

# The functional outcome of patients requiring over 28 days of intensive care: a long-term follow-up study

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Treatment in an intensive care unit is increasingly demanding in terms of health care resources.<sup>1</sup> Such allocation of resources can be justified only by good patient outcomes. However, these are difficult to measure, and outcomes of patients who spend longer periods in the ICU are poorly studied. Past research has found treatment to be "worth-while" for patients with ICU stays of 7 or more days<sup>2</sup> and 14 or more days.<sup>3</sup> Studies of long-stay ICU patients in the Australian population are lacking but important, as lengthy admissions are arduous for patients, their families and staff, and extremely costly in terms of ICU bed-days.<sup>4</sup> In our ICU, the mean, all-inclusive cost of care is about \$3300 per day. However, this cost does not include the effect of not having the resource available to treat other patients (the opportunity cost), which may lead to interhospital transfer of emergency patients, and cancellation of elective surgery known to require postoperative ICU admission.

Previous authors have varied widely in terms of the duration of ICU stay they categorise as "long". Niskanen et al<sup>5</sup> considered stays of 4 days or more to be "prolonged" in assessing quality of life of survivors, while Venker and colleagues<sup>6</sup> studied survival rates following ICU stays of 60 days or more. Longer admissions are less frequent. Thus, while 14-day admissions may be required for around 9% of ICU patients,<sup>3</sup> stays longer than a month appear much less common (eg, 1.6% of patients stayed beyond 30 days in a 3-year study of 23 ICUs<sup>4</sup>). So, while ICU staff can reasonably base decisions on their experience of the many patients they encounter who stay beyond 1–2 weeks, they see considerably fewer admitted for over 4 weeks. Nevertheless, as these patients may use over 15% of critical care bed-days, knowledge of their outcomes should be useful in ICU management, future discussions with other patients and relatives, and decision-making by staff about the appropriateness and value of treatment.

While survival from ICU is often used as a marker of successful treatment, attempts to record more meaningful measures are increasing. The Glasgow Outcome Score (GOS; Table 1), despite some limitations,<sup>7</sup> is well established in this regard, especially in trauma patients,<sup>8</sup> following cardiac arrest,<sup>9</sup> and in some medical patients.<sup>10,11</sup>

We undertook a study of all patients who had long admissions (28 or more days) in our ICU during a 2-year period, and sought to measure their GOS 1 year after that

## ABSTRACT

**Objective:** To measure functional outcome of long-stay intensive care unit patients in the Australian population.

**Methods:** All 68 patients admitted between July 2000 and July 2002 who spent 28 consecutive days or longer in a 30-bed university-affiliated medical-surgical ICU.

**Main outcomes measures:** Glasgow Outcome Scores were recorded by chart review or telephone in the third quarter of 2003, giving a follow-up of 1–3 years (mean, 2 years).

**Results:** Patients comprised 22 trauma (32%), 16 cardiothoracic (24%) and 15 each (22%) general medical and surgical patients. Average age was 59.2 years (SD, 18.3 years), and mean APACHE II score was 22.2 (range, 7–52). Fourteen of 68 patients (21%) died during the hospital admission. Of the 54 patients discharged, 53 were followed up, and one was untraceable. Nineteen of these 53 (36%) had died. Of the 34 survivors (64% of hospital survivors, 50% of long-stay ICU patients), 17 (50%) were leading normal active lives, 15 (44%) were disabled but independent, with two (6%) needing daily support. None were in a persistent vegetative state.

**Conclusions:** Of 68 long-stay ICU patients, an average of 2 years after discharge, 50% were alive, including 25% living normal active lives. The remaining 25% described some disability. In most cases (88%), this was mild: only two patients (3% of the total group) depended on daily support. No patients were left in a persistent vegetative state.

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period ended. The setting for the study was a 30-bed ICU in a university-affiliated, quaternary referral centre, providing state services for artificial heart technology, heart and lung transplantation, bone marrow transplantation, burns, trauma, hyperbaric oxygen, HIV, adult cystic fibrosis and haemophilia.

