doi: 10.1111/nicc.12091

Factors associated with post-intensive care unit adverse events: a clinical validation study

Malcolm Elliott, Karen Page and Linda Worrall-Carter

ABSTRACT

Background: Many patients discharged from intensive care units (ICU) have complex care needs, placing them at risk of an adverse event in a ward environment. Currently, there is limited understanding of factors associated with these events in the post-intensive care population. A recent study explored intensive care liaison nurses' opinions on factors associated with these events; 25 factors were identified, highlighting the multifaceted nature of post-intensive care adverse events.

Aim: This study aimed to clinically validate 25 factors intensive care liaison nurses believe are associated with post-intensive care adverse events, to determine the factors' relevance and importance to clinical practice.

Design: Prospective, clinical validation study.

Method: Data were prospectively collected on a convenience sample of 52 patients at 4 tertiary referral hospitals in an Australian capital city. All patients had experienced an adverse event after intensive care discharge.

Results: Each of the 25 factors contributed to adverse events in at least 6 patients. The factors associated with the most adverse events were those that related to the patient such as illness severity and co-morbidities.

Conclusion: Clinical care and research should focus on modifiable factors in care processes to reduce the risk of future adverse events in post-intensive care patients.

Relevance to clinical practice: Many patients are at risk of post-ICU adverse events due to the contribution of non-modifiable factors. However, by focusing on modifiable factors in care processes, the risk of post-ICU adverse events may be reduced.

Key words: Adverse event • Discharge • Quality • Safety

INTRODUCTION

An adverse event is any unintended injury or complication that arises from health care management rather than the patient's underlying disease, and which results in disability, death or a prolonged hospital stay (Wilson *et al.*, 1995). Examples of these events include nosocomial infection, deep vein thrombosis and medication error. Adverse events are not uncommon, and up to a third of patients experience an event during their hospital admission (Fowler *et al.*, 2008). Of these patients, 20% will die and 13% will suffer a permanent disability (Baker *et al.*, 2004; de Vries *et al.*, 2008). Of greatest importance to care providers, hospital managers and researchers is that up to 80% of all adverse events are considered avoidable (Sinopoli *et al.*, 2007).

Patients admitted to intensive care units (ICU) are at high risk of adverse events because of the critical nature of their illness and the complex care they require (Kane-Gill *et al.*, 2010). Many patients discharged from ICU continue to have complex care needs, sustaining the risk of adverse events in a ward environment (Green and Edmonds, 2004). Up to one third of post-ICU patients for example will experience an adverse event, more than half of which may be preventable with better standards of care (Chaboyer *et al.*, 2008; McLaughlin *et al.*, 2007).

Previous research on post-ICU adverse events has focused primarily on mortality and readmission because these events are easier to quantify than others (Elliott *et al.*, 2012a, 2013a). Contemporary and seminal research found that key factors associated with these two events included older age, illness severity, length

Authors: M Elliott, RN, BN, Doctoral Candidate, St. Vincent's Centre for Nursing Research, Melbourne, Australia ;K Page, RN, DN, Manager, Clinical Care Engagement, Heart Foundation, Melbourne, Australia ;L Worrall-Carter, RN, PhD, Professor of Cardiovascular Nursing, St. Vincent's Centre for Nursing Research, Australian Catholic University, Melbourne, Australia

Address for correspondence: M Elliott, St Vincent's Centre for Nursing Research, VECCI Building, Locked Bag 4115, Fitzroy MDC 3065, Australia.

E-mail: grandmal70@hotmail.com

BACCN Nursing in Critical Care

of ICU stay, residual organ dysfunction and time of ICU discharge (Wallis *et al.*, 1997; Moreno *et al.*, 2001; Singh *et al.*, 2010). Patients readmitted to ICU also had poorer prognoses than those not readmitted including a higher mortality risk (Chrusch *et al.*, 2009; Utzolino *et al.*, 2010).

