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Research paper

Differences in the characteristics, treatment, and outcomes of patient groups reviewed by intensive care liaison nurses in Australia: A multicentre prospective study

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ABSTRACT

Background: There is a lack of knowledge about tasks intensive care unit liaison nurses (ICU LNs) perform during patient review, despite this role operating in at least 31 acute care hospitals in Australia.
Objectives: To evaluate the tasks that ICU LNs perform during patient review in the following referral subcategories: review after ICU discharge, rapid response team (RRT) review, and ward referral.
Methods: A 2-month prospective observational study using standardised case report forms to collect data on patients reviewed by ICU LNs in 20 Australian hospitals was conducted.
Results: From 3799 patients screened, 3542 were included, among whom 1933 (54.6%) were men, and the mean (standard deviation) age was 63 (19.4) years. The admitting units were surgical 1765 (49.8%) and medical 1696 (47.9%), and the breakdown of referral types were routine review after ICU discharge (1732; 47.9%), RRT review (1208; 34.1%), and ward referral (602; 17.0%). Patients subject to ward and RRT reviews were older, more likely to be medical admissions with less favourable vital signs on the initial review, and less likely to have repeat reviews. Of note, ward reviews were more likely to receive palliative care. Intensive care liaison nurse–initiated medication prescription and investigation ordering was uncommon. The most common interventions included consultation with medical staff, bedside education, adjusting oxygen flow and patient position, and directing the change in frequency of vital sign measurement. In-hospital mortality was lower in patients reviewed after ICU discharge (2.3%), compared with those after RRT review (2.8%) and ward referral (4.4%).
Conclusions: Most patients were reviewed after ICU discharge or in the context of the RRT. RRT and ward patients were less physiologically stable and more likely to die in hospital. The most common interventions performed by the ICU LN were nontechnical skills including clinical education, consultation with medical staff, and changes to vital sign frequency. Finally, the most common medication therapies administered related to intravenous therapy and electrolyte administration.

1. Introduction

In response to observations that serious adverse events occur commonly in hospitalised patients and many such events are preceded by signs of instability, healthcare policy makers have introduced national standards related to the recognition of, and response to deteriorating patients in Australian hospitals.[1,2] One of

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the nine essential elements of this approach involves the implementation of rapid response teams (RRTs), also known as medical emergency teams (MET), which involves activation of a specialised team when a patient has deteriorated. A limitation of this approach is that it remains reactive, and the in-hospital mortality of patients reviewed by the RRT can be as high as 30%.[3,4] A less reactive and more proactive approach to at-risk and deteriorating patients is the use of intensive care unit liaison nurses (ICU LNs), also known as ICU nurse consultants, which are present in at least 31 Australian hospitals.[5] The main benefits of critical care outreach nursing services include reduction in ICU readmission, improved discharge planning, and improved patient flow.[6,7] Previous studies, which have evaluated ICU LN services, have mostly come from Australia and the United Kingdom.[6,7] Yet, a recent study from Argentina demonstrates that ICU LN services are beginning to emerge in other countries and describes comparable details in the follow-up of ICU discharge and ward patients with complex care needs.[8]

There is a growing body of literature describing the role of ICU LNs and the nature of the patients reviewed.[9–12] These roles include the routine and pre-emptive review of patients discharged from the ICU, patients referred from the ward (typically from nurses), and participation in the RRT.[13–16] The Australian ICU LN forum previously described the uptake and pattern of case referrals for 17 Australian ICU LN services between 1999 and 2011. This study revealed that ICU discharges, during or after RRT review, and de novo ward referrals comprised 59.3%, 21.7%, and 19.0% of patient reviews, respectively.[17]

The same group also published the findings of a multicentre prospective observational study of 3799 patients reviewed by ICU LN services.[10] This study confirmed that the three most common types of patients reviewed were those after ICU discharge, patients involved in RRT review, and patients referred as part of a ward nurse worried criteria. It also revealed that the in-hospital mortality of ICU LN–reviewed patients was 10.2% overall.[10]

The purpose of this study is to describe in greater detail the differences in the baseline characteristics, treatment, and outcomes of various patient groups reviewed by ICU LN services in Australia, specifically, the tasks that ICU LNs perform among patients discharged from ICU, in the context of ward referral (for worried or physiological criteria), or after RRT review.

