

Characteristics and outcomes of patients subject to intensive care nurse consultant review in a teaching hospital

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In up to 16% of admissions, patients admitted to acute care hospitals suffer serious adverse events.¹⁻⁴ In Victorian public hospitals in 2003–04, patients discharged from the intensive care unit required readmission in up to 8% of cases and the overall in-hospital mortality rate was 13%.⁵ Two critical care outreach strategies for at-risk hospitalised patients are the use of medical emergency teams (METs) and intensive care nurse consultants (ICNCs), also known as ICU liaison nurses (ICU-LN).⁶⁻¹²

Two recent studies identified 31 ICU-LN services in Australia,¹³ with 12 of these in Victoria.¹⁴ Staff from these services provide expertise to ward staff in response to increased and unmet demand for intensive care services and the growing challenge of treating patients with complex needs on general hospital wards.¹⁵⁻¹⁸ Although many hospitals have an ICNC service, there is considerable diversity in the role's scope, structure and operation.^{13,18,19} A detailed understanding of the scope of practice of an ICNC service might assist in the development and implementation of quality-improvement strategies as well as guiding education and training of new ICNC staff.

The usual stated goals of ICNC services are to reduce ICU readmission rates, hospital mortality and adverse events in patients after ICU discharge.¹⁹⁻²⁴ These goals may not always be achieved, perhaps in part because of a lack of service standardisation between organisations and the diversity of research methods used. Limited information exists on the characteristics and outcomes of patients subject to ICNC review.^{20,22} A more detailed understanding of the types of patients reviewed by an ICNC service might guide strategies to further improve their outcomes.

We recently reported that ward staff perceived our ICNCs as approachable and skilled in assessing deteriorating patients.²⁵ Our study had several aims. The first was to describe the evolution of our ICNC service since 2006. In addition, we sought to better understand the epidemiology of our ICNC patient cohort by conducting a retrospective review of the characteristics, interventions and outcomes of patients managed by the ICNC service at our hospital.

Methods

Clinical setting

Austin Health is a university-affiliated hospital complex in Melbourne providing acute care, geriatric and rehabilitation

ABSTRACT

Objective: To describe the evolution of our Intensive Care Nurse Consultant (ICNC) service, the characteristics and outcomes of the patients reviewed, and interventions performed.

Design, setting and participants: Retrospective observational study in a tertiary referral university-affiliated teaching hospital among all patients reviewed by the ICNC service between September 2007 and December 2009.

Main outcome measures: Number and characteristics of patients reviewed, source of referral, interventions performed, in-hospital mortality and hospital length of stay.

Results: Since August 2006, operating hours have increased and provision has been made for senior ICU nurses to undertake 6-month developmental allocations to the role. The name of the service was changed and a weekly report was commenced to capture patient referral source, and subsequent ICU medical referral. Additional changes included provision of an administration day, and use of an ICU discharge scoring tool. A total of 3118 (2278 post-ICU and 840 non-ICU) care episodes were provided by the ICNC service between September 2007 and December 2009. Median patient age was 64 years, in-hospital mortality was about 9% and most reviews occurred in surgical patients and after ICU discharge. Most new ward referrals came from an ICU doctor or ward nurse, with few referrals from ward doctors. Communication with ward nurses was more common than with ward doctors. A common recommendation involved fluid and electrolyte management. In-hospital mortality was higher among patients entering the service after review by a medical emergency team or de-novo referral than in patients after ICU discharge.

Conclusions: Most interventions are relatively simple, and the ICNC role may be augmented by limited rights to prescribe electrolyte replacement. The effect of the intervention on patient outcomes and the reproducibility of our findings in other hospitals remain to be determined.

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medicine. Acute care is delivered in a 400-bed hospital where the ICNC service operates. The 19-bed ICU has about 2200 admissions per year, including those from a collocated obstet-

ric hospital. In the 2009–10 financial year, the ICU admitted 1489 surgical patients (about 70% were ICU admissions), including cardiac, liver transplant, thoracic and neurosurgery patients. There were 555 medical ICU admissions.

Details of emergency response services

The ICU provides three-tiers of outreach — Respond Blue (for cardiac or respiratory arrest), MET and ICNC services.