A recent study surveyed Australian ICU liaison nurses to determine their opinions of 25 factors believed to be associated with post-ICU adverse events (Elliott *et al.*, 2013b). These factors were identified from the literature and research on ICU readmission (Elliott *et al.*, 2011, 2012a, 2013a). In this study, the 25 factors were categorised into 3 domains: system, clinician and patient factors, consistent with an accident causation model (Elliott *et al.*, 2012b). Examples of these factors include staff workloads, nurse:patient ratios, failure to follow a rule or policy and co-morbidities. The ICU liaison nurses rated most of the 25 factors highly in terms of their contribution to post-ICU adverse events (Elliott *et al.*, 2013b).

While the findings of the survey represent important factors associated with post-ICU adverse events, it is crucial when making recommendations for clinical practice to uncover and clarify the empirical evidence that underlies experts' opinions (Balshem *et al.*, 2011). Clinical validation of the 25 factors would allow the streamlining of care processes in order to reduce the mortality and morbidity related to post-ICU adverse events as well as associated health care costs.

AIM

This study aimed to clinically validate intensive care liaison nurses' opinions of factors associated with in-hospital post-ICU adverse events. The study represents the third and final phase of a larger programme of research that aims to improve post-ICU patient outcomes by exploring factors associated with adverse events. Phase I of the research programme, a qualitative study, identified five key factors associated with ICU readmission (Elliott *et al.*, 2011). The second phase explored ICU liaison nurses' opinions of factors associated with post-ICU adverse events (Elliott *et al.*, 2013b).

METHODS

Design

A prospective clinical validation study was conducted, to test in real time, 25 factors believed to contribute to post-ICU adverse events. Validation is the independent determination of data accuracy and is necessary to ensure the data's scientific credibility (McCoubrey *et al.*, 2005). Validation also helps establish the relevance of a study's findings to clinical practice. A limitation of validation studies is that the results may only reflect the environment in which the research is conducted.

Setting

Data were collected at four tertiary referral hospitals in an Australian capital city. The hospitals had between 300 and 850 ward beds and between 10 and 30 ICU beds. Each hospital was serviced by ICU liaison nurses.

Population

The study included a convenience sample of adult patients recently discharged from one of the four ICUs. Some of the patients had been electively admitted to ICU for care following routine surgery such as thoracic lobectomy and craniotomy. Others were emergency ICU admissions for conditions such as septic shock and necrotising pancreatitis. Data were not collected on paediatric patients. All patients experienced an adverse event on a ward following ICU discharge.

Data collection

A data collection tool incorporating the 25 factors believed to contribute to post-ICU adverse events was developed. The ICU liaison nurses who agreed to act as data collectors were instructed to complete the tool whenever they encountered a patient who experienced an adverse event following ICU discharge. Whenever such a patient was identified, the Nurses were asked to speak with the staff involved in the patient's care and to review the medical records to determine the factors contributing to the adverse events. Once the factors were identified, the Nurse ranked the factors in order of their contribution to the event. Factors having the greatest contribution were ranked as 1 and those contributing less given a lower ranking (e.g. 2, 3 or 4).

The clinicians best positioned to collect data were ICU liaison nurses due to their unique role in pre- and post-ICU patient care. Key responsibilities of ICU liaison nurses include facilitating ICU patient discharge, following up and managing unstable patients in ward areas, and providing a critical care resource for ward staff (Endacott *et al.*, 2010). These Nurses were recruited through the Australian College of Critical Care Nurses ICU Liaison Special Interest Group. The Group meets four times a year and communicates via an email list. At one of the group's meetings, a presentation of the research proposal was delivered by the Chief Investigator (M. E.). Following the presentation, Nurses at four Australian tertiary referral hospitals volunteered to act as data collectors.

Data analysis

Descriptive statistics were used for data analyses. To estimate the extent to which each of the 25 factors is present in post-ICU patients experiencing an adverse event, confidence intervals (CI) were calculated. CIs estimate the extent to which a given factor exists within a population based on the sample studied (Clarke, 2012). A method for estimating sample size in a study designed to measure prevalence in a single group is to nominate the level of precision that is required around the prevalence estimate and then to calculate the sample size needed to attain this (Peat *et al.*, 2001). A sample size of 70 was required to report 95% CI with ±10% precision (Peat *et al.*, 2001). 95% CIs are associated with a significance level (p value) of 0·05 (Cadeddu *et al.*, 2012; Connelly, 2013).

