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Clinical incidents in the emergency department: is there an association with emergency nursing shift patterns? A retrospective observational study

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ABSTRACT

Introduction Clinical incident (CI) management within healthcare settings is a crucial component of patient safety and quality improvement. The complex environment in the emergency department (ED) and nursing work schedules are important aspects of human factor ergonomic (HFE) systems that requires closer examination. Nursing shifts are closely related to fatigue, including the late/early shift pattern and night shift. All nursing shifts were examined over a 1-year period when a CI occurred to a patient in the ED to identify if there was an association.

Methods This was a retrospective observational study, conducted and reported using the Strengthening of the Reporting of Observational Studies in Epidemiology statement. All CIs reported in the ED over a 1-year period were reviewed by accessing the CI database, emergency department information system and patient health records. The nursing roster database was accessed to record nursing shifts and were de-identified.

Results A total of n=244 CIs were eligible for inclusion into the study. ED nursing shift analysis included n=1095 nursing shifts. An analysis of early, late and night shifts, including days not worked by the ED nurse was conducted over a 48-hour and 96-hour period. There was no significant relationship identified between the CI and nursing shift patterns. ED length of stay (LOS) was significantly higher for a patient presentation when a CI occurred.

Conclusion This study focused on the HFE system of nursing work schedules and CI events that occurred in the ED. This study found there was no relationship between emergency nursing shift patterns and an increased risk for the occurrence of a CI in the ED. Although a strong link was found between patients experiencing a CI in the ED and an extended LOS. This demonstrates the need for studies to investigate the interrelationships of multiple HFE systems in the ED, including the environment, patient, clinical team and organisational factors.

WHAT IS ALREADY KNOWN ON THIS TOPIC

⇒ Clinical incident reporting in high-risk clinical environments, such as the emergency department, is critical to improve patient safety. Nursing shift schedules lead to fatigue which can increase the risk of clinical errors and affect patient safety.

WHAT THIS STUDY ADDS

⇒ Emergency nursing shift schedules were not associated with the occurrence of adverse events in the emergency department. Patient length of stay was associated with increased risk of a clinical incident occurring.

HOW THIS STUDY MIGHT AFFECT RESEARCH, PRACTICE OR POLICY

⇒ Future studies investigating clinical incidents in the emergency department need to analyse the interrelationship of length of patient stay, inpatient access block, overcrowding, as well as patient, team and organisational factors to improve patient safety.

INTRODUCTION

Clinical incident (CI) management within healthcare settings is a crucial component of patient safety and quality improvement.[1 2] CI management systems have been developed from human factors and ergonomic (HFE) systems theory to investigate, analyse, and manage adverse events, and near misses that occur during the delivery of care to patients.[1 3] The principles of HFE theory originated from safety critical industries such as aviation and have been adapted to the healthcare setting, for example, Systems Engineering Initiative for Patient Safety (SEIPS).[4 5] The core patient safety principles of HFE include the evaluation of work systems, processes, and outcomes when an adverse event occurs within the framework of the complex organisational and system factors within healthcare settings.[3 4]

The emergency department (ED) is a unique environment within the hospital, the ED by nature is busy and chaotic, and multiple factors may increase the risk of a CI occurring during a patient's stay in ED.[6–9] Issues such as overcrowding due to surges of patient presentations, multitraumas and other high acuity presentations, multiple handovers and patient movements in the ED, and lack of available inpatient beds can compromise patient safety.[1 8–15] For

the patient who has experienced a CI in the ED the impact from the event can be substantial, leading to increased length of clinical observation and further treatment, unplanned hospital admission and increased hospital length of stay (LOS).[12 16–18] Overcrowding and increased LOS in the ED is recognised globally to negatively impact patient safety, leading to an increase in mortality risk and adversely affecting the clinical care delivered to patients while in the ED.[13–15 19–22] The role of nursing work systems as part of HFE in the ED is also crucial to examine, as nursing performance and quality of care delivered is closely linked with patient outcomes.[23] Work scheduling practices and shift work have been well established to result in increased fatigue, sleep deprivation, impaired cognition and decision-making errors in the clinical setting, which adversely affect patient safety.[7 11 23–27] Emergency nurses require specialised clinical skills that are distinct to the ED setting,[28] including the resuscitation of patients, trauma care, triage, advanced patient assessment skills, managing acutely ill patients, paediatrics and minor injuries. The clinical skill set of the emergency nurse requires prompt patient assessment, decision-making and time management abilities; as well as the physical capabilities of working in a fast-paced environment.[29] The combination of the complex and busy work environment and nursing work schedules are important aspects of HFE in the ED that requires closer examination, as rostering is an aspect of work practice in the ED environment that can be modified to improve patient safety outcomes.

