we need to do many things at the same time and staff members need to work together to treat the patient and this can make us skip some steps in the treatment. For example, we may miss checking the collar size because everyone is busy with their tasks so a nurse may be intubating the patient and then turn away to do other things. (Nurse 9; 9 years ED experience)

Dealing with a number of patients simultaneously in the resuscitation area was another issue related to care bundle use. Participants stated that it was common for nurses to care for more than one patient, and at times there were up to five patients with emergent conditions requiring care, therefore, nurses commonly needed to deliver care to multiple patients simultaneously. As a result of multiple patients with competing care needs, or single patients with complex injuries, some recommendations in the care bundle were not able to be implemented.

4.1.3. Inadequate equipment

Most participants were concerned with the inadequacy of equipment in the ED, particularly capnography, cervical collars, and patient trolleys. Five respondents stated that one capnograph for the whole ED was insufficient and that once the capnograph was in use for one patient, it was impractical to apply the capnograph to a second patient.

I would like to have additional $ETCO_2$ detectors. Now we have only one [capnograph] and it is definitely not enough when we have to deal with several cases at the same time. We once handled up to five cases at a time. (Nurse 4; 11 years ED experience)

Nurse participants reported issues related to inadequate cervical collar application. At times it was not possible for the nurse to stabilise the patient's head and neck properly because of lack of availability of an appropriately sized cervical collar.

We don't have enough [cervical] collars. When a patient is admitted to the ward, we need to get a collar back but we don't always have one which is the right size (for adults). Sometimes the ones we have are too small. (Nurse 10; 10 years ED experience)

Patient trolleys were a major issue to compliance with use of the care bundle, particularly related to appropriate patient positioning with head of bed elevation to 30 degrees. Participants stated that the patient trolleys were inappropriate for use with neurological patients as it was difficult to elevate the head of bed to 30 degrees, especially when the patient was struggling or agitated.

Some of the beds (patient trolleys) are also not right because in some neurological cases, the patients struggle and these beds aren't suitable for restraining them. (Nurse 5, 15 years ED experience)

4.1.4. Agitated patients

Many participants reported that caring for an agitated patient was one of the major factors preventing compliance with care bundle use. Participants stated that often no prescription for sedatives was provided before endotracheal intubation, so it was difficult to protect the cervical spine as the patients were struggling and moving.

When the patient struggles, we attempt to control them but this doesn't help reduce raised intracranial pressure. Sedation generally is performed after the airway has been stabilized. Sedation is used when the ET tube is difficult to put in. (Nurse 2; 5 years ED experience)

4.1.5. Teamwork

Collaboration between nurses and ED physicians was another factor that was related to care bundle use, particularly regarding the administration of sedatives. Participants felt there was conflict between sedating the patient thus facilitating safe management and being able to accurately assess conscious state.

Some patients keep struggling when they have been intubated but the ER [emergency room] physicians won't sedate them, even though the nurses ask and the neurosurgeon has given permission. This is because the ER physicians are concerned that they won't be able to make an accurate coma score assessment. (Nurse 4; 11 years ED experience)

It may require more efficient coordination with the physicians, especially in terms of sedation. Junior nurses may not be brave enough to make suggestions so we should provide them with assistance. . .if it's a senior nurse, the doctor will usually listen and agree. (Nurse 2; 5 years ED experience)

4.2. Phase-two

Twelve emergency nurses participated in the interviews in Phase-Two. Of the twelve emergency nurses who participated in this phase of the study, 83.3% were female and the median age was 36 years. All 12 nurses were Bachelor degree prepared and the median years of emergency nursing experience was seven years. One nurse had completed a four month course related to trauma care; however ten nurses had completed at 1–5 days training in advanced trauma life support.

Three major themes emerged from the interviews in post-implementation phase: (i) quality of care and patient safety, (ii) positive changes in nursing practice, and (iii) new knowledge, improved skills, and increased confidence (Table 3). Findings from these three themes will be presented in the sections to follow.

4.2.1. Quality of care and patient safety

Participants reported that use of the care bundle helped to improve patient outcomes. The terms 'patient safety' and 'safe' were commonly reported by the nurse participants when asked about the impact of the care bundle on patient care.

The patients get better, safer care. (Nurse 1; 9 years ED experience)

Table 3
Themes and subthemes emerged in Phase-Two: post-implementation.

Major themes	Subthemes
Quality of care and patient safety	Improved patient outcomes Reduced risks related to severe TBI
Positive changes in nursing practice	Changes in nursing practice Increased awareness of care
New knowledge, improved skills, and increased confidence	Improved knowledge of care Improved nursing skills Getting more confidence

Most participants stated that using the care bundle helped to improve patient assessment and they felt that use of the care bundle reduced the risks of adverse events and complications. Participants stated that although patient outcomes would not be apparent in the ED, they believed that use of evidence-based care would improve patient outcomes over the course of their recovery and the patient would have long term benefits from improved quality of care in ED.