No assumptions or sampling techniques were used in the sample size estimation. Descriptive summaries of the frequency and 95% CI for reporting of each of the factors associated with post-ICU adverse events were calculated. For data analysis, factors having the greatest contribution were grouped together (a ranking of 1 or 2), as were those contributing the least (a ranking of 3 or 4). The tool included a section to describe the patient's diagnosis and a section to list any other factors which also contributed to each adverse event.

Ethics approval for this study was obtained from a university Human Research Ethics Committee. The study was deemed negligible risk. Ethics Committees at participating hospitals also gave approval. No identifiable patient data were collected. All data were stored on security protected hardware. The ethical principles highlighted in the Declaration of Helsinki were followed.

RESULTS

Data were collected during an 18-month period in 2012 and 2013. A final sample size of 52 was obtained. This allowed reporting of 95% CI with ±12% precision. The factors associated with post-ICU adverse events were categorised into three domains: system, clinician and patient (Table 1).

Table 1 Factors associated with post-ICU adverse events

Factor	Percentage of patients in whom factor was present	95% Confidence interval	
		Ranking1 or 2	Ranking3 or 4
System factors			
Lack of/inadequate supervision of ward nursing staff	21	4·0–21·9	4·0–21·9
Lack of/inadequate supervision of ward medical staff	21	7·6–28·3	1·1–14·8
Lack of experienced nursing staff on the wards	16	2·9–19·6	1·9–17·3
Lack of experienced medical staff on the wards	27	11·5–34·4	1·1–14·8
Ward staffing levels below normal requirements	13	—	5·4–24·1
Heavy workloads on the wards	23	6·4–26·2	2·9–19·6
Ward nursing staff skill mix not usual ratio	13	1·1–14·8	1·9–17·3
ICU discharge process	23	5·2–24·1	4·0–21·9
Premature ICU discharge	32	7·6–28·3	7·6–28·3
After hours ICU discharge	21	2·9–19·6	5·2–24·1
Patient admitted to inappropriate ward	14	0·4–12·3	4·0–21·9
Lack of adequately qualified ward staff	13	1·1–14·8	1·9–17·3
Fragmentation of patient management due to input of multiple medical teams	20	4·0–21·9	2·9–19·6
Clinician factors			
Failure of staff to follow a rule or policy	21	4·0–21·9	4·0–21·9
Delay in providing nursing care	16	5·2–24·1	0·4–12·3
Inadequate patient handover from ICU to ward staff	11	0·04–9·5	2·9–19·6
Inadequate patient monitoring or assessment	23	10·2–32·4	0·4–12·3
Lack of recognition of or response to patient deterioration	38	15·8–40·3	2·9–19·6
Failure to deliver what is considered standard care	18	7·6–24·1	0·04–9·5
Failure to follow advice from a senior clinician	16	2·9–19·6	1·9–17·3
Delayed medical care on the ward	27	10·2–32·4	1·9–17·3
Patient factors			
Increased illness acuity	70	50·4–76·6	1·1–14·8
Presence of co-morbidities	57	32·9–60·3	4·0–21·9
Clinically challenging patients	46	21·8–47·8	4·0–21·9

ICU, intensive care unit.

Table 2 Other factors contributing to adverse events

- Incorrect choice of discharge ward
- Poor medical follow-up of patient on weekend
- Patient placed in room out of view of ward nurses' station
- High nurse to patient ratios on ward overnight
- Multiple doses of narcotic causing drowsiness
- Hypervolaemia
- Rapid clinical deterioration
- Delayed response to clinical deterioration on ward
- Clinical deterioration due to combination of acute and chronic co-morbidities
- Incorrect choice of medical treatment
- Tracheostomy patient being given oral fluid despite being nil by mouth
- Patient not adherent to ward nursing care due to delirium
- Lack of evidence-based guidelines for medical care
- Patient at high risk of aspiration

Additional factors were identified by the data collectors that were not on the data collection tool but also contributed to the adverse events. Fourteen factors were described (Table 2), and each of these factors was present in only one or two patients.