The most common shift types worked by the emergency nurse in Australia include the early shift (07:00–15:30 hours), late shift (13:00–21:30 hours), and night shift (21:00–07:30 hours).[11 30] Shift patterns such as consecutive late/early shifts (a late shift followed by an early shift) and night shifts can increase the risk of a CI occurring and pose a risk to patient safety.[11 24 26 27 30] The late/early shift pattern is a cause of fatigue among nurses due to the limited break time between the consecutive shifts.[11] Studies have reported the strong association between nurses working night shifts and increases in the rate of CIs, particularly those involving injury to the patient, compared with the early shift and late shift.[24 31 32]

Within the ED a small number of studies have been published on CIs occurring over a 1-year period.[1 12 16 17 33] The aim of this study was to examine all CI's that occurred over a 1-year period in the ED, and examine the nursing shift roster (when an adverse event occurred in the ED) to identify if there was an association. A secondary analysis examined the association of other HFE systems in the ED involved in the CI event, including the CI type, severity outcome, ED LOS and the location of incident within the ED.

METHODS

Study design

This was a retrospective observational study, conducted and reported according to the Strengthening of the Reporting of Observational Studies in Epidemiology statement.[34]

Setting

This study was conducted at the Department of Emergency Medicine, Nambour General Hospital (NGH), Queensland, Australia. All CIs reported between 1 July 2014 and 30 June 2015 were reviewed. At this time, NGH was the major referral hospital for the Sunshine Coast Hospital and Health Service and received 51 462 patient presentations to the ED during the study period.

CI management

The CIs had been recorded, formally analysed and actioned in ED prior to commencement of the study under the supervision of the Patient Safety Officer/s at NGH, adhering to the mandatory National Safety and Quality Health Service Standards.[35] The electronic database Proactive Risk Information for Management Evaluation (PRIME) was used to record and analyse all CI data. Queensland Health has utilised HFE systems in CI analysis and management, involving system improvement and accountability reviews,[35] using Root Cause Analysis (RCA) and the Human Error and Patient Safety (HEAPS) analysis tool.

Clinical areas and nursing ratios

The study location had several clinical areas reflecting the acuity of care and nursing ratios within the ED, including a resuscitation area (three beds, nursing ratio of 1 nurse to 1 patient), acute (14 beds, 1 nurse to 3 patients), paediatric acute (five beds, 1 nurse to 3 patients) and a short stay unit (SSU) and fast track area (seven beds, 1 nurse to 7 patients).

Nursing staff

During the study period, there were 42 registered nurses (RNs) working per day, 15 nurses were rostered for the early shift (07:00–15:30 hours) and late shift (13:00–21:30 hours) and 12 nurses were rostered for the night shift (21:00–07:30 hours). The nursing skill mix in the ED required (each shift): triage/waiting room area—two triage level RNs, resuscitation area—three resus level RNs for early and late shift (decreased to two RNs on night shift), acute area—four RNs, paediatric area—two RNs, SSU—one RN, fast track area—one RN (early and late shift), team leader—one senior RN or clinical nurse, float RN—one RN (early and late shift).

Participants

All CIs reported in the study period were identified from the PRIME database. Patients were identified from the CI database by the identification number for each incident. Emergency nurses who reported and/or provided care to the patient at the time of the CI were identified to record their rostered shift patterns. Subsequent analysis was conducted with nurses de-identified using a unique study number.

Data collection

The PRIME electronic database for CI reporting, TrendCare electronic nursing roster database, Emergency Department Information System (EDIS) and patient health records were accessed for data collection. All subsequent analysis and presentation of results were based on

group not individual data. The data collected from each CI included date and time, CI type and patient outcome (severity assessment code, SAC). From EDIS, ED location, LOS, death of the patient in ED or hospital, number of ED daily patient presentations, diagnosis and discharge destination including own residence, inpatient ward or other (ie, interhopsital transfer, ED SSU, did not wait or left after treatment commenced) was recorded.

The process to identify the nurse providing clinical care to the patient at the time the CI occurred included three pathways: (1) the nurse had reported the incident (identified in CI report), or (2) the nurse was identified from the EDIS record of patient encounter at the time of the incident, or (3) the nurse was identified from documentation in the patient healthcare record. Data collection included the type of nursing shift (early, late or night shift) worked and number of minutes into shift when the CI occurred. The nursing shift pattern was recorded from the date the CI occurred and included shifts worked over a 48-hour and 96-hour period preceding the CI.