The MET reviewed 1731 cases in the 2009–10 financial year, and is staffed by an experienced ICU nurse and an ICU or internal medicine registrar. This service was introduced in August 2000 and has been associated with improvement in a variety of patient outcomes.²⁶⁻²⁷

The ICNC service at Austin Health commenced in September 2006 as a resource to support ward (medical, nursing and allied health) staff in managing patients with complex care needs.

Three modes of referral to the ICNC service were introduced: routine review at the time of ICU discharge; referral from MET staff after MET review of ward patients; and de-novo referral of patients by ward staff (parent-unit doctors or ward nurses) or by ICU doctors *not* in the context of MET review. The latter occurs when staff are worried about patients showing early signs of deterioration.

Study participants and data collected

Data on ICNC patients were maintained on paper case-report forms and manually entered into a Microsoft Excel database from January 2007. We present data collected between September 2007 and December 2009, as we believe this was the most complete and best-quality data.

Separate case-report forms were used for patient information at initial ICNC referral and for aspects of daily review and interventions. The case-report forms contained data on patient demographics, referral source and variables to semi-quantify illness severity. In addition to clinical interventions, we recorded discussions regarding end-of-life care and not-for-resuscitation plans, and escalation of care to ICU medical staff, the MET or our Respond Blue team.

We recorded whether patients discharged from the ICU were seen by an ICNC in the ICU before discharge or on the ward after discharge (eg, if discharged out-of-hours). Information on in-hospital mortality was obtained from the hospital clinical information system. The data fields within the ICNC database did not capture details of patients treated by our high-dependency unit recovery area or patients who died in the ICU.

A care episode was defined as a period of continuous review by the ICNC from the time of entry into the service to the time of discharge from the service. Thus, one patient may have received more than one care episode during the study period either because they were admitted to the ICU more than once during the same hospital admission, or had more than one hospital admission between September 2007 and December 2009.

Ethics

The hospital human research ethics committee approved this retrospective observational audit (H2011/04348) and waived the requirement for patient consent.

Data analysis and statistics

We categorised “admission unit” into six groups: specialty medicine, specialty surgery, cardiology or cardiothoracic surgery, general medicine, general surgery, and haematology–oncology. Descriptive data are described as raw numbers and percentages of total. In cases where data were missing, no assumptions were made about the missing data, and results are presented as n/N , where n is the number of patients or reviews in which the outcome occurred, and N is the total number of patients or reviews for which the outcome was known. Summary data are presented as median and interquartile range (IQR). Comparisons between groups were performed with the Mann–Whitney U test or the χ^2 test with Yates contingency correction for non- 2×2 tables. In all comparisons or hypothesis testing, $P < 0.05$ was taken to indicate statistical significance.

Results

Overview of ICNC service and changes with time

Since August 2006, the operating hours of the ICNC service have increased and provision has been made for senior ICU nurses to undertake 6-month developmental allocations to the ICNC role. The name of the service was changed from ICU Liaison Nurse to Intensive Care Nurse Consultant to reflect the consultative nature of the role (Table 1).

A weekly report was commenced in April 2007 and evolved to capture patient referral source and subsequent ICU medical referral. This document is circulated electronically among ICU and senior hospital management to inform them of ICNC activity and workload.

Additional changes included provision of an administration day, and use of an ICU discharge scoring tool (ranging from zero to 30) adapted from one used previously by ICU-LNs in a hospital where the role was being developed.¹⁶ Using this tool, the ICNC staff now triage patients at ICU discharge, and only follow up patients with a score greater or equal to four.

Details of referral source for ICNC caseload

Between September 2007 and December 2009 there were 4078 care episodes in the ICNC database (Figure 1), comprising 3238 episodes in patients who were eligible to be screened by the service at ICU discharge, 587 episodes entered after MET review of patients, and 253 through de-novo ward referral.

