Long-stay patients in Australian and New Zealand intensive care units: demographics and outcomes

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There is limited published information on patients who stay long periods in the intensive care unit. While it would seem intuitive that these patients are very unwell, and that by definition they consume significant resources in the form of ICU bed days, few studies specifically address this population.

Several definitions of ICU "long stay" have been proposed, but none is universally accepted. Recent publications on long-stay patients have used various definitions — 14,[1] 21,[2] 30[3,4] and 60[5] days — while acknowledging that no consensus definition exists. Previous studies have shown that about 9% of ICU patients stay for as long as 14 days,[6] and that stays longer than 1 month are uncommon (1.6% in one multicentre study,[4] and 1.7% in a recent single-centre review from Australia[3]). The question of what constitutes a long stay is not yet answered, and it may vary both internationally and between different units in the same country.

ICU patients as a whole are known to use a significant proportion of health care resources (20% of total inpatient cost in the United States[7]). Studies indicate that long-stay patients use a large proportion of total ICU bed hours,[2,4,8] with some indicating that patients who stay longer than a week use more than 50% of all resources.[9] This, in addition to the fact that a long ICU stay is difficult for patients, families and staff, makes it surprising that little is known about long-stay ICU patients themselves.

It is known that certain conditions, such as cardiac surgery, seldom lead to long ICU stays.[10] Previous studies have shown that patients with long stays have higher APACHE II scores on admission than those with short stays,[2,4] and are more likely to be medical patients,[2] while a high proportion have respiratory disease.[6] Other studies have shown that trauma, male sex and emergency surgery are associated with longer stay.[11] Age has been found to contribute to long stay in some studies,[2,11] but not others.[4]

Long periods of intensive care support involve considerable costs and potentially significant suffering, and these issues need to be balanced against the potential for worthwhile outcomes. This may be especially important in elderly patients. Two studies of hospital survival have concluded that intensive care treatment should not be withheld from patients on the basis of length of stay (LOS) alone,[4] and that such treatment may represent an efficient use of resources.[6]

ABSTRACT

Aim and methods: There is no consensus definition on what constitutes a long stay in the intensive care unit, and little published information on the demographic characteristics, resource usage or outcomes of long-stay patients. We used data from the Australian and New Zealand Intensive Care Society Adult Patient Database to identify patients who had spent > 21 days in the ICU. We examined their resource usage, hospital type, diagnoses and outcomes, and trends in these characteristics over 5 years (2000–2004).

Results: 6565 patients (2.3% of all ICU patients) had one or more admissions > 21 days and accounted for 23% of total ICU bed-hour usage. Long-stay patients had a mean (SD) age of 60.3 (15.3) years and an APACHE III-J risk of death of 32.7% (21.3%). Metropolitan and tertiary hospitals had the highest proportions of long-stay patients. The three diagnoses most strongly associated with long ICU stay were neuromuscular disease (odds ratio [OR], 13.3; 95% CI, 10.2–17.4; $P < 0.001$), burns (OR, 6.0; 95% CI, 4.9–7.3; $P < 0.001$) and cervical spine injury (OR, 5.1; 95% CI, 3.4–7.5; $P < 0.001$), while the most common diagnosis was pneumonia (12.7% of total). During the period 2000–2004, there was no significant change in the proportion, age, resource usage or outcomes of these patients. Overall observed mortality was 28% (predicted, 32.7%; 95% CI, 31.4%–34.5%). Of those aged ⩾ 80 years, 37% were discharged home, and 39% died.

Conclusions: Patients who spend > 21 days in the ICU use significant resources but appear to have worthwhile outcomes in all age brackets.

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In this study, we aimed:

- to define long stay in Australian and New Zealand ICUs;
- to assess the use of ICU resources by long-stay patients;
- to determine whether the proportion of long-stay patients varies between different categories of hospital;
- to find the most common diagnoses among long-stay patients and the diagnoses most likely to lead to a long ICU stay;

