

The impact of an ICU liaison nurse service on patient outcomes

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Increasing interest in the role of intensive care unit nurses in the care of patients after ICU discharge has led some hospitals to introduce ICU outreach and liaison nurse services.¹ Data are emerging about the extent to which these outreach services have improved health care delivery and patient outcomes. An Australian study showed that the presence of an ICU liaison nurse decreased ICU discharge delay and improved ICU nurses' perceptions of discharge planning.^{2,3} Ward nurses not only supported the role, but also identified further benefits⁴ — findings similar to those of studies in the United Kingdom.^{5,6}

With regard to the impact of such services on patient outcomes, UK-based studies found that ICU outreach services could improve hospital mortality,⁷ yet had a variable impact on ICU readmission rates.^{8,9} A similar Australian study reported a reduction in ICU readmission rates from 2.3% to 0.5%.¹⁰

It is not known whether these benefits of introducing an ICU liaison nurse service are generalisable, given the variations in responsibilities and tasks undertaken by ICU liaison nurses and differences in organisational structure and staff skill mix between health care institutions. We therefore investigated the impact of introducing an ICU liaison nurse service on ICU patient discharges, readmissions and outcomes in an 18-month before-and-after study in our metropolitan university teaching hospital.

Methods

Study design and setting

This was a before-and-after study performed after the implementation of the ICU liaison nurse service at Box Hill Hospital, a metropolitan university teaching hospital, in March 2005. All patients admitted to the ICU during an 18-month control (before) phase (1 September 2003 to 28 February 2005) and an 18-month intervention (after) phase (1 March 2005 to 31 August 2006) were included.

The hospital is a 348-bed university teaching hospital servicing eastern metropolitan Melbourne, Victoria, with a catchment of 750 000 people. The general medical-surgical ICU has 12 beds and is classified as a Level 3 ICU.¹¹

Details of all ICU patient admissions were prospectively recorded onto a custom database. We prospectively collected individual patient admission outcomes data for ICU and hospital length of stay (LOS), mortality and ICU readmission, and aggregate ICU data for ICU step-down

ABSTRACT

Objective: To determine the effect an intensive care unit liaison nurse service had on ICU patient discharges, readmissions and outcomes.

Methods: We evaluated the impact of our ICU liaison nurse service in a 36-month before-and-after study on ICU and hospital length of stay (LOS) and mortality, and ICU step-down days (time spent in ICU in a 1 : 2 nurse to patient ratio).

Results: There was a 13% increase in patient throughput after the introduction of the ICU liaison nurse service (835 ICU admissions in the 18 months before v 943 in the 18 months after). Despite trends to an improvement, there was no significant change in median ICU LOS (2.2 days before v 2.1 days after) or median hospital LOS (12.0 days before v 11.5 days after), or in ICU or hospital mortality (ICU, 15% before v 14% after; hospital, 23% before v 22% after). ICU step-down days were significantly decreased by 48% (71 ± 14.2 days v 37 ± 15.5 days; $P < 0.001$). In the patient group readmitted to the ICU (49 patients before v 55 patients after), there was a 25% (1 day) decrease in median ICU LOS (4.0 v 3.0 days), and a trend to decreased mortality in both the ICU (18% before v 16% after) and hospital (35% before v 26% after).

Conclusions: The introduction of our ICU liaison nurse service was associated with a trend towards more efficient ICU discharges (increased throughput, decreased ICU step-down days and ICU readmission LOS) and improved survival for ICU patients requiring readmission, but overall ICU and hospital LOS and mortality, and ICU readmission rates were unchanged.

Crit Care Resusc 2008; 10: 296–300

days, defined as time spent in the ICU with a nurse-to-patient ratio of 1 : 2.

Role of the ICU liaison nurse

The ICU liaison nurse was introduced as a 56 hours per week service, from 08:00 to 16:00, 7 days a week. The role was shared among three experienced ICU nurses who supported the multidisciplinary team in the management of patients with complex care needs following their discharge from the ICU. Patients discharged from the ICU received an

average of 3.9 ICU liaison nurse visits, but this varied depending on the needs of the individual patient and case complexity.

