Very old patients urgently referred to the intensive care unit: long-term outcomes for admitted and declined patients

Kenneth R Hoffman, Bronwyn Loong and Frank Van Haren

Outcomes for very old patients (≥ 80 years) admitted to intensive care units are poor compared with outcomes for younger adults. This group comprises 13% of ICU admissions in Australia and New Zealand, and there are few publications relating to their long-term outcomes. Analysis of the Australian and New Zealand Intensive Care Society (ANZICS) Adult Patient Database showed a 5.6% annual increase in admissions for this age group. The ICU is a finite resource, limited by bed spaces and staffing. Unless there is increased awareness and application of advance care planning, there will be a requirement to increase ICU capacity or apply distributive justice principles to allocate current resources.

Studies evaluating ICU triage for very old patients are hindered by variability in critical care practices between hospitals and countries. Admission policies are also often arbitrary, rather than evidence-based. Published studies about refusal of admission to the ICU show high variability in outcomes, compounded by the variable health status of very old patients, which is not necessarily correlated with chronological age. As a result, there are no publications showing age being independently used for triage in Australia and New Zealand.

Given the international variations in admission practices, we designed our study to evaluate urgent referrals to an Australian tertiary ICU. Our main outcomes were hospital mortality, 12-month mortality and discharge destination for very old patients urgently referred to the ICU.

Methods

We conducted a retrospective, observational review of medical records of all patients aged ≥ 80 years who had been urgently referred (ie, non-electively) to the Canberra Hospital tertiary ICU. The closed-format medical and surgical ICU consisted of 31 mixed intensive care (nurse:patient ratio, 1:1) and high dependency (nurse:patient ratio, 1:2) beds. In addition to recording ICU admissions, the ICU outreach service recorded all urgent referrals, subdivided into outreach reviews and medical emergency team (MET) calls, with referral pathways as shown in Figure 1. Referrals were divided into those who were too sick, too well, too old, admitted to the ICU, and dying.

Results: Urgent admissions of very old patients accounted for 6.9% of total ICU admissions (443/6415). The hospital mortality rate was 16.0% (93/583) for patients who were too well, 32.1% (142/443) for those admitted to the ICU, and 69.2% (148/214) for those too sick (P ≤ 0.001). Mortality rates 12 months after referral were 40.8% (238/583), 46.0% (204/443) and 88.3% (189/214), respectively (P ≤ 0.001).

Conclusion: Very old patients considered too well for the ICU have a significantly lower hospital mortality rate than those admitted to the ICU after urgent referral. However, 12 months after referral, patients considered too well for ICU admission have a mortality rate approaching that of very old patients admitted to the ICU. Over half of very old patients urgently referred to the ICU die within 12 months.

< 80 years or had elective ICU admissions or interhospital referrals not accepted for transfer. Data were only collected during the first referral of the hospital admission, although any subsequent referral or ICU admission was noted. If a patient had a new hospital admission with urgent referral to the ICU, it was treated as a new referral.

Data sources included the ICU computerised medical record and referral system, hospital digital medical record and the Australian Institute of Health and Welfare (AIHW) National Death Index (NDI). The data elements collected are
summarised in Table 1. The Modified Early Warning Score (MEWS)\textsuperscript{10} quantified the degree of vital sign derangement and was calculated at first review (see Appendix, Table 1, online at cicm.org.au/Resources/Publications/Journal).

Patients were divided into three groups, based on the medical documentation at initial referral:

- patients referred to the ICU but who did not require admission as they were “too well”
- patients admitted to the ICU
- patients “too sick” for the ICU, including patients who would not benefit from the ICU as they were not expected to survive, and those who declined transfer to the ICU because of a pre-existing decision, despite meeting admission criteria.

We defined hospital mortality as death within the tertiary referral centre, documented by death certificates or coronial referral. Twelve-month mortality data were obtained from the AIHW NDI. Patients transferred to the affiliated off-campus hospice for terminal care were considered to have died in the hospital.

The Australian Capital Territory Health Human Research Ethics Committee approved the retrospective study and waived the requirement for consent. The AIHW Ethics Committee approved our use of the NDI.