> *The [patient] outcomes may not be evident now but I believe we should take care of the patients based on best evidence and then patients will benefit from better treatment.* (Nurse 1; 9 years ED experience)

4.2.2. Positive changes in nursing practice

Positive changes to nursing care were identified in four major areas of care of patients with severe TBI including $ETCO_2$ monitoring, assessment of cervical collar application, patients' posturing by keeping head and neck in neutral alignment, and elevating the head of the bed to 30 degrees.

> *In the past, we didn't pay so much attention to the CO_2 level [$ETCO_2$] when assessing patients. We only did it when the anaesthetist asked us to, but now most of us do this regularly. And, again, previously, the collar was sometimes put on wrong or it didn't fit the patient's neck properly or it was loose but we know that it's part of our job to check it.* (Nurse 7; 10 years ED experience)

Respondents indicated that their awareness of specific elements of care for patients with severe TBI increased after using the care bundle, particularly in the areas of cervical spine protection, $ETCO_2$ monitoring, and patients' posturing.

> *The guidelines have made us more aware on the importance of the practice so we try to do it. Really, now, most of us know that the jaw thrust is required in head injury cases. Other things, like the $ETCO_2$ detection, have been taken more seriously.* (Nurse 12; 13 years ED experience)

4.2.3. New knowledge, improved skills, and increased confidence

Participants reported that they had learnt new things from the recommendations of the care bundle, particularly specific reasons for care of patients with severe TBI, such as urinary catheterisation, collar application, oxygen assessment, and blood pressure monitoring.

> *It [care bundle] helped us learn new things and it's been very good for the patients because we now know more about what we have to do. For example, I've just learned that urinary catheterization helps reduce pain in patients with severe TBI.* (Nurse 3; 3 years ED experience)

> *I now realize the usefulness of the collar application. It helps to make sure the c-spine is safe and it also keeps the patient's head and neck in neutral position, which is good for blood circulation to and from the brain.* (Nurse 5; 2 years ED experience)

As well as improved nurses' knowledge and skills, participants also reported that use of the care bundle increased nurse' confidence when caring for patients with severe TBI.

> *When a patient is intubated and we're not certain if it [endotracheal tube] is in properly, we can check by connecting the tube to an $ETCO_2$ detector so this gives us more confidence and we don't worry so much when we move a patient for an x-ray.* (Nurse 1; 9 years ED experience)

5. Discussion

The study highlighted that emergency nurses had positive perception of care bundle implementation and subsequent use in clinical practice. There are several reasons why use of an evidence-based care bundle was considered as positive by Thai emergency nurses. First, care bundles consist of a small group of evidence-based interventions (Resar et al., 2012), and as such, they make information easier for nursing staff to remember and prioritise the important elements of care. It is known that the accuracy of working memory is limited to seven plus or minus two pieces of information (Miller, 1956). Memory failures are more likely when this amount of information is exceeded. Memory failures are made worse by stress, situations of complexity or uncertainty, and multiple tasks (Lorist et al., 2005). These situations are common in emergency nursing (Adriaenssens et al., 2011; Josland, 2008; Kilcoyne and Dowling, 2007). It was apparent that, from the interview data, care provision in this ED in Thailand is stressful. Further, the interview data showed that clinician stress is exacerbated by the complexities of managing multiple critically ill or injured patients at once and lack of resources. In the ED environments, it is emergency nurses who are responsible for emergency care delivery and who are with the patient for the entirety of their ED episode of care (Patrick, 2010). Since care bundles consist of a small group of evidence-based interventions, they can assist emergency nurses to decrease their reliance on memory and increase the ability to apply knowledge to clinical practice when caring for patients with severe TBI.

Second, the format of the care bundle may have also contributed to the increase in nurses' knowledge following care bundle implementation. The care bundle comprised seven major elements that were incorporated into a single page summary. The format of the care bundle may be likened to that of a checklist, which is a systematically arranged list of items or criteria that enables recording of the presence or absence each item, ensuring that all items are considered (Hales and Pronovost, 2006). Use of checklists as part of care bundles in healthcare settings has led to improved clinical outcomes in intensive care contexts (Clark et al., 2007; Pronovost et al., 2006).

Third, context plays a key role in the successful implementation of evidence into practice (Rycroft-Malone, 2004). Context is "the environment or setting in which people receive health care services, or in the context of getting research evidence into practice" (McCormack et al., 2002, p. 96). Evidence suggests that there is a significant relationship between context and evidence-based practice use (McCormack et al., 2002; Wente and Kleiber, 2013). Although there is no evidence supporting a direct relationship between context and clinicians' knowledge, studies have shown a significant increase in nurses' knowledge after use of an evidence-based care bundle when context has been considered as an important factor in translating evidence into practice (Guembe et al., 2012; Subramanian et al., 2013).