If the cause of the incident did not involve nursing care the CI was not further investigated. Data was entered into Microsoft Excel spreadsheets.

Statistical methods

Descriptive statistics are presented using median and IQR when the data were not normally distributed. Normality was assessed using the Shapiro-Wilk test. Categorical variables are described using frequencies and percentages. The comparison in the number of patient presentations during days when a CI occurred compared with days when a CI did not occur in ED was performed using a Mann-Whitney U test for all shifts considered, and then split by early, late and night shifts. The difference in minutes into nursing shift when CI occurred was tested using a Mann-Whitney test (for comparison between two groups) or Kruskal-Wallis test (comparison between more than two groups), for shift on the day of incident (early, late or night shift), total number of early or late shifts (range from 0 to 4), total number of night shifts (range from 0 to 4), and total number of days off (range from 0 to 3) in the 4 days prior to the CI. ED LOS was compared between the number of patient presentations when a CI occurred compared with the total number of patient presentations that did not involve a CI during the study period, using a Mann-Whitney U test. All tests were two tailed and p values lower than 0.05 are considered as significant. All analyses were performed using the R statistical software.[36]

Table 1 Clinical incident summary

Clinical Incident type	n	%
Admission/transfer/discharge/handover	41	16.8
Admission	17	7
Discharge	3	1.2
Follow-up/ongoing care	3	1.2
Referral	1	0.4
Transfer	17	7
Behavioural	5	2
Self-harm/aggression	5	2
Diagnosis/Investigation	25	10
Pathology	25	10
Patient incident	112	45.9
Fall	18	7.4
Harm from unknown cause	3	1.2
Patient accident	7	2.9
Pressure ulcer	84	34.4
Treatment/intervention	61	25
Blood products transfusion and haemovigilance	1	0.4
Invasive/non-invasive care	24	9.8
Medication	36	14.8
Died in hospital	n	%
Yes	18	7
No	226	93
Discharge destination	n	%
Home	16	7
Inpatient ward	192	79
Other: DNW, IHT, LATC, SSU	36	15
ED location	n	%
Waiting room/triage	7	3
Resuscitation	58	24
Fast track/SSU	11	5
Acute/paediatrics	168	69
No of CIs per nursing shift	n	%
Early shift	84	34
Late shift	84	34
Night shift	76	31

CI, clinical incident; DNW, did not wait; ED, emergency department; IHT, interhospital transfer; LATC, left after treatment commenced; SAC, severity assessment code; SSU, short stay unit.

RESULTS

A total of 316 CIs occurred in the ED during the study period, 72 were excluded, leaving 244 CIs eligible for inclusion. Exclusion CIs included: the CI did not occur in the ED (n=11, 4%), unable to access patient healthcare record (n=2, 1%), incorrect patient details entered into CI report (n=4, 1%), duplicates of CI in PRIME database (n=7, 2%), CIs that involved other staff in ED (not nursing staff) (n=42, 13%), and unable to determine if CI involved nursing or other staff in the ED (n=6, 2%). The frequency of CIs compared with ED patient presentations was 0.47% (244/51462).

CI type and issue

Analysis of the CI categories and frequency of events revealed several themes, summarised in table 1. All patient falls (n=18, 7.4%) occurred while patients were mobilising or getting out of bed unattended while nurses were attending to other patients at the time of the fall. Mandatory documentation of a pressure ulcer was associated with pressure area care provided to the patient (and documented in the patients' health record) within 2 hours of arrival to ED in 13% of cases (n=11). The presence of a pressure ulcer/s was reported in 71 CIs (86%) where subsequent pressure area care was not documented. CI involving invasive and non-invasive care (n=24, 9.8%) of the patient included errors in planning for the clinical care of the patient, and errors in the recognition and escalation of deterioration in the patients' condition. Medication incidents (n=36, 14.8%) included incorrect medication dose and rate, documentation errors, and clinical procedures for administering medications not followed.

Emergency nursing shifts, nursing skill mix and CIs

During the study period, 94 emergency nurses were providing care to patients at the time the incidents occurred, with several nurses providing care to the patient for more than one CI. During the study period, 874 (79.8%) nursing shifts had nil CIs recorded, 200 (18.3%) nursing shifts had one CI recorded 19 (1.7%) nursing shifts had two CIs recorded for each shift, and 2 (0.2%) nursing shifts had three CIs recorded for each shift.