Table 1. New diagnostic groups created by combining diagnostic codes

Diagnosis	Diagnostic codes
New diagnostic group	
Burns (total)	603, 1603
Head injury (total)	601, 1601
Sepsis (total)	501–504
Pneumonia (total)	201, 205, 210, 212, 213
Cervical spine injury (total)	605, 1605
Respiratory disease	201–213
Specific diagnosis	
Aspiration pneumonia	201
Respiratory neoplasm including larynx/trachea	202
Respiratory arrest	203
Pulmonary oedema (non-cardiac)	204
Pneumonia (bacterial and viral) (old diagnosis)	205
Chronic obstructive pulmonary disease	206
Pulmonary embolism	207
Mechanical airway obstruction	208
Asthma	209
Parasitic pneumonia	210
Other respiratory diseases	211
Bacterial pneumonia	212
Viral pneumonia	213
Sepsis other than urinary	501
Sepsis of urinary tract origin	502
Sepsis with shock other than urinary	503
Sepsis of urinary tract origin with shock	504
Head trauma ± multitrauma (non-operative)	601
Burns (non-operative)	603
Isolated cervical spine injury (non-operative)	605
Head trauma ± multitrauma (operative)	1601
Burns (operative)	1603
Isolated cervical spine injury (operative)	1605

- to determine whether long-stay patient proportions and demographic characteristics have changed over time; and
- to determine the outcomes of long-stay patients.

Methods

Data were extracted from the Australian and New Zealand Intensive Care Society Adult Patient Database, which contains data from nearly 70% of all ICU admissions in Australia and New Zealand. It offers a representative picture of admission and outcome patterns for the intensive care population.[12] Data were analysed from all 148 contributing ICUs for 2000–2004, detailing 283 522 admissions.

ICU LOS was recorded in hours (considered the most exact method of calculating ICU LOS[13]) and converted to days for further analysis. LOS was not recorded for 759 patients. We decided prospectively to investigate patients in the extreme upper LOS range (> 97.5 percentile). However, 21 days was later selected as the cut-off point, as it has been used previously to define long stay,[2] it is used in the definition of "prolonged mechanical ventilation",[14] and it corresponded to approximately the 97.7 percentile for LOS in our dataset. ICU bed hours were used as a surrogate measure of resource usage.

Both LOS and resource usage were analysed using the entire dataset. A revised dataset was created using only the single longest ICU admission for each patient during their hospital stay. This dataset contained 263 874 patients (5827 with LOS > 21 days), and was used to analyse demographic characteristics, diagnoses and outcomes.

Acute Physiology and Chronic Health Evaluation (APACHE) version III-J scores, risk of death and associated diagnostic codes were used to determine severity of illness and diagnosis.[15] APACHE III has been validated as an accurate prediction tool for ICU admissions in Australia.[16] It incorporates variables for seven separate chronic health conditions, which were used to determine chronic health status. Any patient who had at least one of these conditions was identified as having chronic disease.

Four types of hospital were compared: rural, metropolitan, tertiary and private. Long-stay patients were analysed as a proportion of the total number of ICU patients in each type of hospital.

A number of new diagnostic groups were created (Table 1). These were designed to link operative and non-operative codes for some diagnoses (eg, isolated cervical spine injury) and to group different subsets of a diagnosis together (eg, pneumonia of different aetiologies). They also allowed for changes in diagnostic coding over time. Data were analysed to show the most common diagnoses in long-stay patients, and also the diagnoses most likely to result in a long ICU stay.

To minimise selection bias caused by inconsistent reporting of admissions over time, the dataset was further reduced for the analysis of trends over time. A subset of ICUs that supplied consistent admission data over the period 2000–2004 was used, comprising 51 ICUs and 174 589 patients.

Outcomes investigated were hospital mortality and discharge destination, either to another hospital or rehabilitation facility, or to home. Discharge to a long-term facility, such as a nursing home, was categorised under "other hospital". These outcomes were further stratified by age and diagnostic group.

Figure 1. Distribution of intensive care unit length of stay and bed usage for 283 522 admissions