Statistics
We stored the data in an Excel (Microsoft) spreadsheet and performed analysis using R software (https://www.r-project.org; R Foundation). We compared continuous variables using the Kruskal–Wallis test and report the results with means and SDs. We used medians and interquartile ranges (IQRs) to report lengths of stay, and compared categorical variables using the Fisher exact test. Multivariate logistic regression identified predictors of hospital and 12-month mortality, and we used multinomial logistic regression to identify predictors of admission. We assessed model discrimination with the area under the receiver operator curve, and used the log-rank test to compare survival curves by ICU disposition. We defined statistical significance as $P < 0.05$. We report odds ratios with 95% confidence intervals for ICU admission, hospital mortality and 12-month mortality. We use a Kaplan–Meier curve to show 12-month survival.
Statistically significant factors associated with being declined ICU admission on multivariate analysis are shown in the Appendix, Table 2. Age was an independent predictor of being declined ICU admission ($P \leq 0.001$).

The median ICU length of stay for ICU admissions was 2 days (IQR, 1–4 days) and mean APACHE III score was 75.7 (SD, 27.7). The mean all-ages APACHE III score from 2011 to 2014 was 55.8 (SD, 27.1). Vasopressor or inotropic support was received by 59.4% of patients (263/443), 44.5% of patients (197/443) were intubated, 14.5% (64/443) received non-invasive ventilation and 5.6% (25/443) received renal replacement therapy. Of the patients admitted to ICU, 18.3% (81/443) did not receive organ support.

Mortality

Overall hospital mortality was 30.9% (383/1240); 16.0% (93/583) for patients who were too well, 32.1% (142/443) for patients admitted to the ICU and 69.2% (148/214) for patients who were too sick ($P \leq 0.001$). Significant odds ratios for factors associated with mortality on multivariate analysis are shown in Table 3.
Overall 12-month mortality was 50.9% (631/1240); 40.8% (238/583) for patients who were too well, 46.0% (204/443) for patients admitted to the ICU and 88.3% (189/214) for patients who were too sick ($P \leq 0.001$). The mean time until death was 76.7 days in the too-well group, 46.3 days for those admitted to the ICU and 25.2 days in the too-sick group ($P \leq 0.001$). Statistically significant odds ratios for 12-month mortality on multivariate analysis are shown in Table 3. A Kaplan–Meier curve for overall survival for the 12 months after referral is shown in Figure 2.

The 12-month mortality rate for hospital survivors was 29.6% (145/490) for patients who were too well, 20.6% (62/301) for patients who were admitted to the ICU and 62.1% (41/66) for patients who were too sick ($P \leq 0.001$).
Discharge destination

ICU disposition was a significant predictor of discharge destination ($P = 0.005$). Figure 3 shows a comparison of pre-admission (all patients) and post-discharge residence for patients who survived their hospital stay.

Discussion

Our study describes the characteristics and outcomes of 1240 very old patients referred to a tertiary ICU service over a 40-month period. In addition to obtaining long-term outcome data on patients admitted to the ICU, we also present 12-month mortality outcomes for patients considered too well or too sick for ICU admission. This stratification shows separation of baseline characteristics, hospital and 12-month mortality, and discharge destination, based on ICU disposition. This separation may relate to selection bias, differing baseline health status and treatment variation between groups.

The 12-month mortality data provide insight into the sequelae of critical illness in very old patients. Despite differences between those considered too well and those admitted to the ICU, the 12-month mortality curves trend towards convergence. The 12-month mortality of hospital survivors is lower in patients admitted to the ICU than in patients considered too well for ICU admission.

Our study may help clinicians and patients make decisions relating to ICU admission and advance care planning.