DISCUSSION

Limited data are available on the incidence, characteristics and outcomes of patients who experience an adverse event following ICU discharge (Williams *et al.*, 2010). Little is also known about the quality of patient care during the transition from ICU (Stelfox *et al.*, 2013). To be able to provide post-ICU patients with the best possible outcomes, more needs to be known about factors associated with adverse events in this high-risk population.

This study therefore aimed to clinically validate 25 factors ICU liaison nurses believe are associated with post-ICU adverse events. Seven factors contributed to adverse events in 25% or more of the study sample. Three factors contributed to adverse events in nearly half or more of the sample. These three factors were unique to the patients themselves: illness severity, co-morbidities and patients whom ward staff found to be clinically challenging.

Apart from readmission and mortality, post-ICU adverse events have received scant attention in the research literature. This is probably because these two events are easier to quantify than others. Furthermore, post-ICU mortality, as a potentially preventable and undesirable event, represents the worst of all possible adverse outcomes. However, while much is known about post-ICU mortality and readmission, less is known about other post-ICU adverse events and their associated factors.

Two recent Australian studies examined post-ICU adverse events primarily using chart review (McLaughlin *et al.*, 2007; Chaboyer *et al.*, 2008). In one of these, patients who experienced an adverse event were more frequently discharged in the evening or night (McLaughlin *et al.*, 2007). In this study, after-hours ICU discharge contributed to adverse events in nearly a quarter of patients. The ICU discharge process and premature ICU discharge were also key factors, contributing to events in 23% and 32% of patients, respectively. Other studies also identified the negative consequences of discharging patients from ICU prematurely (Chrusch *et al.*, 2009; Barker and Flint, 2010).

The ICU discharge process may therefore be a key area where strategies to reduce the risk of post-ICU adverse events could be most effective. The ICU discharge process is, however, influenced by many factors such as hospital bed management activity and competing priorities on the receiving ward (Lin *et al.*, 2013). Standardising the ICU discharge process could improve the safety, quality and efficacy of post-ICU care (Stelfox *et al.*, 2013). Research is attempting to identify the best ways to achieve this (Watts *et al.*, 2005; Lin *et al.*, 2009). Proposed strategies include reducing invasive technology prior to ICU discharge (Haggstrom *et al.*, 2012).

An inappropriate level of care on the wards, breakdown in care continuity and failure to record, or infrequent measurement of, vital signs have also been associated with post-ICU adverse events (McLaughlin *et al.*, 2007). Similar factors were identified in this study; these included delayed medical care on the ward and failure to deliver standard care. Other studies have highlighted suboptimal care delivery on hospital wards (Goldhill *et al.*, 1999; Hodgetts *et al.*, 2002).

The landmark inquiry into care before ICU admission found the management of airway, breathing, circulation and oxygen therapy on the wards to frequently be suboptimal (McQuillan *et al.*, 1998). The main causes of suboptimal care were lack of knowledge, lack of supervision, failure to appreciate clinical urgency and failure to seek advice (McQuillan *et al.*, 1998). A failure to measure vital signs has also been observed before emergency ICU admission (Jonsson *et al.*, 2011). A lack of, or inadequate, supervision of ward nursing and medical staff, failure of staff to follow a rule or policy, and lack of experienced medical and nursing staff on the wards similarly contributed to adverse events in this study.

These findings, and those of other studies, highlight the challenges ward staff face when caring for acute patients, and suggest that general wards are not the

ideal environment for post-ICU patients who are at risk. Ward staff have described a sense of dread and feeling of depression when informed that a patient was to be transferred from ICU (Whittaker and Ball, 2000). Providing ward staff with the knowledge and skills needed to care for these patients may be another strategy for limiting the frequency or severity of post-ICU adverse events. Education of ward staff may be a key role of Critical Care Outreach Teams and ICU liaison nurses.