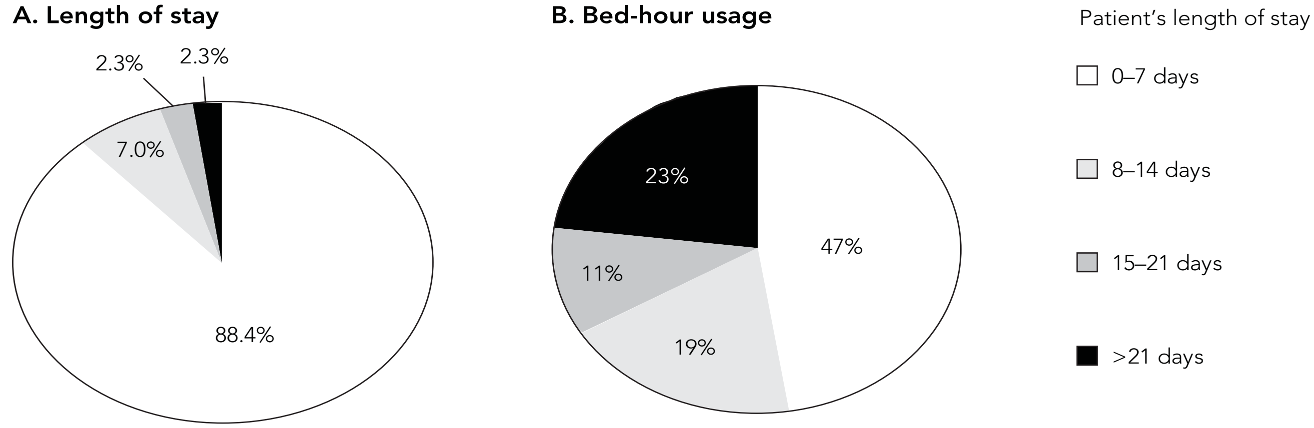


Table 2. Demographic characteristics of patients, by length of stay (LOS)

	LOS ≤ 21 days (n = 258 047)	LOS > 21 days (n = 5827)	P
Age (years)*	60.0 (20.3)	60.3 (15.3)	0.31
APACHE III-J score*	50 (30.5)	75 (33.0)	< 0.001
APACHE III-J risk of death*	15.4% (5.0%)	32.7% (21.3%)	< 0.001
Mortality (%)†	13.6%	28%	< 0.001
LOS (h)‡	41 (22–74)	711 (584–932)	< 0.001
LOS (days)‡	1.7 (0.9–3.1)	29.6 (24.3–38.8)	< 0.001
% of patients†			
Surgical	53.6%	32.6%	< 0.001
Elective surgery	46.3%	19.1%	< 0.001
Medical	46.4%	67.4%	< 0.001
Ventilated at 24 h	48.6%	80.4%	< 0.001
Chronic disease	22.9%	24.9%	< 0.001

* Parametric data shown as mean (standard deviation).
† Categorical data shown as a percentage.
‡ Non-parametric data shown as median and interquartile range.

Table 3. Proportion of long-stay patients at different types of hospital*

	Patients with LOS > 21days
Rural (n = 28 127)	1.7%
Metropolitan (n = 42 062)	2.8%
Tertiary (n = 132 894)	2.6%
Private (n = 54 190)	1.1%

* Difference in proportion between all hospital types was statistically significant. LOS = length of stay.

Statistical analysis

Data were analysed using SAS version 8.0 (SAS Institute, Cary, NC, USA). Univariate comparisons were performed using Student's *t*, Wilcoxon rank-sum, Kruskal–Wallis or χ^2 tests, according to the type of data. To determine changes over time, parametric and non-parametric tests for trend were performed. Parametric data are presented as mean and standard deviation (SD). Non-parametric data are expressed as median and interquartile range (IQR). All P values less than 0.05 were considered significant.

Results

ICU length of stay and resource usage

A total of 6565 patients had at least one admission > 21 days (504 hours), equating to 2.3% of all patients. These patients used 23% of total ICU bed hours. Figure 1 shows the distribution of ICU LOS and resource usage.

Demographic characteristics of long-stay patients

Table 2 compares the demographic characteristics of long-stay (> 21 days) and shorter-stay (≤ 21 days) patients. Median LOS was 29.6 days in the long-stay group (IQR, 24.3–38.8 days) and 1.7 days in the shorter-stay group (IQR, 0.9–3.1 days; P < 0.001).

There was no significant difference in age between the two groups (60.3 v 60.0 years; P = 0.31). Long-stay patients had a significantly higher predicted risk of death. They were less likely to be elective surgical cases and more likely to have been ventilated at 24 hours, and a higher proportion had chronic disease.