### Table 3. Multivariate analysis of factors associated with mortality*

<table>
<thead>
<tr>
<th>Factor</th>
<th>Hospital mortality</th>
<th>12-month mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Odds ratio</td>
<td>95% CI</td>
</tr>
<tr>
<td>Too well</td>
<td>0.33</td>
<td>0.20–0.55</td>
</tr>
<tr>
<td>Too sick</td>
<td>2.78</td>
<td>1.52–5.06</td>
</tr>
<tr>
<td>High-care nursing home</td>
<td>0.40</td>
<td>0.21–0.76</td>
</tr>
<tr>
<td>ICU-initiated treatment limitations</td>
<td>0.45</td>
<td>0.26–0.78</td>
</tr>
<tr>
<td>Treatment limitations after discharge from ICU or outreach</td>
<td>17.40</td>
<td>10.70–28.30</td>
</tr>
<tr>
<td>Subsequent referral</td>
<td>4.14</td>
<td>2.62–6.55</td>
</tr>
<tr>
<td>Cancer</td>
<td>0.90</td>
<td>0.54–1.49</td>
</tr>
<tr>
<td>Metastatic cancer</td>
<td>1.13</td>
<td>0.53–2.39</td>
</tr>
<tr>
<td>Chemotherapy or radiotherapy</td>
<td>2.59</td>
<td>1.07–6.26</td>
</tr>
<tr>
<td>Dementia</td>
<td>0.50</td>
<td>0.31–0.80</td>
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<tr>
<td>Chronic obstructive pulmonary disease</td>
<td>0.59</td>
<td>0.38–0.91</td>
</tr>
<tr>
<td>Heart failure</td>
<td>1.03</td>
<td>0.70–1.53</td>
</tr>
<tr>
<td>Chronic kidney disease, receiving dialysis</td>
<td>0.63</td>
<td>0.17–2.31</td>
</tr>
<tr>
<td>Modified Early Warning Score</td>
<td>1.11</td>
<td>1.05–1.18</td>
</tr>
<tr>
<td>Time from admission to ICU referral</td>
<td>1.07</td>
<td>1.04–1.09</td>
</tr>
</tbody>
</table>

ICU = intensive care unit. * Area under receiver operator curve = 0.89.

**Figure 2. Kaplan–Meier curve showing the proportion of patients alive 12 months after ICU referral**

Information such as pre- and post-admission residence indicates functional outcomes and the social implications of acute illness in critically unwell elderly patients. Being sick enough for ICU referral has prognostic implications that are often not completely discussed with patients and families due to the time constraints of critical care treatments.
support and may systematically underestimate ICU admission scores. Irrespective of this, MEWS remained a predictor of hospital mortality for the overall cohort.

Despite our expectation that age would predict being declined ICU admission, consistent with previous publications, it did not predict hospital or 12-month mortality in this cohort. Age predicting mortality is a variable finding, based on the mechanism for cohort selection. There is significant selection bias before ICU referral, and ICU triage includes declining patients deemed unlikely to survive. Age was an independent predictor for discharge to long-term care, consistent with previous publications.

ICU admission was associated with a low rate of discharge to a nursing home, compared with the too-well and too-sick groups, but a high rate of discharge to another hospital or rehabilitation facility. These destinations were combined, because patients often transfer to interstate or private hospitals without a documented reason for ongoing hospitalisation. Due to limitations of accessing data from interstate and private hospitals, our reported hospital mortality only included deaths within the study centre, which perhaps underestimated the overall hospital mortality.

Data for patients in our study who were admitted to the ICU were similar to data previously reported for very old patients in Australia and New Zealand. The ICU mortality was lower than previously reported, despite a higher intubation rate. This is consistent with the observation that treatment intensity and ICU survival rates are increasing in very old patients. The ANZICS database had a lower national mortality rate of 24%, but included 38.2% elective surgical admissions, which we excluded from our current study.

A prospective French study found similar hospital mortality rates in the too-well and too-sick groups (17.6% and 70.8%, respectively), but the mortality rate in patients admitted to the ICU was dramatically higher than in our study (62.5% v 32.1%). The rate also exceeded those in prior French studies and the predicted mortality rate based on the reported Simplified Acute Physiology Score II. A possible explanation for this difference may be a
higher acceptance rate in our study (35.7% v 26.7%) and shorter ICU stays, suggesting that the patients in our cohort were less sick. The 12-month mortality rate in our cohort was also lower than in previous publications, for all referrals and ICU admissions.\textsuperscript{2,8,15-19}

\textbf{Strengths and limitations}

Strengths of our study include the large number of ICU referrals and the completeness of the dataset. There are limited data published on patients who are declined ICU admission, and a lack of prospective trials. It may take many years to recruit adequate samples for such trials. Correlating hospital outcome with discharge destination and 12-month mortality rates provides insights into the sequelae of acute illness.