In another Australian study, univariate and multivariate predictors of post-ICU adverse events included respiratory rate less than 10 or greater than 25 and a pulse rate greater than 110/min at the time of ICU discharge (Chaboyer *et al.*, 2008). The recording and reporting of vital signs were concluded as being important to post-ICU outcomes (Chaboyer *et al.*, 2008). This would seem self-evident, as simple physiological observations can identify high-risk patients (Goldhill and McNarry, 2004). However, delays in taking action for abnormal vital signs and infrequent charting have been identified in patients experiencing a post-ICU adverse event (McLaughlin *et al.*, 2007). This study validated the contribution of similar factors including inadequate patient monitoring or assessment and lack of recognition or response to patient deterioration. Other research similarly found that ward patients do not have their vital signs measured as often as they should and that patient deterioration often goes unrecognised (Fuhrmann *et al.*, 2008; Leuvan and Mitchell, 2008; Chen *et al.*, 2009). Unfortunately this is not a new clinical problem, suggesting that little progress is being made on this issue (Smith and Wood 1998).

In a retrospective audit of post-operative patients' medical records, ward documentation of vital signs became less frequent as the number of post-operative days increased, possibly suggesting a perception that the patient was stable (McGain *et al.*, 2008). If this is the case with post-ICU patients, it may explain the inadequate monitoring and assessment validated in this study. Ward staff might assume that if numerous days have passed since a patient was discharged from ICU, then the critical illness has resolved and less observation and assessment are needed. This is an important care issue requiring further investigation, particularly if these beliefs or assumptions reflect local practices. If a culture of limited documentation is applied to high-risk patients, it may have appreciable negative consequences (McGain *et al.*, 2008).

Hospital and patient factors can increase the frequency of the measurement and documentation of vital signs. The presence of epidural or patient-controlled analgesia for example has been shown to increase the incidence of vital sign measurement (McGain *et al.*, 2008). The reasons for this are unclear, but it may be due to a mandatory requirement for more frequent documentation in those patients (McGain *et al.*, 2008). The increased frequency may also be due to nurses' perception of the importance of vital signs assessment in certain high-risk patients. Again, this is an area in need of further investigation, particularly to determine the type of post-ICU patient that ward staff perceive to be at greatest risk.

In this study, the three factors contributing to the most adverse events reflected patients' characteristics: illness acuity, co-morbidities and the challenging nature of many patients. The presence of co-morbidities has been previously shown to contribute to other adverse events, although is not a factor which can be modified (Thomas and Brennan 2000). Clinicians should be mindful that post-ICU patients with co-morbidities are at greater risk of an adverse event than other patients. Given that co-morbidities often reflect the ageing process and that many patients admitted to ICU are aged 60 years and over, there will always be a risk of some patients experiencing an adverse event following ICU discharge (Song *et al.*, 2007).

Other factors not previously reported by ICU liaison nurses to be associated with post-ICU adverse events were identified in this study. However, each of these only contributed to adverse events in one or two patients. Some of these factors have been identified in other research and include poor medical follow-up of the patient, fluid mismanagement and nurse to patient ratios (Neale *et al.*, 2001; Rothberg *et al.*, 2005; McGain *et al.*, 2008). Although these factors were not validated by this study, because they have been identified in other research, their impact on post-ICU patient outcomes is worthy of further investigation.

Practice implications

The results of this study allow patients at risk of post-ICU adverse events to be more easily identified at the ward level. While it remains unclear what preventative action should be taken for those patients, this study is a starting point in that process. Ward staff caring for post-ICU patents should be aware that these patients are at higher risk of adverse events than other patients. They should also be mindful of the factors highlighted in this study which contribute to adverse events in post-ICU patients.

In particular, clinicians who help to coordinate post-ICU care such as Critical Care Outreach Teams and ICU liaison nurses should be alert to the potential impact that these factors have on post-ICU patients' outcomes. Factors such as the frequency with which ward staff perform assessments of post-ICU patients for example may be modified through staff education,

and therefore prevent some patients experiencing an adverse event post-ICU discharge.

Research implications

This study has identified numerous issues requiring further investigation. These include staff perceptions of what a high-risk post-ICU patient is; the knowledge and skills ward staff need to care for these at-risk patients; and ward staff perceptions of how high-risk patients should be assessed. The impact of other factors identified by the ICU liaison nurses, which also contributed to the adverse events in this study, is also worthy of further exploration.