Hospital type

Metropolitan and tertiary hospitals had the highest proportions of long-stay patients — 2.8% and 2.6% of total

Table 4. Most common diagnoses in the long-stay patient group

APACHE III-J diagnosis	% of all long-stay patients (n = 5827)	No. of long-stay patients	Mortality*	Mean APACHE III-J risk of death (SD)*	Median LOS (days) (IQR)*
A. Respiratory diagnoses					
Respiratory disease (total)	23.5%	1371	35%	36.6% (24.8%)	29.5 (24.2–38.1)
Pneumonia (total)	12.8%	743	29%	36.5% (25.6%)	35.3 (24.5–38.7)
Chronic obstructive pulmonary disease	3.6%	211	33%	29.3% (23.8%)	27.4 (23.5–36.5)
Respiratory disease (other)	2.8%	163	47.3%	34.6% (22.7%)	29.8 (24.4–37.6)
B. Non-respiratory diagnoses					
Sepsis (total)	11.1%	645	33.9%	46.4% (24.6%)	30.8 (25–40.4)
Head injury (total)	6.5%	381	6.9%	28.5% (24.6%)	25.2 (22.8–29.7)
GI perforation/rupture	4.1%	236	30.6%	42.9% (26.4%)	29.4 (24.7–29.4)
Coronary artery bypass grafting	3.3%	189	23.5%	Not calculated	30.8 (25–37.6)
Dissecting/ruptured aorta	2.5%	138	30%	40.3% (28.4%)	30.2 (24.7–38.3)
GI neoplasm (operative)	2.3%	134	34.7%	19.3% (21.5%)	30.2 (25.2–40.1)
Multitrauma excluding head (non-operative)	2.0%	118	11.2%	14.7% (17.5%)	29.0 (24.4–36.7)
Burns (total)	1.9%	112	20.3%	16.5% (22.1%)	30.5 (24.5–41.6)
GI inflammatory disease (colitis/pancreatitis)	1.8%	105	38.8%	32.2% (26.1%)	35.1 (25.1–50.6)
Cardiac arrest	1.6%	94	41.8%	63.2% (25.7%)	29.5 (25.1–36.5)

* Of long-stay patients. LOS = length of stay. IQR = interquartile range. GI = gastrointestinal.

patient numbers, respectively (Table 3). Private hospitals had the lowest proportion of long-stay patients.

Diagnoses

The most common diagnosis in long-stay patients was respiratory disease, comprising 23.5% of all patients. Of this, pneumonia comprised the largest subgroup (12.8% of all patients), and chronic obstructive pulmonary disease was next (3.6%) (Table 4A). Of the non-respiratory diagnoses, the most common were sepsis and head injury — 11.1% and 6.5%, respectively (Table 4B).

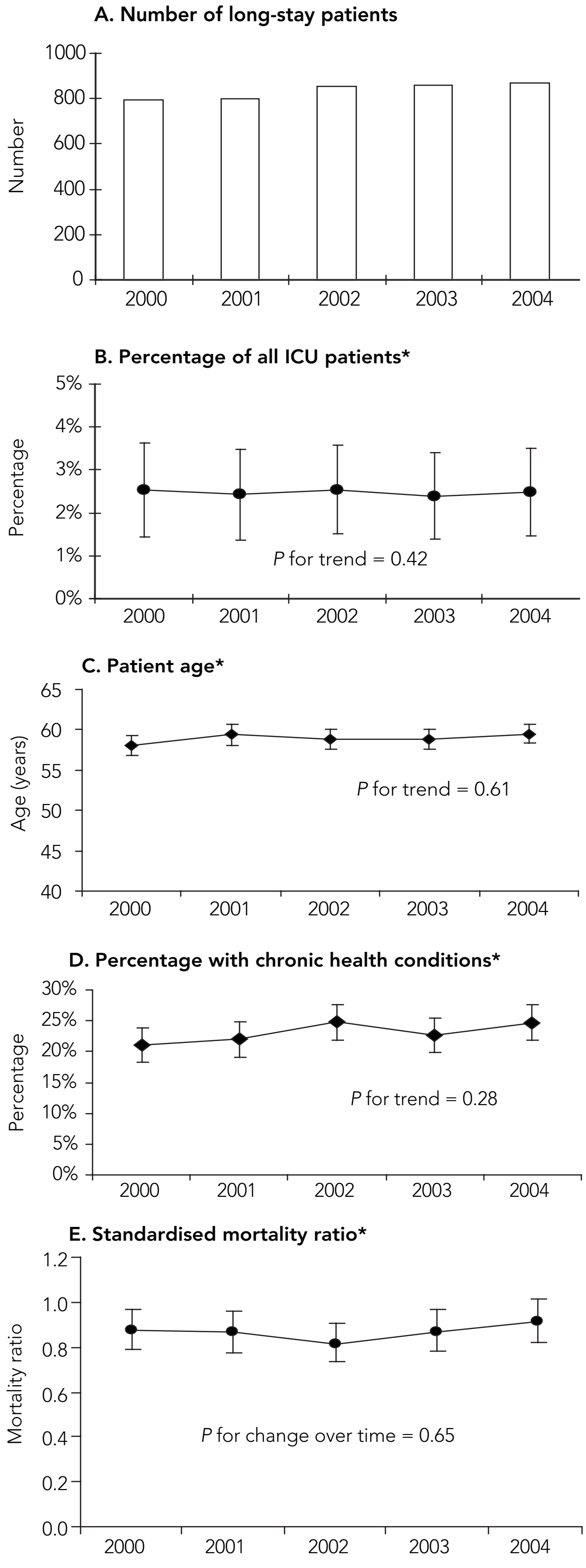
The three diagnoses most highly associated with a long ICU stay were neuromuscular disease (odds ratio [OR], 13.28; 95% CI, 10.16–17.37; P < 0.001), burns (OR, 6.02;