Study limitations include the single-centre retrospective design and the possibility of missing referrals from the database. We were unable to correlate ICU disposition decisions with bed availability, although severity of illness is the primary determinant of ICU admission in the study centre. We stratified patients into groups based on their clinical state, and this stratification is inherently subjective and highlights the requirement for more objective classifications in future research.

The literature on intensive care focuses on outcomes of patients admitted to the ICU. Using simple methods, we investigated long-term outcomes in a cohort which had not been described in Australia and New Zealand. Our study provides new insights into patient outcomes and justifies multicentre prospective investigations to optimise resource allocation. Our study also justifies further social and political discussion on allocation of resources to a population with high mortality.\textsuperscript{9}

\textbf{Conclusion}

Very old patients who are considered too well for the ICU have a significantly lower hospital mortality rate than patients admitted to the ICU after urgent referral. However, 12 months after referral, patients considered too well for ICU admission have a mortality rate approaching that of patients admitted to the ICU. Patients considered too sick for ICU admission have high hospital and 12-month mortality, and a low rate of discharge back to the residence category they were in before ICU referral. Over half of very old patients urgently referred to the ICU die within 12 months of referral.

\textbf{Acknowledgements}

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\textbf{Competing interests}

None declared.

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\textbf{References}


ORIGINAL ARTICLES


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TCD MONITORING in INTENSIVE CARE

VENUE: Royal Brisbane and Women’s Hospital
DATES: 10th – 11th OCTOBER 2016
TIMING: 2 days distributed in 4 modules
2 morning modules + 2 afternoon modules

10th October – morning (1st module)
08-09.30h: Physics in Ultrasound
09.30h-10.30h: Ultrasound probe and types of ultrasound
10.30h-11h: coffee break
11h-12h: General applications
12h-13h: PFO and emboli detection (This presentation may be re-scheduled as for convenience of the speaker)
13h-14h: Lunch time (supplied)

10th October – afternoon (2nd module)
14h-17h: 3h non-interrupted hands-on sessions
Coffee + snacks supplied

11th October – morning (3rd module)
08-09h: Subarachnoid haemorrhage and TCD
09-10h: Stroke and TCD
10-10.30h: coffee break
10.30-12h: Simulation
12-12.30h: Demonstration of a complete examination
13h-14h: Lunch time (supplied)

11th October – afternoon (4th module)
14h-17h: 3h non-interrupted hands-on sessions
Coffee + snacks supplied

MATERIAL:
A CD will be supplied with the updated reviews of literature on TCD, most relevant articles and power-points presentations of all talks

WORKSHOPS:
Will be equipped with one TCD device per participant.

REGISTRATION NUMBERS:
Maximum of 10 participants per course is ideal to ensure one-to-one tutoring and access to TCD devices.

SPEAKERS:
• Dan Traves (Vascular Sonographer – Distributor Delica Transcranial Doppler Systems)
• Dr Hayden White (Intensive Care Specialist-Logan Hospital)
• Ada, Io (Cardiac sonographer: RBWH)
• Dr Judith Bellapart-Rubio (Intensive Care Specialist-RBWH)

FEE:
800 AUD per person / course or 200 AUD / module (via credit card on registration)

Appendix
This appendix was part of the submitted manuscript and has been peer reviewed. It is posted as supplied by the authors.

Appendix Table 1 – Method of calculating and recording Modified Early Warning Score (MEWS)
### Appendix Table 2 – Factors associated with being declined ICU admission on multivariate analysis

<table>
<thead>
<tr>
<th>Factor</th>
<th>Odds Ratio</th>
<th>95% CI</th>
<th>p</th>
<th>Factor</th>
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