The initial funded project focused on patients who were discharged from the ICU, and ward referrals to the ICU liaison nurse service were not specifically encouraged. Nevertheless, 102 ward patients were referred to the service by ward medical or nursing staff, physiotherapists or speech pathologists, requiring a total of 292 visits.

The service involved:

- visiting patients while they were in the ICU and after discharge to the ward, to help the patients and their relatives with the transition to the ward environment;
- communicating with ward staff who received patients discharged from the ICU, and providing support and bedside education as required during post-ICU discharge visits to the ward;
- assisting with stabilisation and care of critically ill patients in the ward whose condition had deteriorated, necessitating ICU admission; and
- providing support and education for patient, family and ward staff.

The most common interventions implemented or initiated by the ICU liaison nurse were:

- respiratory — education about tracheostomy care, delivery of high flow oxygen and non-invasive ventilation in the ward area, and care of intercostal catheters; and
- cardiovascular/haemodynamic — education about care of central venous catheters, fluid and electrolyte management, haemodynamic monitoring and administration of inotropic support in collaboration with medical staff.

Patients were discharged from the ICU liaison nurse service when they no longer had clinical markers present, and the ICU liaison nurse was no longer required to provide support in patient care in the ward. After patient discharge from the service, ward staff were encouraged to access the service again if they required support in patient care.

A customised Access database was established to record their activities.

Statistical analysis

Details of all ICU patient admissions were prospectively recorded in the Australian and New Zealand Intensive Care Society (ANZICS) Adult Patient Database (APD). Data were transferred electronically from this database to an SPSS database. These data were collected by an experienced and trained data manager. The database has built-in quality checks, and manual quality checks are conducted monthly.

Statistical analyses were undertaken using SPSS software, version 14 (SPSS Inc, Chicago, Ill, USA). Descriptive data are presented as frequencies and percentages of overall cases.

Distributed data are presented as mean \pm standard deviation (SD). Differences in numerical data were assessed using the Mann–Whitney test or Student *t* test. The ICU step-down hours spent over the period January 2004 to August 2006 are plotted and analysed as a time series. Analysis began by attempting to fit the best possible time series model. We used the ARIMA (autoregressive integrated moving average) model that best fit the series over the period of time. Separate models were fitted for the series before and after March 2005. A *P* value < 0.05 and two-tailed tests were used to determine statistical significance.

Approval for the study was obtained from La Trobe University and Griffith University Human Research Ethics Committee and Eastern Health Research and Ethics Committee. Individual patient consent was waived.

Results

There were 835 admissions and 49 readmissions in the 18 months before the liaison nurse service was introduced and 943 admissions and 55 readmissions in the 18 months afterwards (Table 1). There was no significant difference in average patient age or illness severity assessed by APACHE II scores before and after introduction of the service.

We found after the introduction of the ICU liaison nurse service that there was a 13% increase in patient throughput. However, the median ICU and hospital LOS remained unchanged, and there was no change in overall ICU or hospital mortality (Table 1). The ICU liaison nurse service appeared to have an impact on ICU step-down days, which fell by 48% from an average of 71 ± 14.2 days to 37 ± 15.5 ($P < 0.001$).

There were no differences in the rate of ICU readmission, which was just under 6% in each period. However, within this population, there was a 25% decrease (1 day) in the median ICU LOS (4.0 v 3.0 days) and trends to decreased mortality in both the ICU (18% [before] v 16% [after], $P = 0.79$) and hospital (35% [before] v 26% [after], $P = 0.30$) (Table 1). The ICU liaison nurse service saw 41 (75%) of the patients within the 24 hours before ICU readmission and triggered 30 (55%) of these readmissions.