Table 5. Diagnoses with odds ratio > 2 for long stay

Diagnosis	Odds ratio for long stay	95% CI	P	Mortality*	Mean APACHE III-J risk of death (SD)*	Median LOS (days) (IQR)*
Neuromuscular disease (n = 70)	13.28	10.16–17.37	< 0.001	12%	9.2% (11.0%)	46.4 (33.8–62.8)
Burns (total) (n = 112)	6.02	4.93–7.34	< 0.001	20%	16.5% (22.1%)	30.5 (24.5–41.6)
Cervical spine injury (total) (n = 28)	5.06	3.42–7.49	< 0.001	18%	8.9% (19.6%)	36.6 (24.1–43.1)
Multitrauma with spinal injury (non-operative) (n = 29)	4.27	2.91–6.25	< 0.001	3%	8.2% (13.5%)	25.5 (22.95–36)
GI inflammatory disease (colitis/pancreatitis) (n = 105)	4.03	3.30–4.93	< 0.001	39%	32.2% (26.0%)	35.1 (25.1–50.6)
Pneumonia (total) (n = 743)	3.95	3.65–4.28	< 0.001	29%	36.5% (25.6%)	35.3 (24.5–38.7)
Dissecting/ruptured aorta (n = 138)	3.78	3.17–4.50	< 0.001	30%	40.3% (28.4%)	30.2 (24.7–38.3)
Sepsis (total) (n = 645)	2.75	2.53–2.99	< 0.001	34%	46.4% (25.9%)	30.8 (25.0–40.4)
GI obstruction/perforation (old diagnosis) (n = 52)	2.67	2.07–3.46	< 0.001	23%	40.3% (24.5%)	33.3 (24.2–37.9)
Respiratory disease (total) (n = 1370)	2.63	2.47–2.79	< 0.001	35%	36.6% (24.8%)	29.5 (24.2–38.1)
GI disease (other) (n = 82)	2.59	2.07–3.24	< 0.001	42%	34.8% (28.1%)	32.1 (26.8–44.2)
GI perforation/rupture (n = 236)	2.32	2.03–2.65	< 0.001	31%	42.9% (26.1%)	29.4 (24.7–37.8)
Head injury (total) (n = 381)	2.3	2.1–2.6	< 0.001	7%	28.5% (24.6%)	25.2 (22.8–29.7)

* Of long-stay patients. LOS = length of stay. IQR = interquartile range. GI = gastrointestinal.

Figure 2. Characteristics of long-stay patients by year, 2000–2004



* Bars represent 95% confidence intervals.

95% CI, 4.93–7.34, $P < 0.001$) and cervical spine injury (OR, 5.06; 95% CI, 3.42–7.49; $P < 0.001$). Coronary artery bypass grafting had an OR of 0.24 (95% CI, 0.21–0.28; $P < 0.001$) of leading to a long stay. Table 5 shows the diagnoses with an OR > 2 for long stay.