Limitations

The method used for data validation in this study has a number of limitations. The study results may reflect each liaison nurse's interpretation or analysis of the adverse events they encountered in clinical practice. Each Nurse's analysis may have been based on clinical data and documentation in medical records. As such, there is a degree of subjectivity to the data collected and the results of this study. This, however, is a limitation common to any study with clinician involvement in the interpretation or documentation of adverse events. The results of this study also reflect adverse events occurring in post-ICU patients in the Australian health care system. It is recommended that the 25 factors be further validated in other health care systems round the world.

Some of the study's findings may also reflect inadequate communication between health professionals. The contribution of poor communication, however, is difficult to identify and measure; this should be considered when interpreting the study's findings.

The 25 factors validated in this study originated from the literature and other research. It is possible, however, that factors other than these 25, contribute to post-ICU adverse events. Some for example, may be those in Table 2, which require further validation.

CONCLUSION

Little is currently known about factors associated with post-ICU adverse events. This study validated 25 factors clinical experts believe to be associated with adverse events in the post-ICU population. Key factors were those unique to patients, and as such are not easily modified. Future research should focus on how clinical care should be streamlined in light of factors which are modifiable. Changing the way in which clinical care is delivered may help reduce the risk of future adverse events in post-ICU patients.

WHAT IS KNOWN ABOUT THIS TOPIC

- Patients admitted to ICU are at high risk of adverse events.
- Many patients discharged from ICU continue to have complex care needs, sustaining the risk of adverse events in a ward environment.
- Research on post-ICU adverse events has focused primarily on mortality and readmission.

WHAT THIS PAPER ADDS

- Factors associated with the most post-ICU adverse events are those related to the patient.
- By focusing on modifiable factors in care processes, the risk of post-ICU adverse events may be reduced.

ACKNOWLEDGEMENTS

The authors thank the ICU liaison nurses who collected data for this study, Professor Jenny Peat for statistical advice and Dr Aziz Rahman for editorial feedback.

REFERENCES

Baker G, Norton P, Flintoft V, Blais R, Brown A, Cox J, Etchells E, Ghali W, Hebert P, Majumdar S, O'Beirne M, Palacios-Derflingher L, Reid R, Sheps S, Tamblyn R. (2004). The Canadian adverse events study: the incidence of adverse events among hospital patients in Canada. *Canadian Medical Association Journal*; **170**: 1678–1686.

Balshem H, Helfand M, Schunemann H, Oxman A, Kunz R, Brozek J, Vist G, Falck-Ytter Y, Meerpohl J, Norris S, Guyatt G. (2011). GRADE guidelines: 3. Rating the quality of evidence. *Journal of Clinical Epidemiology*; **64**: 401–406.

Barker R, Flint N. (2010). Consequences of time of discharge from Intensive Care on mortality and readmission rates in a UK university teaching hospital. *Intensive Care Medicine*; **36**: S164.

Cadeddu M, Farrokhyar F, Levis C, Cornacchi S, Haines T, Thoma A. (2012). Understanding confidence intervals. *Canadian Journal of Surgery*; **55**: 207–211.

Chaboyer W, Foster M, Kendall E, James H. (2004). The impact of a liaison nurse on ICU nurses' perceptions of discharge planning. *Australian Critical Care*; **17**: 25–32.

Chaboyer W, Thalib L, Foster M, Ball C, Richards B. (2008). Predictors of adverse events in patients after discharge from intensive care. *American Journal of Critical Care*; **17**: 255–263.

Chen J, Hillman K, Bellomo R, Flabouris A, Finfer S, Cretikos M, MERIT Study Investigators. (2009). The impact of introducing

a medical emergency team on the documentation of vital signs. *Resuscitation*; **80**: 35–43.

Chrusch C, Olafson K, McMillan P, Roberts D, Gray P. (2009). High occupancy increases the risk of early death or readmission after transfer from intensive care. *Critical Care Medicine*; **37**: 2753–2758.

Clarke J. (2012). What is a CI? *Evidence-Based Nursing*; **15**: 66.

Connelly L. (2013). What are Confidence Intervals? *Medsurg Nursing*; **22**: 56.

De Vries E, Ramrattan M, Smorenburg S, Gouma D, Boermeester M. (2008). The incidence and nature of in-hospital adverse events: a systematic review. *Quality & Safety in Health Care*; **17**: 216–223.