2. Methodology

2.1. Study design

Expressions of interest to participate in the study were sought via an email sent to all members of the Australian College of Critical Care Nurses ICU LN special interest group. After 28 initial expressions of interest, 20 sites were enrolled in the study. The group did not collect information on LN credentials, scope of practice, or role and responsibilities for the study. We conducted a 2-month prospective observational study in 20 participating hospitals; 17 commenced data collection on 23rd March 2012, with the last hospital commencing on 31st May 2012.

2.2. Study infrastructure and coordination

The study was conducted under the auspices of the Australian ICU LN forum and was coordinated by a management and writing committee. The committee developed and promulgated the study protocol, paper-based scannable case report forms (CRFs), and data dictionary; prospectively devised a data analysis plan; drafted and revised manuscripts; and sent intermittent reports to sites to assist with compliance with local Human Research Ethics Committee (HREC) requirements (see Appendix).

Assistance was provided to sites for ethics submissions, data dictionary, and CRF queries. CRFs were scanned, and in instances where data variables were significantly outlying, cross-referencing was conducted between the spreadsheet generated by the automated scanning process and the handwritten text on the CRF, and data queries were subsequently resolved.

2.3. Case report forms

The CRFs were adapted from the International Liaison Committee on Resuscitation guidelines, which provides instruction for monitoring, reporting, and conducting research on MET, outreach, and rapid response systems.[18] Each patient episode had its own unique identifier. Patients were followed up until they were perceived to be well enough, at which time they are discharged from the service. If a patient returned to the ICU, experienced subsequent deterioration, or underwent a subsequent hospital readmission, the patient could be readmitted to the service for ICU LN review. These instances were treated as a separate review episode, and the subsequent review(s) was assigned a new unique identifier. CRF reports were scanned and automatically entered into an electronic database once completed. A patient log was maintained at all participating hospitals to permit re-identification for data queries.

2.4. Nature of data collection

Patient demographics collected include age, gender, and the presence of several comorbidities, including dementia; liver, cardiovascular, respiratory, and renal disease; immune compromise; and diabetes mellitus. The parent unit, inclusive of medical, surgical, obstetric, paediatric, or 'other' was also obtained.

Details were recorded for the primary reason for ICU LN review, i.e. after ICU discharge, ward referral, and part of RRT review or follow-up (RRT review). Documentation of physiological status with the recording of vital signs such as respiratory rate, oxygen saturation, blood pressure, pulse, temperature, level of consciousness using "Alert, Voice, Pain, Unresponsive" scale, presence of pain, an estimated urine output of less than 30 mls per hour, and if the patient received intravenous therapy, were also collected.

Intensive care liaison nurses often screen patients to determine whether they require ongoing ward follow-up. On initial review, the patients considered low clinical risk, requiring no interventions, and no follow-up review was considered "screened only" and not formally entered on to the ICU LN caseload for follow-up review.

A detailed list of interventions and tasks performed by the ICU LN was also recorded during each review. This included capturing changes to medical treatment plans (i.e., not for resuscitation/treatment limitation plan), referrals to multidisciplinary hospital staff, details of medication administration, diagnostic tests ordered, and a list on nonmedication-related therapies.

Finally, patient outcomes relating to the date of acute hospital discharge, including discharge destination, or of death while in hospital was noted.

2.5. Statistical analysis

All data were initially assessed for normality. Group comparisons were made using chi-square tests for equal proportion, Student t-tests or analysis of variance for normally distributed data, and Wilcoxon rank-sum or Kruskal–Wallis tests otherwise. Results have been reported as numbers (%), mean (standard deviation), or median (interquartile range), respectively.