## Methods

Using a prospectively recorded database of all ICU admissions, we performed a secondary analysis of all records in a 2-year interval from 1 July 2000 to 30 June 2002 and, with ethics committee approval, identified patients who had spent

**Table 1. Glasgow Outcome Score****Score definitions**

- 1: Death
- 2: Persistent vegetative state
- 3: Severe disability (conscious but disabled), needing daily support
- 4: Moderate disability (disabled but independent)
- 5: Good recovery, normal active life with minimal deficits

**Assessment questionnaire**

- Is the patient able to communicate and follow commands?
- Is the patient able to manage unsupervised at home for several hours?
- Can the patient safely undertake complex tasks, such as shopping?
- Has the patient returned to their pre-illness function with regard to study, work or recreational activity? ◆

28 or more consecutive days in the ICU. From this database, we recorded patient age and APACHE II score on admission, and whether the patient survived to hospital discharge. In keeping with the broad classification of patients in the ICU database, we also recorded the category of illness as trauma, cardiothoracic, general medical or general surgical.

In July 2003, a mean of 2 years after ICU discharge, we began telephoning hospital survivors or their relatives to ask about functional status and outcome of these patients. As the patients were admitted over a 2-year period, the interval to follow-up varied from 1 to 3 years. The outcomes were recorded as Glasgow Outcome Scores, assessed by a structured telephone interview, as response rates to postal surveys are often poor<sup>12</sup> (Table 1).

**Statistical analysis**

Data were analysed using SAS version 8.2 (SAS Institute Inc, Cary, NC, USA). Proportions were compared between groups using  $\chi^2$  tests for equal proportion, while age and

APACHE II scores were compared between groups using Student *t* tests and were reported as means ( $\pm$  standard errors). GOS scores were compared between groups using Wilcoxon rank sum tests and reported as median (interquartile range [IQR]). The relationship between GOS and other continuous variables was explored using Spearman correlation coefficients. Because of the small numbers, GOS categories were compared using Kruskal–Wallis tests, with results reported as medians (IQRs). A two-sided *P* value of 0.05 was considered to be statistically significant.

**Results**

Over the 2-year study period, there were 4003 admissions to the ICU, and 68 patients (1.7%) stayed for 28 or more consecutive days. Mean age did not differ significantly between long-stay patients and those staying less than 28 days ( $59.2 \pm 2.2$  versus  $56.8 \pm 0.3$  years;  $P=0.33$ ), but long-stay patients had significantly higher APACHE II scores on admission ( $22.2 \pm 1.0$  versus  $15.0 \pm 0.2$ ;  $P<0.001$ ). While the median duration of all ICU admissions over this period was 4 days, the median length of stay in the long-stay group was 37 days (IQR, 31–41 days).

When considering category of illness, long-stay patients were more likely than short-stay patients to have suffered trauma (32.3% versus 23.5%,  $P=0.12$ ) and less likely to be in the cardiothoracic group (23.5% versus 34.6%;  $P=0.07$ ), but neither result was statistically significant. The proportions of general medical (22% versus 23.2%;  $P=0.93$ ) and surgical patients (22% versus 18.7%;  $P=0.59$ ) were also similar in long- and short-stay groups. While GOS scores were weakly correlated with both APACHE II score ( $r=0.22$ ;  $P=0.08$ ) and age ( $r=0.18$ ;  $P=0.14$ ), these relationships did not achieve statistical significance (Table 2).

We were able to obtain outcome data for 67 of the 68 patients (98%) in the long-stay group a mean of 2 years

**Table 2. Characteristics of 67 long-stay ICU patients, by category of outcome at 1–3 year follow-up\***

	Outcome (Glasgow Outcome Score) <sup>†</sup>				<i>P</i>
	1	3	4	5	
No. of patients	33 (49%)	2 (3%)	15 (22%)	17 (25%)	
Median (interquartile range)					
APACHE II score on admission	23 (20–28)	19 (15–23)	18 (12–25)	21 (16–27)	0.11
Age (years)	66 (58–74)	57 (54–60)	58 (40–70)	55 (44–68)	0.38
Length of stay (days)	37 (30–44)	37 (36–38)	37 (30–40)	35 (31–41)	0.84

\* Long-stay was defined as ICU stay  $\geq 28$  days. One surgical patient was untraceable and was excluded from calculations.