Of the 3238 eligible ICU episodes, 3009 (92.9%) were screened and scored for ICNC follow-up before discharge;

Table 1. Summary of Intensive Care Nurse Consultant service changes with time at Austin Health

Date	Staff	Other events
Aug 2006	2*	Name of service: Intensive Care Unit Liaison Nurse
Dec 2006	3†	Name of service: Intensive Care Nurse Consultant Staff development role. 6-month rotation for senior ICU nurses Weekly report commenced
Apr 2007	3	Audit and reporting of system factors leading to adverse outcomes
Sep 2007	3	Introduction of ICU scoring tool Commencement of electronic database
Feb 2009	3	Weekly administration day Funding for electronic data entry Member of the ICU Liaison National Network Forum
2010	3	Review of electronic data systems Research activities commenced Member of the Australian College of Critical Care Nurses – ICU Liaison Nurse special interest group (name change from ICU Liaison National Network Forum)
2011	3	Research activities Education and presentation at nursing induction

* 40 service hours per week (five 8-hour shifts). † 70 service hours per week (seven 10-hour shifts).

2278 of these had a discharge score greater than four and were reviewed after ICU discharge. Of the 229 not screened and scored before ICU discharge, 188 received at least one visit after discharge. Thus, in 943 cases (41 not screened and 902 screened), the patient was not reviewed by the ICNC service after ICU discharge.

A total of 3118 (2278 post-ICU and 840 non-ICU) care episodes were provided by the ICNC service. The median age of patients was about 64 years, and most were surgical patients. There were statistically significant differences between the patients reviewed after ICU discharge and the non-ICU patients (Table 2). The largest patient group reviewed by the ICNC after ICU discharge was cardiology and cardiothoracic surgery patients (35.4% of total cohort) followed by general surgical patients (24.9%). The least-visited patient groups after ICU discharge were "other" (2.2%), comprising paediatric and plastic surgery patients, as well as the haematology–oncology group (2.7%).

The largest cohort of non-ICU discharged patients reviewed by the ICNC service were general surgery patients (37.0%), followed by cardiology and cardiothoracic surgery patients (17.3%).

For the 253 cases of de-novo referral of ward patients, the referring clinician was documented in 201 cases (79.4%). Eighty-three referrals (41.3%) were by ICU doctors, 82 (40.8%) by ward nurses, 23 (11.4%) by ward doctors and 13 (6.5%) by others.

Description of number and nature of routine visits

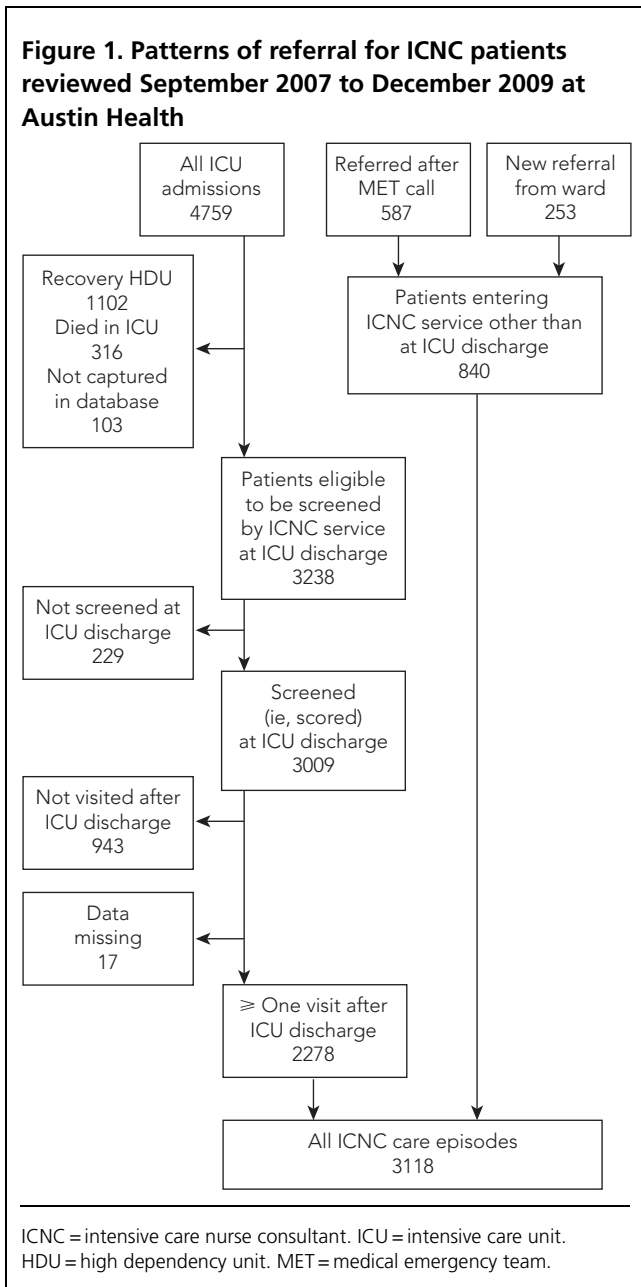
In all patient visits, the ICNC met the primary ward nurse to review and discuss vital sign trends, fluid balance, and concerns about patient's status and clinical course. The