All analyses were conducted using SAS version 9.3 (SAS Institute Inc., Cary, NC, USA), and a two-sided p-value of 0.05 was considered to be statistically significant.

2.6. Ethics and funding

Approval to perform the study was obtained from the human research ethics committees of all participating hospitals (HREC approval numbers in appendix). A project grant from the Intensive Care Foundation in 2010 was used to fund the study.

3. Results

3.1. Details of the overall cohort

During the study, 3799 patients were initially screened by the 20 ICU LN services with adequate data to permit analysis. For the purposes of this study, patients who were subject to total parenteral nutrition or tracheostomy rounds were excluded (257 or 6.8% of cohort), leaving 3542 patients. Among these, 1933 (54.6%) were men, and the mean (standard deviation) age was 63 (19.4) years. The breakdown of the admitting unit included surgical 1765 (49.8%), medical 1696 (47.9%), paediatric 34 (1%), obstetric 24 (0.7%), and other 22 (0.6%).

The three prospectively defined groups included the following: (1) those followed up routinely after ICU discharge (1732); (2) ward review (602), including referral for worried (413) and physiological (189) criteria; and (3) RRT review (1208) which included either review during (916) or after (292) RRT activation.

3.2. Differences in the baseline characteristics and comorbidity

There were clinical differences in the baseline characteristics between the three groups (Table 1). Patients followed up in the context of ward referral or RRT review were more likely to be medical patients, female gender, and older than those followed up after ICU discharge. They were also more likely to have dementia and liver disease and to be immune compromised.

3.3. Differences in physiological status at an initial review

With the exception of temperature, there were statistically significant differences in the vital signs across the three predefined groups. The respiratory rate, oxygen saturation, systolic blood pressure, heart rate, and requirement for oxygen were all less favourable in patients subject to ward referral or RRT review (Table 2).

Similarly, patients subject to ward or RRT review had lower levels of consciousness (Table 2). This was particularly the case for RRT review, during which 8.5% of patients were unresponsive to pain. Approximately one in 10 ward review patients had oliguria, despite one in four of them receiving intravenous therapy (Table 2).

3.4. Details of reviews, referrals, and treatment limitations

Patients subject to RRT review were less likely to have multiple reviews and also had a lower number of reviews requiring interventions (Table 3). Among the 3542 patients, 1429 (40.3%) were screened and had no subsequent interventions, 781 (22.0%) were seen once, and 1332 (37.6%) received multiple reviews. Patients reviewed in the context of de novo ward referrals and RRT calls were more likely to be screened than those reviewed after ICU discharge ($p < 0.0001$). Data on this variable were missing for five patients. There were a total of 7336 reviews, of which 7274 (99.2%) had completed CRFs detailing the interventions performed in the review.

Table 1
Demographics of major categories of patients reviewed by ICU LNs.

Patient feature	After ICU discharge, N = 1732	Ward referral, N = 602	RRT review, N = 1208	p-value
Parent unit, N (%)				
Medical	669 (38.6)	326 (54.2)	701 (58.0)	<0.0001
Surgical	1042 (60.2)	263 (43.7)	460 (38.1)	<0.0001
Obstetric	4 (0.23)	9 (1.5)	11 (0.91)	0.002
Paediatric	16 (0.92)	4 (0.66)	14 (1.2)	0.58
Other	0 (0)	0 (0)	22 (1.8)	<0.0001
Gender, N (%), male	1016 (58.7)	300 (49.8)	617 (51.1)	<0.0001
Age (years), mean (standard deviation)	60.6 (19)	63.9 (19.2)	65.9 (19.7)	<0.0001
Comorbidity, N (%)				
Dementia	54 (3.1)	46 (7.6)	91 (7.5)	<0.0001
Liver disease	82 (4.7)	38 (6.3)	71 (5.9)	0.22
Cardiovascular disease	736 (42.5)	259 (43)	496 (41.1)	0.65
Respiratory disease	375 (21.7)	173 (28.7)	237 (19.6)	<0.0001
Renal disease	169 (9.8)	85 (14.1)	119 (9.9)	0.007
Immune compromise	95 (5.5)	56 (9.3)	107 (8.9)	0.0003
Diabetes mellitus	331 (19.1)	104 (17.3)	170 (14.1)	0.002

Patients reviewed after ICU discharge received the most number of reviews. Referral to ICU and specialist doctors was more common in ward referral and RRT reviewed patients, as was implementation of new treatment limitations of medical therapy. The administration of palliative care more often occurred in ward referral patients (Table 3).