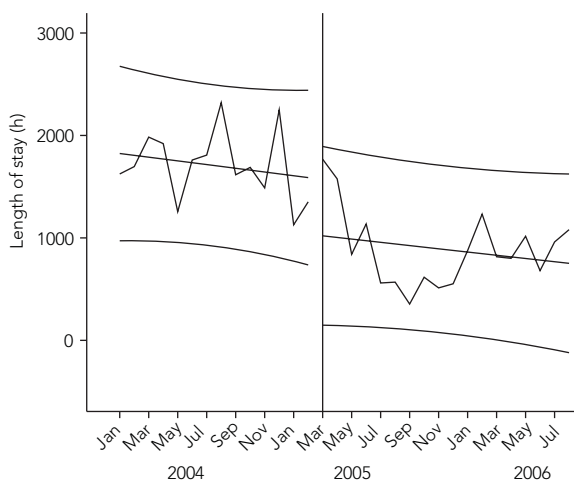
Figure 1 shows the time series of ICU step-down hours, including the best fitted line and 95% confidence intervals. A reference line at March 2005 shows the variability in ICU step-down hours before and after the liaison nurse intervention. As there were no significant autoregressive patterns in either of the series, the regression technique was used to compare the series before and after the intervention. Regression models showed that there was a statistically significant drop in ICU step-down hours after March 2005 ($P = 0.03$). The average duration of ICU step-down was 71 ± 14.2 days before the intervention and 37 ± 15.5

Table 1. Outcomes data for all ICU patients and for those readmitted to the ICU

	ICU patient admissions			ICU patient readmissions		
	Before ICU LN service (n = 835)	After ICU LN service (n = 943)	P	Before ICU LN service (n = 49; 5.9%)	After ICU LN service (n = 55; 5.8%)	P
Age (years)*	67 ± 17	65 ± 18	0.09	72 ± 10	70 ± 15	0.49
APACHE II score*	19 ± 9	20 ± 9	0.38	20 ± 8.5	21 ± 7.8	0.62
ICU LOS (days)†	2.2 (0–86)	2.1 (0–68)	0.07	4.0 (0.3–86)	3.0 (0.3–41)	0.89
Step-down LOS (days)*	71 ± 14.2	37 ± 15.5	<0.001	na	na	na
Hospital LOS (days)†	12.0 (0.2–230)	11.5 (0.4–68)	0.16	39 (8–139)	35 (6–174)	0.59
ICU mortality no. (%)	126 (15%)	136 (14%)	0.69	9 (18%)	9 (16%)	0.79
Hospital mortality no. (%)	188 (23%)	207 (22%)	0.78	17 (35%)	14 (26%)	0.30

ICU LN = intensive care unit liaison nurse. APACHE = Acute Physiology and Chronic Health Evaluation. LOS = length of stay.

* Mean ± standard deviation. † Median (range).

Figure 1. Time series analysis of ICU step-down hours

The analysis shows the line of best fit and 95% CIs. The vertical line represents the introduction of the ICU liaison nurse service.

days afterwards. It is clear that ICU step-down hours halved after the intervention (dropped by almost 48%). Separate regression analysis in each of the series showed that the slope parameters were not statistically significant, indicating that, although the mean step-down hours decreased after the intervention, there was no change in these hours within each of the two periods.

Discussion

Our study found that the introduction of an ICU liaison nurse service was associated with a trend towards more efficient ICU discharges (increased throughput, decreased ICU step-down days and ICU readmission LOS) and

improved survival for ICU patients requiring readmission, in the 18 months after introduction of the intervention compared with the previous 18 months. However, overall ICU and hospital LOS and mortality, and ICU readmission rate remained unchanged.

We considered this evaluation important to determine whether the purported benefits of an ICU liaison nurse service, such as reduced hospital mortality and ICU readmission rates, were generalisable to our health care institution. This is particularly relevant, as health care institutions may have limited funds to allocate to such outreach services, including medical emergency teams, and therefore need to critically evaluate the return on investment. Moreover, variations between health care institutions in the responsibilities and tasks undertaken by ICU liaison nurses, the organisational structure and staff skill mix might lead to variation in the benefits of similar ICU liaison nurse services between institutions.

The introduction of an ICU liaison nurse service might improve the efficiency with which ICU beds are occupied because of proactive discharge planning,⁴ and because the support available for the patient and ward nursing staff from the ICU liaison nurse service might enable potentially less stable patients to be discharged from the ICU. Indeed, our data support this contention, as evidenced by the significant reduction in ICU step-down days and associated increased ICU patient throughput following the introduction of our ICU liaison nurse service, yet we did not note any significant reduction in overall ICU LOS.