Elliott S, Ernest D, Doric A, Page K, Worrall-Carter L, Thalib L, Chaboyer W. (2008). The impact of an ICU liaison nurse service on patient outcomes. *Critical Care and Resuscitation*; **10**: 296–300.

Elliott M, Crookes P, Worrall-Carter L, Page K. (2011). Readmission to intensive care: a qualitative analysis of nurses' perceptions and experiences. *Heart & Lung*; **40**: 299–309.

Elliott M, Worrall-Carter L, Page K. (2012a). Factors associated with in-hospital mortality following ICU discharge: a comprehensive review. *British Journal of Intensive Care*; **22**: 120–125.

Elliott M, Page K, Worrall-Carter L. (2012b). Reason's accident causation model: application to adverse events in acute care. *Contemporary Nurse*; **43**: 22–28.

Elliott M, Worrall-Carter L, Page K. (2013a). Intensive care readmission: a contemporary review of the literature. *Intensive & Critical Care Nursing*(DOI: org/10.1016/j.iccn.2013.10.005, In press).

Elliott M, Page K, Worrall-Carter L. (2013b). Factors contributing to adverse events after ICU discharge: a survey of Liaison Nurses. *Australian Critical Care*; **26**: 76–80.

Endacott R, Chaboyer W, Edington J, Thalib L. (2010). Impact of an ICU Liaison Nurse Service on major adverse events in patients recently discharged from ICU. *Resuscitation*; **81**: 198–201.

Fowler F, Epstein A, Weingart S, Annas C, Bolcic-Jankovic D, Clarridge B, Schneider E, Weissman J. (2008). Adverse events during hospitalization: results of a patient survey. *Joint Commission Journal on Quality and Patient Safety*; **34**: 583–590.

Fuhrmann L, Lippert A, Perner A, Ostergaard D. (2008). Incidence, staff awareness and mortality of patients at risk on general wards. *Resuscitation*; **77**: 325–330.

Goldhill D, McNarry A. (2004). Physiological abnormalities in early warning scores are related to mortality in adult patients. *British Journal of Anaesthesia*; **92**: 882–884.

Goldhill D, White S, Sumner A. (1999). Physiological values and procedures in the 24 h before ICU admission from the ward. *Anaesthesia*; **54**: 529–534.

Green A, Edmonds L. (2004). Bridging the gap between the intensive care unit and general wards – the ICU Liaison Nurse. *Intensive and Critical Care Nursing*; **20**: 133–143.

Haggstrom M, Asplund K, Kristiansen L. (2012). To reduce technology prior to discharge from intensive care – important but difficult? A grounded theory. *Scandinavian Journal of Caring Sciences*; **27**: 506–515.

Hodgetts T, Kenward G, Vlackonikolis I, Payne S, Castle N, Crouch R, Ineson N, Shaikh L. (2002). Incidence, location and reasons for avoidable in-hospital cardiac arrest in a district general hospital. *Resuscitation*; **54**: 115–123.

Jonsson T, Jonsdottir H, Moller A, Baldursdottir L. (2011). Nursing documentation prior to emergency admissions to the intensive care unit. *Nursing in Critical Care*; **16**: 164–169.

Kane-Gill S, Jacobi J, Rothschild J. (2010). Adverse drug events in intensive care units: risk factors, impact, and the role of team care. *Critical Care Medicine*; **38**: S83–S89.

Leuvan C, Mitchell I. (2008). Missed opportunities? An observational study of vital sign measurements. *Critical Care and Resuscitation*; **10**: 111–115.

Lightall G, Markar S, Hsuing R. (2011). Abnormal vital signs are associated with an increased risk for critical events in US veteran hospitals. *Resuscitation*; **80**: 1264–1269.

Lin F, Chaboyer W, Wallis M. (2009). A literature review of organisational, individual and teamwork factors contributing to the ICU discharge process. *Australian Critical Care*; **22**: 29–43.

Lin F, Chaboyer W, Wallis M, Miller A. (2013). Factors contributing to the process of intensive care patient discharge: an ethnographic study informed by activity theory. *International Journal of Nursing Studies*; **50**: 1054–1066.