Table 2. Age and admission category of patients subject to intensive care nurse consultant review between September 2007 and December 2009

Variable	Total eligible for review	ICU patients eligible	Reviewed by ICNC after ICU discharge	Non-ICU patients reviewed
Total number	4078	3238	2278	840
Proportion that were surgical*	59.3%	61.3%	61.1%	51.4%
Age, years, median (IQR)†	64.7 (50.5–75.5)	63.4 (49.6–74.3)	65.0 (51.2–75.3)	68.2 (54.6–80.0)
Cardiology/cardiothoracic surgery, no. (%)	1376 (33.7%)	1231 (38.0%)	807 (35.4%)	145 (17.3%)
General medicine, no. (%)	396 (9.7%)	284 (8.8%)	193 (8.5%)	112 (13.3%)
General surgery, no. (%)	1021 (25.0%)	710 (21.9%)	568 (24.9%)	311 (37.0%)
Haematology–oncology, no. (%)	130 (3.2%)	90 (2.8%)	61 (2.7%)	40 (4.8%)
Specialty medicine, no. (%)	529 (13.0%)	425 (13.1%)	316 (13.9%)	104 (12.4%)
Specialty surgery, no. (%)	481 (11.8%)	364 (11.2%)	283 (12.4%)	117 (13.9%)
Other,‡ no. (%)	145 (3.6%)	134 (4.1%)	50 (2.2%)	11 (1.3%)

ICU = intensive care unit. ICNC = intensive care nurse consultant. IQR = interquartile range. * $P < 0.001$ for comparisons of all ICU patients v non-ICU patients AND followed-up ICU patients v non-ICU patients, ie, non-ICU patients were significantly less likely to be surgical. † $P < 0.001$ for comparisons of all ICU patients v non-ICU patients AND followed-up ICU patients v non-ICU patients, ie, non-ICU patients were significantly older than ICU patients. ‡ Paediatric and plastic surgery patients.

Figure 1. Patterns of referral for ICNC patients reviewed September 2007 to December 2009 at Austin Health



ICNC performed a targeted physical examination and discussed their assessment and recommendations with nursing and/or medical staff. The review also involved assessment of drug therapy and suggestions for allied health referral or therapeutic interventions.

Interventions

ICNCs conducted a comprehensive patient assessment in 18.3% of first visits; 5.9% of second reviews and 2.4% of third visits (Table 3). This involved a thorough physical examination to formulate a problem list for clinical status and causes of instability.

Investigations that were reviewed included biochemical and inflammatory marker levels, haemoglobin level, coagulation profile and results of microbiology tests and limited radiological examination. Reviewing results was the intervention most frequently performed by ICNCs, occurring at least once in 88.9% of patients, with more than one in seven patients requiring more than three reviews of results (Table 3). Results were not assessed in 11.1% of care episodes. In an unknown proportion of these cases, this occurred because they were not yet available at the time of review.

Additional documented interventions included adjusting oxygen therapy, tracheostomy care (58/3111 care episodes [1.9%]), advice regarding fluid and electrolyte management and central line device management and surveillance (Table 3). The most common of these involved suggestions for adjustment to fluid and electrolyte therapy, which occurred in at least one in eight patients.

Communication

Discussions with clinicians involved suggestions for ongoing management, areas of concern related to possible deterioration, perceived need for specialist referral, or re-evaluation of management plans. Such communication was much more frequent with ward nurses than ward doctors (Table 4). The most common allied health referral was to physiotherapists, while referral to acute pain services, speech pathologist and dietitians occurred in 112/3111 visits (3.6%).