† No patient had a Glasgow Outcome Score of 2. Spearman correlation coefficients showed no statistically significant correlations between GOS category and APACHE II score ( $P=0.08$ ), age ( $P=0.14$ ) or length of stay ( $P=0.38$ ). ◆

**Table 3. Characteristics of 67 long-stay ICU patients, by category of illness at 1–3 year follow-up\***

	Trauma	Cardiothoracic	Medical	Surgical <sup>†</sup>	<i>P</i>
No. of patients	22 (33%)	16 (24%)	15 (22%)	14 (21%)	
Median (interquartile range)					
APACHE II score on admission	17 (12–23)	23.5 (20.5–29)	23 (16–28)	24 (19–28)	0.01
Age (years)	56.5 (34–77)	62.5 (55–72)	61.0 (40–70)	67.5 (65–72)	0.23
Glasgow Outcome Score	4 (1–5)	4 (1–5)	1 (1–4)	1 (1–4)	0.04

\* Long-stay was defined as ICU stay  $\geq$  28 days. One surgical patient was untraceable and was excluded from calculations. ◆

after discharge. Fourteen of the 68 patients (21%) died during the initial hospital admission, including four (6%) who died during the ICU stay. One surgical patient survived to discharge but was untraceable and was excluded from calculations. In all other cases, surviving patients or their relatives were able to complete the GOS assessment. Of the 53 survivors followed up, 19 (36%) had died in the intervening period, after discharge home or to other health care facilities. Seventeen (50%) of the remaining 34 (ie, 25% of the total group) described themselves as living a normal active life (GOS of 5). The remaining 17 surviving patients (25% of the total group) included two (3% of the total group) with disabilities they regarded as severe (ie, requiring daily support), while 15 (22%) were independent, with less severe levels of disability.

Of the long-stay ICU patients, the largest subgroup by nature of illness was the trauma group (22; 32%). When compared against all other categories, long-stay trauma patients had significantly lower APACHE II scores ( $17.6 \pm 1.2$  versus  $24.4 \pm 1.2$ ;  $P = 0.001$ ), significantly higher GOS scores (4 [IQR, 1–5] versus 1 [IQR, 1–4];  $P = 0.03$ ) and were slightly younger ( $54.8 \pm 4.8$  versus  $61.4 \pm 2.3$  years;  $P = 0.31$ ). A GOS of 5 was achieved by 36% of the trauma patients, while 27% had died (GOS of 1), although the two patients with severe disability were also in this group.

The cardiothoracic patients (16 of 68) were older (mean age, 61.3 years), and 44% of them had died. Along with the general surgical group, they had the highest APACHE II scores (24.5). Nonetheless, five of these 16 patients (31%) described a return to full functional status (GOS of 5). The surgical patients (15 of 68) were the oldest (mean age, 68.4 years), and 64% of them had died. The medical patients (15 of 68) were the youngest (mean age, 54.2 years). Their mean APACHE II score was 24. Their outcomes were the worst, with 73% dead at follow-up, while only one patient (7% of the group) was living a normal active life (Table 3).

A commonly used, broader classification categorises patients with a GOS of 4 or 5 (ie, no to mild disability) as having a "good outcome".<sup>13–15</sup> By this criterion, 64% of the trauma group, 56% of the cardiothoracic group, 36% of

the surgical group, and 27% of the medical group had a good outcome.

### Discussion

ICU admissions lasting over 28 days are unusual; our finding that they made up 1.7% of ICU admissions is similar to the findings of others.<sup>4</sup> These admissions involve the allocation of large amounts of medical resources to individual patients. It is difficult to predict the duration of admission, as late complications often contribute to such protracted courses of treatment. Thus, it is common for extended courses of intensive care to develop unexpectedly. This often raises the question of the value of ongoing care at a relatively late point in the admission. We wondered whether the need for such a protracted ICU admission might be a useful prognostic indicator.

From our data, 79% of long-stay patients survived to discharge, but 36% of these died before follow-up 1–3 years later. Excellent outcomes (GOS of 5) were obtained by half of those surviving to the point of follow-up and, among those who described disability, in 88% of cases it was mild. Surprisingly, the patients who had died were not significantly older than those living normal active lives, nor had they had significantly longer stays or more severe illnesses, as indicated by APACHE II scores. It thus appears that these simple variables, although commonly recorded in the ICU population, are not particularly helpful in predicting outcomes of these patients. While serial or daily assessment of illness severity has been found to be more predictive of outcome,<sup>16,17</sup> it is not commonly done. Furthermore, the finding from such studies that the severity of illness on the current day is highly predictive of mortality<sup>16</sup> is not surprising or especially useful in clinical practice.