The need to escalate and call the MET/RRT appeared to occur most commonly in patients who had previously received an RRT review, rather than patients who had been discharged from the ICU (Table 3).

3.5. Details of medications commenced

Medication initiated by ICU LNs was relatively uncommon, particularly in patients after ICU discharge. Of note, in patients who did receive medications, these therapies included intravenous fluids, electrolyte replacement, analgesia, and diuretics (Table 4).

3.6. Details of diagnostic tests ordered

Diagnostic investigations initiated by ICU LNs were also relatively uncommon (Table 5). The most common investigations

Table 2
Physiological status on initial review.

Patient feature	After ICU discharge, N = 1732	Ward referral, N = 602	RRT review, N = 1208	p-value
Vital signs; mean (SD)				
RR (breaths/min)	18.7 (4.4)	22.1 (7.3)	21.1 (7.9)	<0.0001
SpO_2 (%)	96.7 (2.52)	94.7 (6.2)	94.7 (9.2)	<0.0001
SBP (mmHg)	127 (19.3)	119 (25.6)	120 (34.2)	<0.0001
HR (beats/min)	84.6 (16.2)	95.3 (23.9)	93.1 (31.0)	<0.0001
Temperature (°C)	36.6 (0.6)	36.7 (0.8)	36.9 (10.4)	0.39
On oxygen; N (%)	922 (65.3)	421 (76.0)	805 (76.4)	<0.0001
Pain present; N (%)	244 (14.1)	100 (16.6)	127 (10.5)	0.0006
Conscious level; N (%)				
Alert	1465 (84.6)	450 (74.8)	764 (63.2)	<0.0001
Voice	117 (6.8)	95 (15.8)	207 (17.1)	<0.0001
Pain	19 (1.1)	24 (4.0)	77 (6.4)	<0.0001
Unresponsive	6 (0.35)	13 (2.2)	103 (8.5)	<0.0001
UO < 30 mL/h; N (%)	57 (3.3)	57 (9.5)	65 (5.4)	<0.0001
On IV therapy; N (%)	343 (19.8)	151 (25.1)	183 (15.1)	<0.0001

SD, standard deviation; RRT, rapid response team; ICU, intensive care unit; RR, respiratory rate; SBP, systolic blood pressure; HR, heart rate; IV, intravenous; SpO_2, oxygen saturation, UO, urine output.

Table 3
Details of review, referrals and treatment limitations.

Treatment limitations	After ICU discharge	Ward referral	RRT review
Review and interventions, N (%)			
Screened only	390 (22.5)	286 (47.7)	753 (62.4)
Single review	610 (35.2)	43 (7.2)	128 (10.6)
Multiple reviews	735 (42.4)	271 (45.2)	326 (27.0)
Total reviews	3601	1681	2054
Reviews per patient median (IQR)	2 (1–2)	2 (1–3)	1 (1–2)
Total number of reviews with interventions	2887	1168	1112
Nature of referrals, N (%)			
ICU medical team	34 (1.2)	34 (2.9)	20 (1.8)
Medical specialist unit	24 (0.8)	36 (3.1)	28 (2.5)
Allied health	32 (1.1)	23 (2.0)	12 (1.1)
MET/RRT escalation	19 (0.7)	18 (1.5)	43 (3.9)
Code blue escalation	1 (0.04)	1 (0.09)	6 (0.5)
Other	9 (0.3)	15 (1.3)	11 (1.0)
DNR/NFR order	7 (0.2)	16 (1.4)	9 (0.8)
Treatment limitation	9 (0.3)	6 (0.5)	14 (1.3)
Advanced care plan	3 (0.1)	1 (0.1)	1 (0.1)
Palliative care	5 (0.2)	5 (0.4)	1 (0.1)