Finally, the care bundle approach is aimed at improving clinical care for a particular patient population and care setting. Therefore, in this study, the care bundle elements were used regularly in clinical practice so the direct clinical relevance of the care bundle content may have increased its acceptability to ED nursing staff. Use of the care bundle also improved some elements of care for patients with severe TBI such as $ETCO_2$ monitoring, assessment of cervical collar application, patients' posturing by keeping the head and neck in neutral alignment, and elevating the head of the bed to 30 degrees. As a result of the improvement in clinical care, nurse participants perceived that use of the care bundle may have led to a positive impact on patient outcomes, although patient safety and clinical outcomes for patients with severe TBI were not measured in this study.

In addition, the emergency nurses from the study site were involved in the care bundle review process and had input into the content and format of the care bundle. Evidence suggests that adequate support from nurse administrators or members of the healthcare team is a major facilitator to guideline use (Goossens et al., 2008; Hutchinson and Johnston, 2004). Further, the care bundle was developed and designed specifically for the ED environment, processes of care, and resources, so may have influenced care bundle use by emergency nurses working at the study site.

Although participants perceived that use of the care bundle had positive impacts on their knowledge and clinical care for patients with severe TBI, nurse participants also reported important barriers and facilitators to care bundle use, including competing priorities, inadequate equipment, agitated patients, and teamwork. The complexity of the patient's condition, being a barrier to using research evidence, is supported by other studies (Burney et al., 2012; Carlbom and Rubenfeld, 2007). Another issue related to competing priorities and decreased care bundle use reported by emergency nurses was having to deal with a number of patients simultaneously in the resuscitation area. As a result of workload pressure and need to prioritise care, some recommendations in the care bundle were not able to be implemented. Heavy workloads have been reported previously as major barriers to consistent use of clinical practice guidelines (Asadoorian et al., 2010; Koh et al., 2008).

Equipment availability appeared to be both a barrier and a facilitator to care bundle use. The interviews with emergency nurses indicated that inadequate or inappropriate ED equipment were key barriers to care bundle use. These findings were consistent with several studies where a lack of facilities and equipment was reported as a barrier to use of evidence-based practice guidelines (Hutchinson and Johnston, 2004; Koh et al., 2008). In this study, changes in equipment accessibility adapted to process of care for patients with severe TBI were made to facilitate use of care bundle. As there was only one capnograph for use within the ED, intermittent $ETCO_2$ readings were taken if there were more than one intubated patient in the ED at the same time. This solution helped to facilitate use of capnography by nurses to confirm endotracheal tube placement as well as increasing continuous $ETCO_2$ monitoring.

Nurse participants reported that caring for agitated patients was also a major barrier to compliance with care bundle use. Participants frequently stated that no sedatives were prescribed before endotracheal intubation, so it was difficult to protect the cervical spine as the patients were struggling and moving. Generally, ED physicians were more likely to prescribe sedatives, usually diazepam, before intubation and when patients were agitated. However, discussion with emergency nurses suggested that there were variations in prescription and administration of sedatives in this ED setting as there was a group of interns who rotated to the study ED and these junior medical staff were involved in care of patients with severe TBI, particularly in resuscitation phase. Variation in individual junior medical staff's attitude and knowledge regarding prescription of sedative drugs may decrease sedation administration before endotracheal intubation to patients with severe TBI. Although, deliberately, the primary focus of this study was the emergency nursing management of patients with severe TBI, there were elements of the care bundle that may have influenced emergency medical practice. As a result, education sessions and interactive small group meetings focusing on the importance of prescription and administration of sedatives prior to intubation were then provided to the medical staff who were involved in care of patients with severe TBI to overcome the barrier to care bundle use.

Many variations in prescription and administration of sedatives were related to collaboration between nurses and ED physicians. Evidence from the interviews with emergency nurses suggested that teamwork was perceived as a key factor related to care bundle use, particularly in the administration of sedatives and analgesics. The interview findings indicated that inadequate communication between nurses and ED physicians regarding prescription of sedatives and analgesics impeded nurses' ability to follow the care bundle recommendations. Lack of communication or insufficient collaboration among multidisciplinary team members was reported as a barrier to pain management in emergency care (Bennetts et al., 2012). Furthermore, lack of communication and ineffective teamwork are associated with poor medical outcomes, such as surgical errors (Greenberg et al., 2007).

Teamwork has a clear relationship with patient safety in high-risk clinical settings. Effective cooperation among healthcare teams promotes improvement of patient care processes (Wolf et al., 2010). Effective collaborative communication between nurses and physicians was associated with lower stress of ICU nurses, and improved nurse–physician collaborative communication is a key factor in improving outcomes of ICU patients (Boyle and Kochinda, 2004). Consultation with staff including education sessions, demonstrations, and small group discussions was provided to overcome the barriers identified in the early-implementation phase.

6. Conclusion

Thai emergency nurses perceived that using the care bundle helped them to improve quality of care as a result of increased knowledge, skills, and confidence. A care bundle approach is an acceptable strategy to increase integration of research evidence into the Thai ED context and facilitate Thai emergency nurses to deliver optimal care to patients with severe TBI in a resource poor environment.

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