The nursing skill mix of staff in the ED who were providing care to a patient at the time a CI occurred was clinical nurse 10.2% (n=25), team leader RN 17.2% (n=42), triage RN 16.4% (n=40), resuscitation RN 30.7% (n=75), RN 20.5% (n=50), casual staff RN 4.5% (n=11) and enrolled nurse 0.4% (n=1). The skill mix of nursing staff was 74.6% (n=182) senior level RNs and 25.4% (n=62) junior to intermediate level RNs.

Nursing shifts and patient presentations per CI

There was no significant difference in the number of patient presentations per nursing shift including when a CI occurred and did not occur in the ED (table 2). The analysis included all nursing shifts worked during the study period (n=1095).

Table 2 Number of patient presentations per nursing shift: no CI versus CI

	No of patient presentations per shift n; median (IQR Q1–Q3)		
Shift	No CI	CI	P value
All	874; 47 (36–56)	244; 48 (37–56)	0.76
Early	289; 59 (54–65)	84; 57 (50–65)	0.23
Late	289; 49 (44–53)	84; 49 (43.75–53)	0.95
Night	296; 33 (29–37)	76; 32 (30–37.25)	0.52

CI, clinical incidents; n, number.

Time of CI from commencement of shift

CI typically occurred between 3 and 5 hours from the shift commencement, and this was not influenced either by the shift types worked on the day of the CI, or the shift pattern worked in the 4 days prior to the incident (table 3).

Forty-eight-hour shift pattern

The most common shifts worked on the day of the CI and the previous day were consecutive night shifts (n=41, 16.8%). Twenty CIs (8.2%) occurred when an ED nurse was working the late/early shift pattern.

Ninety-six-hour shift pattern

The five most common shift patterns worked over a 96-hour period prior to the CI occurring did not include the late/early shift combination (table 4).

Late/early shift pattern

There were 35 (14.3%) CIs reported in ED that occurred when the nurse worked at least one late/early shift pattern during a 96-hour period prior to when the incident occurred.

Night shifts

The frequency of CIs that occurred during the night shift was higher (76/12058, 0.63%) compared with the early shift (84/21679, 0.39%) and the late shift (84/17725, 0.47%). The CI type and issue were different on night shifts with 82% (n=62) of CIs that occurred involved direct care to the patient, compared with 67% of CIs that occurred on the early shift and 76% of CIs on the late shifts.

Patient outcome and severity assessment code

There were nil SAC 1 CIs identified that involved death or likely permanent harm of the patient, there were 4 (2%) SAC 2 incidents with the outcome of temporary harm to the patient and 240 (98%) SAC 3 incidents that involved minimal or no harm to the patient.

ED location

The highest number of CIs in ED occurred in the acute and paediatric areas (69%) with a total of 19 beds and a nursing to patient ratio of 1:3, followed by the resuscitation area (24%) with a total of 3 beds and 1:1 nursing to patient ratio.

ED length of stay

The ED LOS was significantly higher for a patient presentation when a CI occurred (median 5.75 hours) compared with the ED LOS stay for a patient presentation not involving a CI (median 3.12 hours) (table 5). Seventy-nine per cent (n=192) of patients who experienced a CI were admitted to hospital but had an extended LOS in ED due to an inpatient bed not being available on the ward.

Table 3 Time of CI from shift commencement and shift pattern analysis

Nursing shifts	n	Minutes into shift Median (IQR Q1–Q3)	P value
Shift on day of CI			0.11*
Early/late	168	300 (180–430)	
Night	76	204.5 (117.5–450)	
No of early/late shifts in past 4 days			0.10†
0	33	210 (130–470)	
1	71	240 (163.5–390)	
2	78	285 (150–412.5)	
3	42	325 (240–465)	
4	20	369 (286.25–442.5)	
No of Night shifts in past 4 days			0.15†
0	147	300 (190–432.5)	
1	48	235 (137.5–386.25)	
2	25	209 (90–300)	
3	15	240 (137.5–497.5)	
4	9	240 (159–485)	
No of days off in past 4 days			0.56†
0	59	300 (190–445)	
1	65	300 (150–450)	
2	90	281.5 (152.5–420)	
3	30	212.5 (161.25–417.5)	

*Mann-Whitney U test;
†Kruskal-Wallis test.
CI, clinical incident.;