RRT, rapid response team; ICU, intensive care unit; IQR, interquartile range; MET, medical emergency team; DNR, do not resuscitate; NFR, not for reususcitation.

included the acquisition of a 12-lead electrocardiograph (ECG), chest X-ray, ordering of pathology tests for urea and electrolytes, whole-blood examination, and an arterial blood gas.

3.7. Details of nonmedication therapy commenced

The most frequently delivered treatments directly provided by the ICU LNs were nonmedication therapies (Table 6), although these were given less often in patients reviewed after ICU discharge. The most frequent nonmedication-related interventions included consultation with medical staff, bedside education (particularly for ward referrals), adjusting oxygen flow and patient position, and directing the change in frequency of vital sign measurement (this was not specified as being an increase or decrease).

3.8. Differences in disposition at hospital discharge

There were statistically significant and clinically important differences in the outcomes of the three predefined patient groups (Table 7). In-hospital mortality and transfer to a nursing home was lower in patients reviewed after ICU discharge, compared with those after RRT review and those reviewed after ward referral.

Table 4
Details of medications commenced.

Medication, N (%)	After ICU discharge	Ward referral	RRT review
Normal Saline nebs	38 (1.1)	46 (2.8)	18 (0.9)
Ventolin nebs	32 (0.9)	52 (3.1)	42 (2.1)
Fluids	57 (1.6)	188 (11.3)	278 (13.9)
Potassium	59 (1.6)	48 (2.9)	56 (2.9)
Magnesium	23 (0.6)	39 (2.3)	57 (2.9)
Phosphate	23 (0.6)	16 (1.0)	3 (0.1)
GTN patch	4 (0.1)	11 (0.7)	38 (1.9)
Digoxin	5 (0.1)	21 (1.3)	29 (1.4)
Frusemide	20 (0.6)	85 (5.1)	77 (3.8)
Antihypertensives	14 (0.5)	15 (1.0)	22 (1.1)
Analgesia	43 (1.2)	66 (4.0)	85 (4.2)
Antiemetics	9 (0.3)	19 (1.1)	23 (1.1)
Antibiotics	17 (0.5)	39 (2.3)	40 (2.0)
DVT prophylaxis	13 (0.4)	11 (0.7)	3 (0.1)
Other	98 (2.7)	128 (7.7)	197 (9.8)

GTN, glyceryl trinitrate; DVT, deep vein thrombosis; RRT, rapid response team; ICU, intensive care unit.

Table 5
Details of diagnostic tests ordered.

Diagnostic tests, N (%)	After ICU discharge	Ward referral	RRT review
Urea and electrolytes	82 (2.8)	56 (4.8)	115 (10.3)
Whole-blood examination	58 (2)	58 (5.0)	104 (9.4)
Ca, PO_4, and Mg	51 (1.8)	29 (2.5)	42 (3.8)
Clotting	17 (0.6)	23 (2.0)	53 (4.8)
Cardiac enzymes	14 (0.5)	28 (2.4)	41 (3.7)
Liver function test	29 (1.0)	12 (1.0)	35 (3.1)
Arterial blood gas	25 (0.9)	63 (5.4)	81 (7.3)
Blood cultures	11 (0.4)	10 (0.9)	23 (2.1)
Sputum cultures	6 (0.2)	9 (0.8)	7 (0.6)
Urine cultures	4 (0.1)	11 (0.9)	10 (0.9)
12-lead ECG	34 (1.2)	78 (6.7)	135 (12.1)
Chest X-ray	33 (1.1)	58 (5.0)	71 (6.4)
Other	19 (0.7)	44 (3.8)	41 (3.7)

Ca, calcium; PO_4, phosphate; Mg, magnesium; RRT, rapid response team; ICU, intensive care unit; ECG, electrocardiograph.