There are a number of significant limitations to the interpretation of these data. Firstly, pre-existing diseases and comorbidity may also be important in determining ICU survival, particularly in older medical patients.<sup>18</sup> However, our database included only illnesses recorded in the APACHE II scoring system. Secondly, the ICU database is

maintained by a team of three data-entry clerks, who enter all data and make required calculations (eg, of APACHE II scores) using predefined criteria. The GOS assessment was done by the first author (BO'B) following a structured interview, limiting bias in recording these parameters.

Thirdly, the GOS assessment is one of a wide variety of outcome measures and has some limitations.<sup>7</sup> Black et al found 161 different outcome measures described in the adult ICU literature, most of which had only one recorded use.<sup>19</sup> Of the 38 measures for which they found more than one citation, they recommended that only 11 (including the GOS) should be used in future studies. The GOS focuses on recovery from illness, while a more global indication of outcome would probably be derived from multidimensional assessment of perceived quality of life, such as the SF36 or Nottingham health profile.<sup>5,12,20</sup> However, these assessments cannot be done accurately by proxy, necessitating more complicated follow-up, and the outcome in terms of health-related quality of life is influenced by the availability of multidisciplinary care in the community<sup>21</sup> and probably by patients' socioeconomic and health insurance status.<sup>12</sup> As well as being beyond the control of the ICU, these are likely to vary widely between patients in our cohort. Therefore, we chose the GOS assessment, as it provides a clinically meaningful outcome measure that is well validated and familiar in the critical care environment.<sup>19</sup>

A fourth limitation of our study is the heterogeneity in follow-up time, which may have increased variability of the GOS, as patients may have been at different stages of recovery. However, this is not likely to be very significant at 1–3 years after ICU discharge and was unavoidable, given the retrospective nature of the study. To gather similar data prospectively would have taken up to 4 years.

Analysis by category of illness indicates that trauma patients were over-represented in the long-stay group (32.3% versus 23.5% in the shorter stay group), while cardiothoracic patients were under-represented (23.5% versus 34.6%). This may reflect the nature of such admissions — cardiothoracic admissions are usually elective, while trauma admissions are emergent in nature. The proportions of medical and surgical patients were similar to the overall case-mix of the ICU.

Analysis of the data by category of illness reveals that the trauma patients — a younger and apparently less ill subgroup — achieve the best outcomes (36% were living a normal life at follow-up; mortality rate, 27%). This may be due to lower illness severity, reflected by the lower APACHE II score of 17, but it must be noted that age is a component of the APACHE II evaluation, and thus younger age contributes to a lower APACHE II score.

The other three subgroups had comparable APACHE II scores (between 23 and 24). However, the 15 medical

patients had very poor outcomes: only one described a normal level of activity, while most of the group (73%) had died. This occurred despite their being one of the younger patient groups. The cardiothoracic patients had a high proportion of good functional outcomes, with 31% describing normal activity with minimal deficits. The surgical patients were the oldest subgroup, with median age 67.5 years. More than half of them were dead at follow-up (64%), but 21% had resumed normal levels of activity.

This article describes the outcomes of long-stay patients (28 days or more) from a single ICU over a mean follow-up of 2 years. The subgroups contain small numbers of patients, making statistically significant conclusions difficult. However, this 30-bed ICU is comparatively large, serving as a trauma and major cardiothoracic surgery centre, as well as a general hospital for a large urban population. As very few patients undergo such long periods of intensive care treatment, it would be difficult for any single centre to collect a larger group of patients with such long ICU stays. A multicentre study with hundreds of thousands of admissions would be required to derive any statistically significant results.

In conclusion, it appears that worthwhile outcomes can be achieved even after 28 days of intensive care, given that a quarter of such patients had made a good recovery and were leading normal active lives with minimal deficits an average of 2 years after discharge. Trauma patients, perhaps because of their relative youth and less severe illness, appear to fare better than the other patient groups. Conversely, long-stay medical patients appear to do poorly. Reliable methods to predict long-term outcomes remain elusive, and are beyond the scope of the present study, probably requiring the use of much larger databases.

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