DISCUSSION

In this study, the frequency of CIs reported compared with ED patient presentations was 0.47%, a result consistent with previous studies.[16 17] The most common type of CIs recorded was similar both in theme and occurrence to other ED studies reported in adult[1 14 16 33 37] and paediatric ED's.[12 17 18] Patient outcomes from the CIs were similar to the rates of temporary harm and minimal harm reported previously.[3] However, some other studies have reported higher rates of temporary harm.[4–6 9 29]

This study did not demonstrate a link between fatiguing shift patterns worked by emergency nurses and an increased risk of CIs over a 1-year period. There was no causal relationship found between the shifts worked by the emergency nurse in the preceding 48-hour and 96-hour period and CIs occurring in the ED. The analysis of 244 CIs and 1095 nursing shifts revealed despite a reported relationship between fatigue and nursing shift schedules,[11 24–27 30 32] this was not reflected in an increased risk for CIs in the study location.

The aim in this study was to expand on the analysis of CIs to include nursing work schedules, as a nursing system within the HFE umbrella that could be modified. HFE systems theory is integral in the development and refinement of CI management systems within healthcare settings.[38] CI management systems are dynamic

Table 4 CIs and 96-hour shift pattern

Incident-3	Incident-2	Incident-1	Day of CI	n	%
Day not worked	Day not worked	Early	Early	17	7
Day not worked	Day not worked	Late	Late	16	6.6
Day not worked	Day not worked	Day not worked	Late	13	5.3
Night	Day not worked	Day not worked	Late	10	4.1
Day not worked	Day not worked	Day not worked	Early	9	3.7

Incident-3, 3 days prior to incident; Incident-2, 2 days prior to incident; Incident-1, 1 day prior to incident;
CI, clinical incident.

Table 5 ED LOS: CI versus no CI

Variable	CI (n=238)* Median (IQR Q1–Q3)	No CI (n=51 224) Median (IQR Q1–Q3)	P value
ED LOS (hours)	5.75 (3.95–8.17)	3.12 (1.95–4.65)	<0.001

*Three patient presentations had two CIs reported during the same ED presentation.
ED LOS, emergency department length of stay; N, number.

and have assisted healthcare providers to systematically review adverse events to improve patient safety and clinical care.[38] There are numerous HFEs used internationally in hospitals, such as SEIPS, SEIPS 2.0 [38] (38), SEIPS 3.0[39] (39), RCA[40] and AcciMap (Accident Mapping).[41] The HEAPS analysis tool was introduced to CI analysis in 2008 by Queensland Health, focusing on the type of review, HEAPS team composition, sequence of events, contributing factors, recommendations and outcome measures.[35 42]

In the ED, CI analysis and management is complex due to the relationship and interaction between the environment, multidisciplinary healthcare team and individual patient factors, such as overcrowding, increased LOS in ED, high workloads and roster schedules worked by staff.[43] The state government of Queensland (Queensland Health) adopted the methodology of RCA in CI analysis focusing on the contributing factors of 'task, equipment, work environment, patient, healthcare team and organisational factors'[35] p. 15); similar to the SEIPS model.

The combination of late/early shift patterns are a common fixture of the working roster for nursing staff.[26] Nursing studies have recognised roster patterns that include shorter rest periods between consecutive shifts, such as with less than a 10-hour break, may lead to increased fatigue, decreased alertness and clinical task performance, and thus lead to increased clinical errors and risk to patient safety.[11 25–27] The late/early shift pattern leads to reduced sleeping hours,[25 30] previously reported at less than 6 hours,[30 32] and reduced sleep quality.[26] The impact of reduced sleep time, fatigue, and amount of sick leave among nursing staff working the late/early shift pattern was more pronounced compared with night shifts.[32] These effects have led to the recommendation to reduce or cease the combination of the late/early shift pattern within the nursing schedule.[25] Our results do not support this.

The frequency of CIs that occurred in the ED (compared with patient presentations) during the night shift was highest at 0.63%, when compared with the early (0.39%) and late shifts (0.47%). This result for night shift was slightly higher than the frequency range of CIs (0.012%–0.61%) that was reported in a paediatric ED study.[17] The effects of fatigue experienced by nurses working night shift, such as decreased sleep, alertness, concentration and feeling tired while on shift, have been well documented,[24 31 32 44 45] and an increase in CIs in the ED during night shifts has been reported.[24 32 44 45] Two studies have reported a 0.5% rise in patient mortality on the night shift compared with the early and late shifts in the ED.[24 44] However, both studies found the measures of clinical care provided by nurses were not reduced during night shift.[24 44]

