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

ABSTRACT

Background: Outcomes for very old patients (≥ 80 years) referred but not admitted to an intensive care unit have not been described in Australia and New Zealand.

Objective: To ascertain long-term (12-month) outcomes for very old patients urgently referred for ICU support at a tertiary referral hospital.

Design, setting and patients: A retrospective, medical record review of 1240 very old patients (≥ 80 years) who were urgently referred to an Australian, 31-bed ICU over a 40-month period from March 2011 to August 2014. Referrals were divided into those who were "too well" for the ICU, admitted to the ICU, and "too sick" for the ICU.

Data and main outcome measures: Data were extracted from hospital records, the ICU patient database and the Australian Institute of Health and Welfare National Death Index, and our main outcome measures were health status and destination at hospital discharge, and 12-month mortality rates.

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 ($P \leq 0.001$). Mortality rates 12 months after referral were 40.8% (238/583), 46.0% (204/443) and 88.3% (189/214), respectively ($P \leq 0.001$).

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.

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Outcomes for very old patients (≥ 80 years) admitted to intensive care units are poor compared with outcomes for younger adults.[1] This group comprises 13% of ICU admissions in Australia and New Zealand,[1] and there are few publications relating to their long-term outcomes.[2] 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.[1] 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.[3]

Studies evaluating ICU triage for very old patients are hindered by variability in critical care practices between hospitals[4] and countries.[5,6] Admission policies are also often arbitrary, rather than evidence-based.[7] Published studies about refusal of admission to the ICU show highly variable mortality,[6,8] compounded by the variable health status of very old patients, which is not necessarily correlated with chronological age.[9] As a result, there are no publications showing age being independently used for triage in Australia and New Zealand.

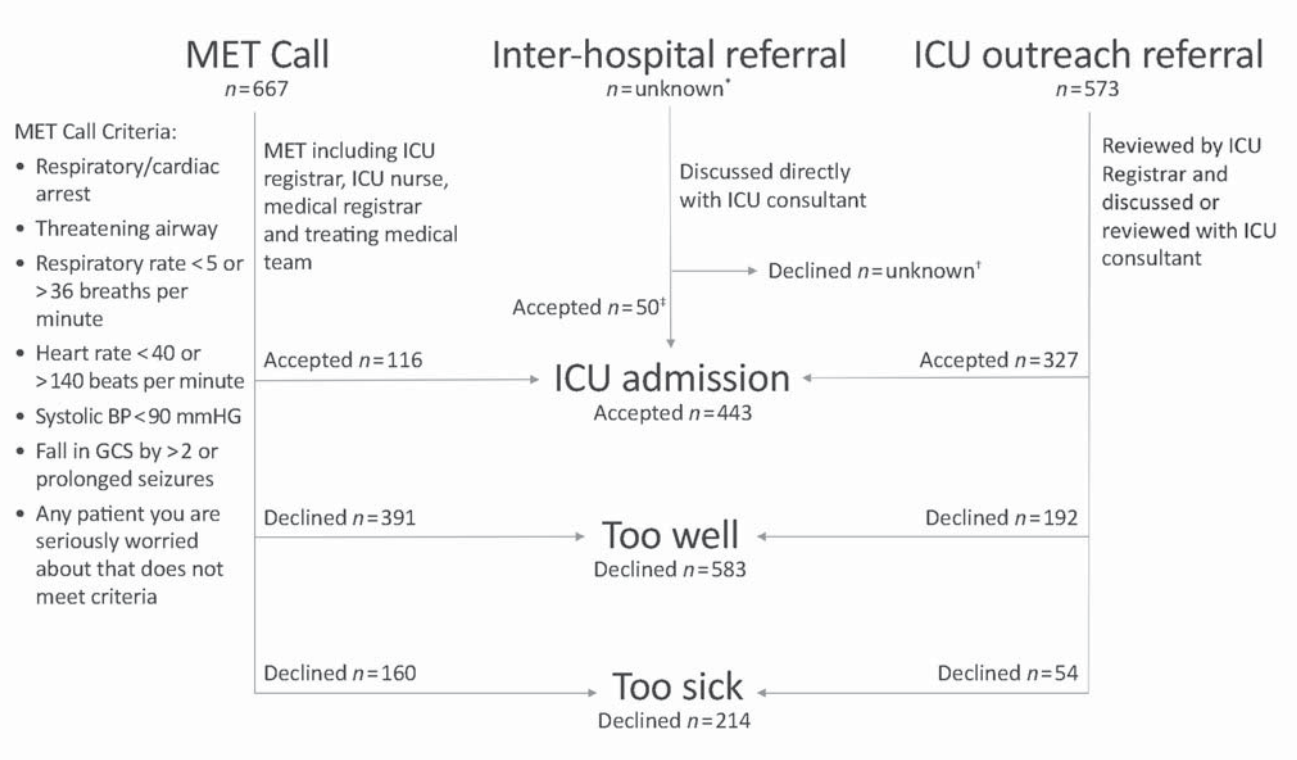
Given the international variations in admission practices, we designed our study to evaluate urgent referrals to an Australian tertiary ICU. Our main outcomes were hospital mortality, 12-month mortality and discharge destination for very old patients urgently referred to the ICU.