Table 3. Frequency of intensive care nurse consultant intervention, by type of intervention, as a proportion of all care episodes

No. of interventions per patient*	Comprehensive patient assessment (N= 3110)	Review results (N= 3112)	Fluid and electrolyte (N= 3111)	Intravenous line management (N= 3110)	Oxygen therapy (N= 3110)
1	568 (18.3%)	1401 (45.0%)	433 (13.9%)	165 (5.3%)	121 (3.9%)
2	182 (5.9%)	619 (19.9%)	119 (3.8%)	19 (0.6%)	19 (0.6%)
3	73 (2.4%)	290 (9.3%)	39 (1.3%)	3 (0.1%)	2 (0.1%)
> 3	70 (2.3%)	457 (14.7%)	23 (0.7%)	1 (0.1%)	0

* For each separate care episode. One patient may have received more than one care episode during the study period.

Table 4. Frequency of discussions between intensive care nurse consultants and families or hospital staff members, as a proportion of all care episodes (N = 3111)

No. of discussions per patient*	Patient and family	ICU doctor	Ward nurse	Ward doctor	Physiotherapist	MET registrar
1	605 (19.5%)	231 (7.4%)	1339 (43.0%)	723 (23.2%)	241 (7.8%)	195 (6.3%)
2	163 (5.2%)	34 (1.1%)	576 (18.5%)	247 (7.9%)	57 (1.8%)	37 (1.2%)
3	53 (1.7%)	8 (0.3%)	290 (9.3%)	102 (3.3%)	14 (0.5%)	8 (0.3%)
>3	47 (1.5%)	4 (0.1%)	407 (13.4%)	93 (3.1%)	13 (0.4%)	4 (0.1%)

ICU = intensive care unit. MET = medical emergency team. * For each separate care episode. One patient may have received more than one care episode during the study period.

Communication with the patient and family members to clarify questions about the patient's condition or concerns after ward transfer from ICU occurred in more than a quarter of visits. Communication with ICU medical staff occurred regarding concerns about possible deterioration or the need for ICU admission. The ICU doctor and MET registrar were each contacted in about 8% of visits (Table 4). Targeted education to either patients or ward staff occurred in 9.5% of visits.

Alterations to the level of care

The ICNC escalated care by initiating an MET call in 62/3111 reviews (2%) and a Respond Blue call in 6/3111 cases (0.2%). In a further 31 cases (1.0%), the ICNC initiated discussions about end-of-life care planning with the parent unit, independently of ICU medical staff.

Patient outcomes

Overall, the median (IQR) hospital length of stay for the 4078 patients who were eligible for ICNC review was 13 days (7–27 days). The median (IQR) length of stay for the 2278 patients reviewed after ICU discharge was 15 days (8–30 days) which was similar to the 17 days (8–34 days) for the 840 patients seen after MET review or after new ward referral ($P=0.26$).

Data on in-hospital survival were available for 96.1% of patients, and the overall in-hospital mortality was 8.9% (347/3920). The hospital mortality for patients reviewed after MET call or de-novo referral was 18.0% (145/807) — substantially higher than for those reviewed after ICU discharge (6.5% [202/3113]; odds ratio, 3.16; 95% CI, 2.53–3.93; $P<0.001$).

In 118 episodes (3.8%) patients were discharged from the service because they were palliated. Palliation was less frequent in patients after ICU discharge (3.1% [71/2272]) compared with those seen after MET review, or as a new ward referral (47/840 [5.6%]; OR, 0.54; 95% CI, 0.38–0.79; $P=0.002$).

Discussion

Summary of major findings

The ICNC service has evolved over time with an increase in operating hours, a change in name to reflect the consultative nature of the role, a weekly report and administration day, and the commencement of a scoring tool to facilitate the triage of patients needing review.

Our retrospective assessment of the characteristics, interventions and outcomes for patients subject to ICNC review showed that most reviews occurred in surgical patients and after ICU discharge. Most new ward referrals came from an ICU doctor or ward nurse, with few referrals from the ward doctor.

Communication between ICNCs and ward nurses was more common than with ward doctors. A common recommendation involved fluid and electrolyte management. In-hospital mortality was higher among patients entering the service after MET review or de-novo referral than among patients after ICU discharge.