4. Discussion

4.1. Summary of major findings

We conducted a 2-month multicentre prospective observational study of the characteristics, treatment, and outcomes of patients reviewed by ICU LN services in Australia. The three groups reviewed in the decreasing order were the following: post-ICU discharge, RRT patients, and those referred from ward staff. Patients discharged from the ICU were younger, had fewer comorbidities, less deranged physiology, appeared to have fewer end-of-life care issues, were less likely to die, and more likely to go home. Of interest, the groups with the highest in-hospital mortality (RRT review and ward referral) were the most likely to receive ICU LN screening, without an intervention.

The most common interventions performed by the ICU LN appeared to relate to nontechnical skills (consultation with medical staff, bedside education, changing vital sign frequency, and adjustment of the oxygen flow and patient position), with intravenous therapy and electrolytes being the most common medication intervention. Overall ICU LN initiated medication administration was relatively an uncommon clinical intervention.

Table 6
Details of nonmedication therapy commenced.

Therapy, N (%)	After ICU discharge	Ward referral	RRT review
Changed vital sign frequency	58 (2.0)	201 (17.2)	112 (10.1)
Position change (sat upright)	102 (3.5)	133 (11.4)	113 (10.2)
Adjustment of oxygen flow	97 (3.4)	149 (12.8)	144 (12.9)
Pain management assessment	70 (2.4)	77 (6.6)	31 (2.8)
Tracheostomy care	65 (2.3)	8 (0.7)	0 (0)
Suctioned	41 (1.4)	24 (2.1)	11 (1.0)
Insertion of airway	4 (0.14)	4 (0.3)	8 (0.7)
Insertion IVC/venepuncture	10 (0.3)	20 (1.7)	52 (4.7)
Removal/maintenance IVC/CVC	49 (1.7)	9 (0.8)	11 (1.0)
Insertion of NGT	6 (0.2)	10 (0.9)	2 (0.18)
Equipment troubleshooting	59 (2.0)	21 (1.8)	13 (1.2)
Bedside education	296 (10.3)	205 (17.6)	94 (8.5)
Consultation with medical staff	265 (9.2)	273 (23.4)	203 (18.3)
Other	47 (1.6)	49 (4.2)	25 (2.2)

RRT, rapid response team; ICU, intensive care unit; IVC, intravenous cannula; CVC, central venous catheter; NGT, nasogastric tube.

Table 7
Patient outcomes based on the original ICU LN referral pattern.

Patient outcomes	After ICU discharge, N = 1732	Ward referral, N = 602	RRT review, N = 1208	p-value
Hospital LOS days, median (IQR)	5 (3–9)	5 (2–10)	4 (1–9)	<0.0001
Discharged, N (%)				
In hospital	38 (2.3)	22 (4.4)	29 (2.8)	
Home	1233 (75.2)	344 (68.4)	720 (70.0)	
Nursing home	34 (2.1)	21 (4.2)	49 (4.8)	
Other hospital	334 (20.4)	116 (23.1)	231 (22.4)	
Died	93 (5.4)	100 (16.6)	179 (14.8)	<0.0001

LOS, length of stay; IQR, interquartile range; RRT, rapid response team; ICU, intensive care unit.

Although uncommon, ordering of diagnostic tests appeared to occur mostly at RRT review and ward referral patients than post-ICU discharge. The investigations included the acquisition of a 12-lead ECG, ordering of pathology tests for urea and electrolytes, whole-blood examinations, and arterial blood gases.