The most common nursing shift pattern worked over the 48-hour-period preceding a CI was two consecutive night shifts. The impact of fatigue on concentration and cognition among nurses working night shifts has been found to be more pronounced when working two, rather than four, consecutive night shifts.[45] Unlike the late/early shift patterns, night shifts cannot be removed from the nursing roster, as clinical care to patients within hospitals is provided 24 hours per day. This highlights the need for strategies by nurses during the night shift to reduce fatigue and clinical errors, such as taking scheduled rest/meal breaks, a healthy diet, limiting caffeine consumption and increased vigilance when completing clinical tasks (such as medication administration and checking).[30]

The relationship between CIs and ED LOS is an important finding of this study. Delayed access to an inpatient bed was reported in 79% of patients who experienced a CI. This finding is supported by previous studies.[10 16 22 46 47] A similar ED study reported admitted patients who had experienced a CI in the ED had a LOS of greater than 8 hours compared with 5 hours for patients who did not experience a CI.[16] A study from the USA found patients who experienced an ED LOS greater than 6 hours while waiting for an inpatient bed were more likely to experience an adverse event in the ED.[14] Increased LOS and overcrowding in the ED is recognised worldwide to have a negative impact on patient safety, adversely affecting the clinical care delivered to patients and leading to an increase in inpatient hospital LOS and mortality risk.[10 13–15 19–22 46–49] To decrease ED LOS in Australia, National Emergency Access Targets (NEAT) were introduced in 2012.[19 50] In 2015, the NEAT was set at 90%, the proportion of ED patients that must be admitted to an inpatient ward, discharged or transferred from ED within 4 hours of presentation.[19 50] At almost six (5.75) hours the median ED LOS for patients experiencing a CI in this study is well above the 4-hour target for NEAT,[50] while the median LOS for patients not experiencing a CI (3.12 hours) is well below the 4-hour target.

Limitations

The focus on fatigue as a result from nursing shift work schedules is a limitation in this study and may by its nature oversimplify the true complexity of a CI in the ED. Nursing work schedules were focused on as a nursing system in the ED that can easily be modified to improve patient safety and clinical outcomes for patients who present to the ED for care. Future studies analysing CIs in the ED need to include issues, such as overcrowding, patient LOS in ED, high patient volumes etc, to create a more complete picture of the risks to patient safety in the ED.

As CIs are under-reported, the true amount of CIs that occur in hospital and ED may not be accurately captured within CI management systems.[8 51] However, CI under-reporting may be less of an issue in the ED as patients admitted to inpatient wards come under the care of the inpatient team, and any issues or missed care identified are recorded as a CI.[8 52]

A limitation of this study was the number of nursing staff on the early and late shift (15 nurses) was higher than the night shift (12 nurses), therefore, the number of nursing staff was not equal on each shift.

In order to better reflect clinical load at the time of a CI, we intended to report on ED capacity status. Unfortunately, in 2016 healthcare staff in Queensland, Australia, lost access to the state-wide ED capacity alert system and were unable to retrieve any data, including previous data recorded. From January 2017 electronic access to the CI database (PRIME) was lost as a new incident reporting database was introduced state-wide, from this time hard copy files of reported CIs were accessed to investigate the CIs, and 259 of the CIs were reviewed by accessing patient healthcare records. Another limitation of this study was a single researcher (KR) conducted the review of all CIs investigated in this study, this researcher had undergone training on investigating CIs for the ED as part of quality improvement strategies implemented in this hospital, however the potential for bias is acknowledged.

CONCLUSION

This study focused on the nursing system of shift work schedules worked by the emergency nurse and CI events that occurred in the ED over a 1-year period. The outcomes of this study have found there was no relationship between emergency nursing shift patterns and an increased risk for the occurrence of a CI in the ED. This study found a strong link between patients experiencing a CI in ED and an extended LOS while awaiting an inpatient bed to become available. This demonstrates the crucial need for future studies to investigate the interrelationships of multiple HFE systems in the ED, including the interrelationships between the environment, patient, clinical team and organisational factors (such as patient surges, overcrowding and high workloads) to improve patient safety outcomes and reduce CI.

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Contributors KR is guarantor of the study. KR conceptualised the study design, created data collection tools, performed data collection, cleaned data, completed original manuscript draft. OT conceptualised the study design, reviewed and edited manuscript. JH conceptualised the study design, reviewed and edited manuscript. AB contributed to methodology and completed statistical analysis. TD reviewed and edited manuscript.

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