Comparison with previous studies

Published research surrounding ICU-LN has focused on ward nurses' perceptions of the role^{25,28-30} and outcomes associated with the implementation of the service including ICU readmission,^{8,9,23,24} discharge process or delay,^{20,31} in-hospital mortality,^{8,9,19,24} adverse events,²² and patient or family anxiety before ICU discharge.³²

We described the evolution of our service over time. Previous studies have documented service implementation within their organisation^{15,16} but few have described how they developed over time. Our finding that most patients were captured after ICU discharge or MET review is consistent with that seen in multiple previous studies.^{8,13-16,20-22}

A United Kingdom study found the most common interventions performed by a nurse-led critical care outreach team were tracheostomy management, physiotherapy, guiding non-invasive ventilation, and optimising patient position. Referrals were made to the parent medical

team (44%), speech and language therapist (12%), physiotherapist (11%) and critical care registrar (11%).⁸ In a New Zealand study the patient cohort included ICU discharges (71%), ICU registrar referral of unwell ward patients (16%), and direct ward staff (medical or nursing) referral (13%). Activities performed included patient and family support and education, as well as prescribing medication — in particular, electrolyte supplementation.²³

An integrative review and metasynthesis of activities and outcomes of ICU liaison services showed a predominant benefit of improved communication between critical care and ward staff.¹⁹

An evaluation of a critical care nursing outreach service identified the care needs of patients discharged from the ICU, which included vascular access, respiratory therapy care, urinary catheters, intravenous therapy, cardiac monitoring and delirium. The main interventions performed related to respiratory, gastrointestinal, catheter, renal, psychiatric or psychological, and electrolyte issues.²⁰

Other studies have also revealed that ICNC interventions are directed towards optimisation of patient management, including clinical support and education or manipulation of existing therapies, such as fluid, oxygen, electrolytes, allied health referral and education.^{8,15,16}

Interpretation of findings

Our service reviewed patients with an in-hospital mortality of 8.9%, higher than the 2%–3% mortality for overall hospital admissions.³³ This is consistent with findings of our previous survey suggesting that ward nurses refer patients not suffering major deterioration.²⁵ The mortality for patients seen after MET review was 18.0%, lower than the 30% mortality for all MET patients in our hospital.³⁴ This may reflect preferential referral to the ICNC service of MET patients without limitations of medical therapy.

The extent of ICNC interventions was less than expected, perhaps reflecting incomplete documentation during review, or incomplete transcription into the ICNC database. Alternatively, it may also reflect that while interventions are not complex, their timeliness is potentially important. In a previous survey of ward nurses, we reported that ICNC review helped nurses prioritise management goals, particularly when acute deterioration had occurred (ie, after MET review).²⁵ Our case-report form may not have allowed us to capture any more complex interventions provided.

Study strengths and limitations

To our knowledge, this is one of the few detailed studies to document changes in an ICNC service over time and outline the characteristics, outcomes and interventions for more than 3000 patients. It is also one of the first to detail the ICNC scope of practice. Despite these strengths, our study has the limitations of a retrospective study design, incom-

plete capture of cases, lack of cross-validation of data entered into the database, and likelihood of incomplete data entry at the time of patient review. Our study provides no information on the effect of our intervention on patient outcomes. In addition, our findings must be seen within the dynamic changes in the care of deteriorating patients that are taking place in the Australian health care system and other similar systems.³⁵⁻⁴⁰ Finally, our findings represent those of a single hospital, and a multicentre survey is required to place our findings in the context of the broader Australian hospital system.

Implications for clinicians, policymakers and researchers

Our study suggests patients subject to ICNC review are at moderate risk, as the associated mortality was greater than the overall hospital mortality but less than that of patients reviewed by the MET. We have demonstrated that many interventions are not complex, and that much of our input relies on education of ward staff.

We have shown, however, that a substantial proportion of cases involve suggestions surrounding fluid and electrolyte replacement, which may highlight a deficit in ward-level medical monitoring and prescribing, and may in future be considered as a possible extension to ICNCs' scope of practice.