4.2. Interpretation of findings and comparison with previous studies

The sampled cohort demonstrates that the reasons for ICU LN review of patients are after ICU discharge, RRT review, or new ward referrals. These observations are consistent with the findings of our previous 17-hospital study[17] and the two single-centre studies of McIntyre et al.[9] and Alberto et al.[8] Interestingly, one-third of reviews in the present study occurred during or after RRT review, compared with 21.7% in our previous study.[17] This increase may represent differences in the participating hospitals, an increasing role of ICU LNs in the RRT, or the increased frequency of such calls in hospitals with time.[4]

Elliott et al.[5] have previously reported on the scope of practice of ICU LN services in Australia via an online voluntary survey. At the time, 31 of 113 (27%) ICU-equipped hospitals operated an ICU LN service. In the hospitals that provided data on having both an MET and ICU LN service (of which there were 25), 17 of these (68%) reported that the ICU LN participated as an RRT responder. Activities undertaken in this study summarised ICU LN practice to include bedside education, troubleshooting equipment, ordering pathology and radiology tests, and prescribing medications. Although this survey reported on activities undertaken by the ICU LN, it does not indicate how often the reported activities occur in relation to patient visits.

Limited studies have reported the mortality risk among patients seen by an ICU LN, where service features include RRT and ward referral reviews. One previous single-centre study also revealed that patients reviewed after ICU discharge had lower in-hospital mortality than those reviewed on the ward or in the context of an RRT call.[9]

We found that most interventions were related to nontechnical skills, in particular, communication and education. This observation has also been cited in other studies exploring the role of ICU LNs and RRT nurses. Topple et al.[19] reported the tasks of MET nurses to include technical tasks and nontechnical tasks. The technical tasks performed by MET nurses included neurological assessment, examination of the circulation, and technical skill–related oxygen therapy, noninvasive ventilation, administration of emergency drugs, ECG monitoring, and fluid resuscitation strategies. Nontechnical tasks included communication, acquisition of history, contribution to management plan, review of investigations, education, staff–family reassurance, documentation procedures, and patient transport. Overall, nontechnical skills were performed more often, and critical care interventions were not as frequent as expected.[19]

In comparison, McIntyre et al.[9] reported that the main interventions of ICU LNs included fluid and electrolyte management, ordering a diagnostic test, administration of a medication, and initiation of interprofessional referrals. Other studies have identified that ICU LNs often undertake independent reviews after ICU discharge and ward referrals, with interventions including patient assessment, clinical support to patients and staff, medication review, diagnostics, referral pathways, and education.[5,8,10,12] One analysis included the comparison of ICU LN job descriptions in Australia and England in relation to Manley's conceptual framework for advanced practice consultant nurses.[20] Four aspects of the role included patient interventions (direct care), ward staff support, ward–ICU liaison, and hospital impact, such as the patient flow and outcomes across hospital systems.[20] Similarly, Elliott et al.[5] reported ICU LN activities and found consistencies within the Advanced Practice Nurse domains: education, collaboration, practice, and research quality.

The interventions of ICU LNs have not shown to be complex, yet instruction through communication and education is often needed to re-iterate the importance of the priorities of care, particularly in the context of deterioration and critical illness. Ward settings are busy, as seen with an ageing population which has multiple comorbidities and often complex diagnosis.

Qualitative findings looking at critical care nurse consultant' clinical activities identified themes around 'clinical reasoning' and 'clinical instruction' practice. These results have found to provide risk minimisation and provision of quality care, with outcomes being the detection and resolution of adverse events.[21] Clinical reasoning was highlighted as evaluating clinical data to make decisions about patient problems, their diagnosis, and treatment—optimisation of care was achieved through communicating these findings to the multidisciplinary team. Clinical reasoning corresponds with the activities identified in this ICU LN study where assessment of treatment limitations, medications, diagnostic testing, and nonmedication therapy occurs.