Trends over time

Comparison over the 5 years 2000–2004 revealed no change in:

- the number or proportion of long-stay patients (Figure 2A and Figure 2B);
- the average age of long-stay patients (Figure 2C);
- the proportion of long-stay patients with chronic health problems (Figure 2D); and
- the standardised mortality ratio of long-stay patients (Figure 2E).

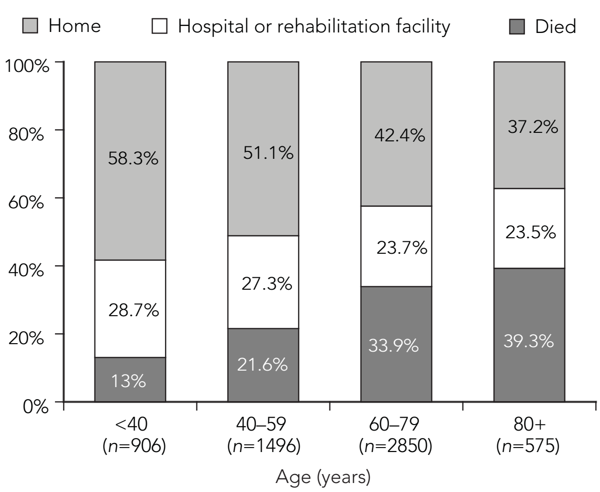
Outcomes

The mortality for long-stay patients was 28%, compared with 13.6% for others ($P < 0.001$) (Table 2). When analysed by age strata, mortality was 13% for those < 40 years of age, and rose to nearly 40% in patients aged ⩾ 80 years (Figure 3). Nearly 60% of patients aged < 40 returned home after their admission, with that number decreasing to 37.2% in those aged ⩾ 80. The number of patients discharged to another hospital or rehabilitation facility was consistent across all age groups (28.7%–23.5% for < 40 to ⩾ 80 years). Table 4 and Table 5 show the outcomes and LOS for certain diagnoses in long-stay patients.

Discussion

In Australian and New Zealand ICUs, the proportion of long-stay patients was just under one in every 50 admis-

Figure 3. Outcomes of long-stay patients, by age



sions. This proportion (2.3%) is similar to that found in previously published studies.[4]

These patients used nearly a quarter (23%) of all ICU bed hours, with the associated costs in terms of money and resources that this entails. Long-term patients are known to be the most expensive group of critically ill patients,[6] and our results are in keeping with those of previous studies of resource usage — long-stay patients use around 10 times the bed hours predicted from their proportion alone.[4] We did not attempt to quantify resource usage in terms of absolute costs or cost–benefit ratios. However, a review of an Australian ICU by O'Brien et al quoted the mean all-inclusive cost of care in that ICU at A$3300 per patient per day, noting that this did not include the costs incurred by interhospital transfer of patients and cancellation of elective surgery because of lack of ICU beds.[3] Based on this figure, a 3-week ICU stay might cost more than A$69 300. Although this is a crude approximation and may not be applicable to other ICUs, it indicates the high costs involved.

It is not surprising that respiratory disease accounts for a high proportion of long-stay patients. Respiratory disease and the need for ventilatory assistance are very common reasons for ICU admission and have been noted in previous studies to be associated with prolonged stay.[6] Although coronary artery bypass grafting (CABG) accounted for 189 long-stay patients, this was a tiny proportion of the total number of CABG patients (33 264). This is consistent with previous data[10,17] showing that these patients rarely have a prolonged stay in the ICU. In contrast, the diagnosis most likely to result in a long stay was neuromuscular disease, although this is an uncommon cause of admission (only 70 patients in our study). It is notable that this group also had a low mortality rate.

Neuromuscular disease, pneumonia, sepsis and trauma[6,7] have previously been shown to be among the most common admission diagnoses for long-stay patients. However, we are unaware of any publications showing burns to have one of the highest risks for prolonged ICU admission. ICUs that admit a high proportion of patients with head injury, burns, or spinal or neuromuscular disease can, on this information, expect to have longer average LOS. Nevertheless, it is worth noting that the *median* LOS for all patients with these diagnoses is less than 3 weeks.