McCoubrey J, Reilly J, Mullings A, Pollock K, Johnston F. (2005). Validation of surgical site infection surveillance data in Scotland. *Journal of Hospital Infection*; **61**: 194–200.

McGain F, Cretikos M, Jones D, Van Dyk S, Buist M, Opdam H, Pellegrino V, Robertson M, Bellomo R. (2008). Documentation of clinical review and vital signs after major surgery. *Medical Journal of Australia*; **189**: 380–383.

McLaughlin N, Leslie G, Williams T, Dobb G. (2007). Examining the occurrence of adverse events within 72 hours of discharge from the intensive care unit. *Anaesthesia and Intensive Care*; **35**: 486–493.

McQuillan P, Pilkington S, Allan A, Taylor B, Short A, Morgan G, Nielson M, Barrett D, Smith G, Collins C. (1998). Confidential inquiry into quality of care before admission to intensive care. *BMJ*; **316**: 1853–1858.

Moreno R, Miranda D, Matos R, Fevereiro T. (2001). Mortality after discharge from intensive care: the impact of organ system failure and nursing workload use at discharge. *Intensive Care Medicine*; **27**: 999–1004.

Neale G, Woloshynowych M, Vincent C. (2001). Exploring the causes of adverse events in NHS hospital practice. *Journal of the Royal Society of Medicine*; **94**: 322–330.

Peat J, Mellis C, Williams K, Xuan W. (2001). *Health Science Research: A Handbook of Quantitative Methods*. Sydney: Allen & Unwin.

Rothberg M, Abraham I, Lindenauer P, Rose D. (2005). Improving nurse-to-patient ratios as a cost-effective safety intervention. *Medical Care*; **43**: 785–791.

Singh M, Nayyar V, Clark P, Kim C. (2010). Does after-hours discharge of ICU patients influence outcome? *Critical Care and Resuscitation*; **12**: 156–161.

Sinopoli D, Needham D, Thompson D, Holzmueller C, Dorman T, Lubomski L. (2007). Intensive care unit safety incidents for medical versus surgical patients: a prospective multicenter study. *Journal of Critical Care*; **22**: 177–183.

Smith A, Wood J. (1998). Can some in-hospital cardio-respiratory arrests be prevented? A prospective survey. *Resuscitation*; **37**: 133–137.

Song X, MacKinght C, Latta R, Mitnitski A, Rockwood K. (2007). Frailty and survival of rural and urban seniors: results from the Canadian Study of Health and Ageing. *Aging, Clinical and Experimental Research*; **19**: 145–153.

Stelfox H, Perrier L, Straus S, Ghali W, Zygun D, Boiteau P, Zuege D. (2013). Identifying intensive care unit discharge planning tools: protocol for a scoping review. *BMJ Open*; **3**: e002653.

Thomas E, Brennan T. (2000). Incidence and types of preventable adverse events in elderly patients: population based review of medical records. *BMJ*; **320**: 741–744.

Utzolino S, Kaffarnik M, Keck T, Berlet M, Hopt U. (2010). Unplanned discharges from a surgical intensive care unit: readmissions and mortality. *Journal of Critical Care*; **25**: 375–381.

Wallis C, Davies H, Shearer A. (1997). Why do patients die on general wards after discharge from intensive care units? *Anaesthesia*; **52**: 9–14.

Watts R, Gardner H, Pierson J. (2005). Factors that enhance or impede critical care nurses' discharge planning practices. *Intensive & Critical Care Nursing*; **21**: 302–313.

Whittaker J, Ball C. (2000). Discharge from intensive care: a view from the ward. *Intensive and Critical Care Nursing*; **16**: 135–143.

Williams T, Leslie G, Elliott N, Brearley L, Dobb G. (2010). Introduction of discharge plan to reduce adverse events within 72 hours of discharge from the ICU. *Journal of Nursing Care Quality*; **25**: 73–79.

Wilson R, Runciman R, Gibberd R, Harrison B, Newby L, Hamilton J. (1995). The quality in Australian health care study. *Medical Journal of Australia*; **163**: 458–471.