Elements of the ICU LN role appear to align with the nurse practitioner standards of practice outlined by the Nursing and Midwifery Board of Australia,[22] building on the platform of the registered nurse with expanded and advanced practice. This can be seen in the requirements of critical thinking where advanced assessment, ordering of diagnostic tests, medication administration, education, and communicating with patients/families and other health professionals are undertaken.[22] At a minimum, the Clinical Nurse Consultant title and Nurse Practitioner title should be endorsed as it reflects advanced practice to promote improved service delivery, expanded professional clinical leadership, research, and governance structures.[23] As such, a masters postgraduate qualification is desirable to enable extended scope of practice to support patient managment. So far, the progression of this role to Nurse Practitioner remains limited within the literature in Australia.[15]

Of note, this article did not explore the factors which limit appropriate usefulness of senior ward staff during patient management. Anecdotally, significant workforce and system flow demands can adversely impact patient management, limiting treatment among the primary multidisciplinary team. Hence, ICU LN complements patient care where such management deficits occur.

4.3. Study strengths and limitations

Our study has several strengths, including a prospective design, use of standardised scannable forms with data dictionary, use of a

prospectively defined data analysis plan, and oversight by a steering committee. We have demonstrated important findings about the baseline characteristics, tasks performed, and outcomes of patients reviewed by ICU LNs in a multicentre study.

Despite these strengths, our study has several limitations. Although multicentre, our findings represent those of only 20 of the 31 ICU LN equipped hospitals, and the study was conducted only over 2 months. Participating sites were not randomly selected, raising the potential for participation bias from the hospitals included in the study. In addition, we were not able to adjust our analysis for repeat reviews, and it is possible that patient deaths were counted twice, slightly overestimating the in-hospital mortality. Comorbidities were simple and pragmatic and did not have strictly defined definitions. Finally, 4.5% of review forms were not included in the data analysis because of the lack of outcome data or unique identifiers. This study does not make comparisons with other models of critical care outreach (nursing) services where extended practice rights exist, which may demonstrate significant differences related to scope of practice.

The data presented here were collected in 2012. After the study, the introduction of national clinical standards has been endorsed by the Australian Commission for Quality and Safety in Healthcare. These standards were devised to protect the public from harm and improve the quality of health care. The current ninth standard includes 'recognising and responding to acute deterioration '.[1] As part of this standard, it is a condition that healthcare settings provide recognition and response systems to ensure appropriate and timely treatement to a deteriorating patient. This mandated cultural change towards improved clinical outcomes, promoting earlier detection and escalation to prevent treatment complications and adverse events. It could be argued with the introduction of this standard that there is an increased focus on the deteriorating patient and that escalation processes may have impacted on an increase in ICU LN referrals and MET activity which could have a quantitative change to our study findings. Finally, we cannot comment on the credentialling process, scope of practice, or training of the participant ICU LNs and any impact that this might have had on the observed interventions or patient outcomes.

4.4. Implications for clinicians and policy makers

Differences in critical care outreach services exist, and role variance of the ICU LN model exists. This can be seen where some ICU LNs act as the RRT member compared with a focus where independent reviews occur after ICU discharge. In this study, interventions related to medication prescription and ordering of diagnostic tests were not distinguished between hospital and liaison nurse service, making it difficult to ascertain similarities and differences in the detail of this role across organisations.

Although role variation exists, many elements of the ICU LN role appear to align with the expanded and advanced practice that a clinical nurse consultant or nurse practitioner role represents. A national framework to help guide role qualification and educational guidelines currently does not exist and would be beneficial to the roles ongoing success and sustainability for the benefit of improving patient outcomes.

4.5. Areas of future research

Further research into the domain of critical care outreach nursing services related to staffing models, job classifications, and ICU LN qualifications is required. Further understanding in relation to which medications are most commonly required during ICU LN review and whether ICU LNs can prescribe some of these medications is required. In Australia, this would require the ICU LN to have Nurse Practitioner qualification for limited prescribing of medications.

5. Conclusions

In Australia, most ICU LN reviews occur after ICU discharge or in the context of RRT reviews. Patients reviewed after ward referral, or in association with the RRT, appear to be at increased risk with high mortality. Most common tasks performed by the ICU LN related to nontechnical skills, with medication prescription and ordering of diagnostic tests, appear to be less common. Communication and education are important characteristics within the ICU LN role.

Appendix. ICU Liaison Nurse Scope of Practice Investigators

Writing and management committee

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