We have also demonstrated that the vast majority of patients reviewed by our service are those recently discharged from the ICU. Accordingly, this is the patient cohort in whom ICNC interventions are most likely to have an impact. Similarly, given that ICNCs see a very small proportion of general ward patients who have not been admitted to the ICU, it is much less likely that their interventions will have a major impact on the outcomes of this much larger group of patients, for example, unplanned ICU admissions from the ward. Finally, our findings also suggest that a substantial proportion of referrals come from the ICU doctor, rather than directly from ward staff. This may indicate a need to improve the profile and communication processes with ward medical staff.

Conclusions

In our study of more than 3000 ICNC patients, most patients reviewed were surgical and recently discharged from the ICU, and about 9% died in-hospital. Most interventions captured were relatively simple, and the ICNC role may be augmented by limited rights to prescribe electrolyte replacement. The effect of our intervention on patient outcomes and the reproducibility of our findings in other hospitals remain to be determined.

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Competing interests

None declared.

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References

- 1 Thomas EJ, Studdert DM, Burstin HR, et al. Incidence and types of adverse events and negligent care in Utah and Colorado. *Med Care* 2000; 38: 261-71.
- 2 Wilson RM, Runciman WB, Gibberd RW, et al. The Quality in Australian Health Care Study. *Med J Aust* 1995; 163: 458-71.
- 3 Davis P, Lay-Yee R, Briant R, et al. Adverse events in New Zealand public hospitals I: occurrence and impact. *N Z Med J* 2002; 115: 1-9.
- 4 Vincent C, Neale G, Woloshynowych M. Adverse events in British hospitals: preliminary retrospective record review. *BMJ* 2001; 322: 517-19.
- 5 Australian and New Zealand Intensive Care Society. Intensive care for adults in Victorian public hospitals 2003-04. Melbourne: Department of Human Services, Quality and Safety Branch, 2005. <http://www.health.vic.gov.au/criticalcare/icu-report03-04.pdf> (accessed Sep 2011).
- 6 Bellomo R, Goldsmith D, Uchino S, et al. Prospective controlled trial of effect of medical emergency team on postoperative morbidity and mortality rates. *Crit Care Med* 2004; 32: 916-21.
- 7 Buist MD, Moore GE, Bernard SA, et al. Effects of a medical emergency team on reduction of incidence and mortality from unexpected cardiac arrests in hospital: preliminary study. *BMJ* 2002; 324: 387-90.
- 8 Ball C, Kirby M, Williams S. Effect of critical care outreach team on patient survival to discharge from hospital and readmission to critical care: non-randomised population study. *BMJ* 2003; 327: 1014-7.
- 9 Elliott S, Doric A, Ernest D, et al. The ICU Liaison Nurse service improves patient outcomes. *Aust Crit Care* 2008; 21: 57-8.
- 10 McFarlane SJ, Hensley S. Implementation and outcomes of a rapid response team. *J Nurs Care Qual* 2007; 22: 307-13.
- 11 Garretson S, Rauzi MB, Meister J, Schuster J. Rapid response teams: a proactive strategy for improving patient care. *Nurs Stand* 2006; 21: 35-40.
- 12 Jones DA, DeVita MA, Bellomo R. Rapid-response teams. *N Engl J Med* 2011; 365: 139-46.
- 13 Elliott S, Chaboyer W, Ernest D, et al. A national survey of Australian intensive care unit (ICU) liaison nurse (LN) services. *Aust Crit Care* 2012; 25: 253-62.
- 14 Elliott S, Doric A, Ernest D. Mapping the ICU liaison nurse services in Victoria. *Aust Crit Care* 2008; 21: 73-4.
- 15 Barbeti J, Choate K. Intensive care unit liaison nurse service: implementation at a major metropolitan hospital. *Aust Crit Care* 2003; 16: 46-52.