Diagnostic groups pertain to admission diagnoses only and not to subsequent events in the ICU. These events (eg, development of critical-care neuropathy or acute renal failure) may contribute significantly to a patient's LOS. Certain admission diagnoses, such as sepsis, may predispose to long stay precisely because of these factors.

We found that most long-stay patients were in metropolitan or tertiary hospitals, which is in keeping with previous studies.[4] This may reflect the centralisation of services in Australia and New Zealand. It is important to note that, as Australia and New Zealand have very few facilities designed to care for patients undergoing long-term ventilation, it is likely that our data captured most ICU and hospital days associated with these patients.

Our analysis showed that there was no significant change in characteristics of long-stay patients over the 5-year period 2000–2004. We found no evidence to support the perception of some clinicians that long-stay patients have become more prevalent in recent years.

The hospital mortality rate for long-stay patients was 28%, which was less than predicted by APACHE III scores (32.7%). Previous studies have listed mortality rates of long-stay patients at 35.2%,[2] 44.3%,[6] 44.7%[7] and 41.4%.[8] In our cohort of very elderly patients (⩾ 80 years), the mortality was 39.3%. A previous study of elderly long-stay ICU patients (⩾ 70 years) showed a 49.3% hospital mortality.[18] Another study showed approximately 50% mortality in the over-70-years age group.[4] Comparisons with our data may be difficult because of differences in casemix and sample size.

Importantly, most of the survivors in every age group were discharged home from hospital. We also found that good survival outcomes are achievable in all the diagnostic subgroups associated with a long stay. The role of treatment limitation or withdrawal in producing these outcomes is uncertain, particularly in the elderly.[19] It may be that clinicians are correctly predicting those patients who will benefit from long-term ICU care, and identifying and withdrawing treatment early from those who will not.

As noted, the proportion of patients discharged to other hospitals or rehabilitation facilities (including nursing homes) is fairly consistent across all age brackets. The eventual outcomes of these patients are unknown and deserve further study, as the difference between successful rehabilitation and long-term institutional care is of great significance across all age groups.

Our study did not determine long-term outcomes after hospital discharge. However, there is growing evidence that survivors of prolonged ICU stay have good quality of life[6,9] and good performance in activities of daily living,[20] feel happy in themselves, and would be prepared to undergo intensive care again if necessary.[18] In terms of survival, reports range from 92%[1] to 44%[6] at 12 months, and 41% ± 6% at 12 months in the ⩾ 70 age group.[18] Studies of long-term outcomes have concluded that long-term ICU care can produce worthwhile outcomes[3,5] and should not be withheld from selected elderly patients.[18] However, a recent literature review has highlighted the need for more research into post-hospital outcomes of elderly ICU patients.[21]

Our study had a number of other limitations. Firstly, the accuracy of information entered into the database is unknown. The data are captured as part of a binational peer review program,[12] and any errors during data collection may have affected results. Secondly, despite the high proportion of respiratory patients, there is currently no information on duration of ventilation beyond 24 hours. Thirdly, although we have demonstrated significant resource usage in the form of ICU bed days, we did not analyse cost and therefore cannot express a quantitative opinion on the economic aspects of prolonged ICU care. Fourthly, our results are taken from a very large and diverse population of ICUs and may not necessarily be applicable to a particular ICU or ICUs in isolation. In particular, the study included adult patients only, and results are not applicable to paediatric or neonatal intensive care. Finally, our diagnosis and outcome measurements are observational only. For instance, while we have shown that long-stay patients have significantly higher APACHE III scores on admission, it is known that APACHE score is not an accurate predictor of long stay.[7,11] We have not developed a model that can be applied to a particular patient or group of patients to predict LOS or outcome. This area requires further study if an accurate predictive model is to be designed.

Conclusions

This analysis offers a definition of "long" ICU stay as 3 weeks. It showed that long-stay patients have higher initial APACHE III risk of death and more chronic health conditions. Increasing age is not associated with long ICU stay. Long-stay patients use a significant proportion of intensive care resources. Certain diagnoses, such as neuromuscular disease, burns and spinal injuries, are more likely to lead to a long stay. Over the past 5 years, there has been no change in the demographic characteristics of long-stay patients. Outcomes of long-stay patients, irrespective of age and diagnosis, appear to be good.

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