While it is intuitive to consider that an ICU liaison nurse service might benefit all patients discharged from the ICU, the subgroup most likely to benefit are patients with ongoing complex medical and nursing requirements, particularly those whose condition is sufficiently unstable to require ICU readmission. This ICU readmission subgroup may benefit

from the ICU liaison nurse's management advice during their initial post-discharge ward stay. Others have noted that such expert advice is often required.^{1,10} Further, the ICU liaison nurse service is expected to help stabilise patients whose condition is deteriorating and to facilitate ICU readmission in a more timely manner, thereby enabling the readmitted patient to arrive back into the ICU in a more stable state. Our study suggests that for an equivalent cohort of readmitted patients, the ICU liaison nurse service was associated with a trend to both decreased ICU readmission and decreased overall hospital LOS and mortality. Similarly, Garcea et al showed reductions in both ICU and hospital mortality for patients readmitted to the critical care area.¹²

Ideally, an ICU liaison nurse service might decrease the ICU readmission rate by facilitating improved ward care for unstable patients discharged from ICU. We noted no change in the ICU readmission rate and consider that the use of ICU readmission rate as a marker of the quality of an ICU liaison nurse service may be flawed. Others too have noted that ICU readmission may increase, as patients requiring critical care services are identified.¹⁰ Additionally, the ICU liaison nurse service should be based on the objective of delivering the best possible care to patients, which, according to the health care institution, may mandate ICU readmission. To illustrate, within our hospital, the use of non-invasive ventilation is restricted to critical care areas such as the ICU, coronary care, and the emergency department. Therefore, patients who developed respiratory compromise after their ICU discharge despite the support of the ICU liaison nurse service were referred back to the ICU for consideration of readmission.

Our analysis failed to demonstrate any statistically significant differences in ICU and hospital LOS or mortality as has been reported by other investigators.^{7,8} There are a number of possible explanations. Firstly, it may be that LOS and mortality are clinical outcome measures that are insensitive to the interventions of an ICU liaison nurse service and are determined by other considerations during the patient's admission over which an ICU liaison nurse service has minimal influence.

Secondly, the tasks undertaken by the ICU liaison nurse may differ substantially between health care institutions, a factor that may affect the benefit an ICU liaison nurse service can provide through their interventions. We have documented substantial variations in the staffing, hours of service, key responsibilities and extended practices between hospitals, highlighting the diverse nature of the ICU liaison nurse services across Victoria.¹³ Notwithstanding this observation, there appears to be a common core of four activities for Australian ICU liaison nurses, including staff education and support; ward assessment and liaison; patient care and support; and family education and support.⁴

Finally, there are a number of limitations to this study. Firstly, it was performed at a single site. The ICU liaison nurse role may differ greatly between sites, and outcomes may vary depending on the service delivered. Secondly, the study was not powered sufficiently to detect significant differences in outcomes. Numbers, particularly for the readmission group, were too small to detect statistical significance. The trend to decreased LOS and mortality in the ICU readmission group might be statistically significant given a larger sample size. Finally, the before-and-after design did not permit cause and effect relationships to be established, and cannot rule out other explanations such as confounding.

Clearly there are other potential benefits from an ICU liaison nurse service that we have not reported. These include increased satisfaction of ICU and ward nursing staff with the improved ICU discharge planning process, and increased confidence of the ICU medical staff in discharging their patients to the ward in the knowledge that an expert resource is available to ward staff should difficulties arise.

Conclusions

The introduction of our ICU liaison nurse service was associated with a trend towards more efficient ICU discharges (increased throughput and decreased ICU step-down days and ICU readmission LOS) and improved survival for ICU patients requiring readmission, but overall ICU and hospital LOS and mortality and ICU readmission rates remained unchanged.

Acknowledgements

The Victorian Department of Human Services and the Victorian Managed Insurance Authority provided funding to establish the ICU liaison nurse role (initial 6 months) and to conduct the evaluation.

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