- 16 Green A, Edmonds L. Bridging the gap between the intensive care unit and general wards the ICU liaison nurse. *Intensive Crit Care Nurs* 2004; 20: 133-43.
- 17 Endacott R, Chaboyer W. The nursing role in the ICU outreach: an international exploratory study. *Nurs Crit Care* 2006; 11: 94-102.
- 18 Victorian Government Department of Health. A framework for the intensive care unit liaison nurse in Victorian health services. Melbourne: Victorian Government Department of Health, 2010. http://www.health.vic.gov.au/criticalcare/icu_nurse.pdf (accessed Sep 2011).
- 19 Endacott R, Elliott S, Chaboyer W. An integrative review and meta-synthesis of the scope and impact of intensive care liaison and outreach services. *J Clin Nurs* 2009; 18: 3225-36.
- 20 Williams TA, Leslie G, Finn J, et al. Clinical effectiveness of a critical care nursing outreach service in facilitating discharge from the intensive care unit. *Am J Crit Care* 2010; 19: e63-72.
- 21 Elliott SJ, Ernest D, Doric AG, et al. The impact of an ICU liaison nurse service on patient outcomes. *Crit Care Resusc* 2008; 10: 296-300.
- 22 Endacott R, Chaboyer W, Edington J, Thalib L. Impact of an ICU liaison nurse service on major adverse events in patients recently discharged from ICU. *Resuscitation* 2010; 81: 198-201.
- 23 Pirret AM. The role and effectiveness of a nurse practitioner led critical care outreach service. *Intensive Crit Care Nurs* 2008; 24: 375-82.
- 24 Doric A, Duke G. ICU liaison nurse service in combination with MET improves survival [abstract]. *Aust Crit Care* 2011; 24: 68.
- 25 McIntyre T, Taylor C, Eastwood GM, et al. A survey of ward nurses attitudes to the Intensive Care Nurse Consultant service at a teaching hospital. *Aust Crit Care* 2012; 25: 100-9.
- 26 Bellomo R, Goldsmith D, Uchino S, et al. A prospective before-and-after trial of a medical emergency team. *Med J Aust* 2003; 179: 283-7.
- 27 Jones D, Bellomo R. Introduction of a rapid response system: why we are glad we MET. *Crit Care* 2006; 10: 121.
- 28 Athifa M, Finn J, Brearley L, et al. A qualitative exploration of nurse's perception of critical care outreach service: a before and after study. *Aust Crit Care* 2011; 24: 39-47.
- 29 Chaboyer W, Gillespie B, Foster M, Kendall M. The impact of an ICU liaison nurse: a case study of ward nurses' perceptions. *J Clin Nurs* 2005; 14: 766-75.
- 30 Richardson A, Burnand V, Colley H, Coulter C. Ward nurses' evaluation of critical care outreach. *Nurs Crit Care* 2004; 9: 28-33.
- 31 Chaboyer W, Thalib L, Foster M, et al. The impact of an ICU liaison nurse on discharge delay in patients after prolonged ICU stay. *Anaesth Intensive Care* 2006; 34: 55-60.
- 32 Chaboyer W, Thalib L, Alcorn K, Foster M. The effect of an ICU liaison nurse on patients and family's anxiety prior to transfer to the ward: an intervention study. *Intensive Crit Care Nurs* 2007; 23: 362-9.
- 33 Duke GJ, Graco M, Santamaria J, Shann F. Validation of the hospital outcome prediction equation (HOPE) model for monitoring clinical performance. *Intern Med J* 2009; 39: 283-9.
- 34 Calzavacca P, Licari E, Tee A, et al. Features and outcomes of patients receiving multiple medical emergency team reviews. *Resuscitation* 2010; 81: 1509-15.
- 35 Flabouris A, Jeyadoss J, Field J, Soulsby T. Direct and delayed admission to an intensive care of high dependency unit following discharge from the emergency department: associated patient characteristics and hospital outcomes. *Crit Care Resusc* 2012; 14: 191-7.
- 36 The Australian ICU Liaison Nurse Forum. Uptake and caseload of intensive care unit liaison nurse services in Australia. *Crit Care Resusc* 2012; 14: 221-6.
- 37 Kansal A, Havill K. The effects of introduction of new observation charts and calling criteria on call characteristics and outcome of hospitalized patients. *Crit Care Resusc* 2012; 14: 38-43.
- 38 Considine J, Lucas E, Wunderlich B. The uptake of an early warning system in an Australian emergency department: a pilot study. *Crit Care Resusc* 2012; 14: 135-41.
- 39 Medical Emergency Team End-of-life Care Investigators. The timing of rapid-response team activations: a multicenter international study. *Crit Care Resusc* 2013; 15: 15-20.
- 40 Jones S, Mullally M, Ingleby S, et al. Bedside electronic capture of clinical observations and automated clinical alerts to improve compliance with



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