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 seen by, or discussed with, a consultant intensivist regarding disposition based on illness severity. The hospital did not have an age-based ICU admission policy. All urgent referrals from 29 March 2011 to 8 August 2014 were included. Patients were excluded if they were aged < 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

Figure 1. Referral pathways and triage decisions



MET = medical emergency team. ICU = intensive care unit. BP = blood pressure. GCS = Glasgow Coma Scale. * Interhospital referrals were discussed directly with the ICU consultant and were not recorded in the database. † Number declined is unknown because interhospital referrals were not recorded. ‡ These patients are counted as outreach referrals in tables and statistics.

summarised in Table 1. The Modified Early Warning Score (MEWS)[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.

Table 1. Summary of data elements collected

- Demographics
  - Sex
  - Age
- Dates
  - Hospital presentation
  - ICU referral
  - ICU discharge
  - Hospital discharge
  - Date of death
- Hospital referral source
  - Home
  - Low-level care
  - High-level care
- Scores
  - APACHE II
  - APACHE III
- Length of stay
  - Hospital
  - ICU
- Referral information
  - MET call/outreach
  - Location*
  - MEWS
- Treatment limitations†
  - In place before ICU referral
  - Established in ICU review
  - In place after ICU discharge
- ICU disposition
  - Too well
  - Admitted
  - Too sick
- ICU intervention
  - Non-invasive ventilation
  - Intubation
  - Vasopressors or inotropes
  - Renal replacement therapy
- Comorbid conditions
  - Cancer
  - Metastatic cancer‡
  - Haematological malignancy
  - Undergoing chemotherapy or radiotherapy§
  - Dementia
  - Chronic obstructive pulmonary disease¶
  - Cirrhosis
  - Heart failure**
  - Diabetes mellitus, receiving insulin
  - Chronic kidney disease, receiving dialysis
  - Immunosuppression††
- Mortality rate
  - Hospital
  - 12-month

ICU = intensive care unit. APACHE = Acute Physiological and Chronic Health Evaluation. MET = medical emergency team. MEWS = Modified Early Warning Score. CPR = cardiopulmonary resuscitation. * Emergency department, operating theatre, inpatient ward, other hospital. † Included limitations which would affect ICU management, eg, "not for ICU", "not for intubation", "not for CPR". ‡ Subgroup of cancer group, with radiographic or surgical evidence of metastasis. § Within 6 months before ICU referral. ¶ Severe exercise limitation or receiving home oxygen. ** Symptoms consistent with New York Heart Association III/IV dyspnoea. †† Received prednisolone 10 mg or greater daily, or had HIV or had undergone organ transplantation.

Results

Patient demographic data

During the 40-month study period, 1240 urgent referrals were made for patients aged ≥ 80 years, who were included in the study. Urgent admissions to the ICU for patients ≥ 80 years accounted for 6.9% of total ICU admissions (443/6415). There were 46 patients with separate hospital admissions requiring ICU referral; these were analysed as separate referrals. Two patients had Acute Physiology and Chronic Health Evaluation (APACHE) scores missing from their medical record. Hospital mortality data were not available for one ongoing inpatient, and 12-month mortality data were not available for one international patient. The characteristics of patients by admission status are compared in Table 2.

ICU admissions

The acceptance rates for ICU admission after urgent referral were 58.7% (155/264) from the emergency department, 17.2% (130/755) from inpatient wards and 63.2% (108/171) from the operating theatre ($P \leq 0.001$). 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.

Table 2. Demographic and referral data of study patients

Parameter	Total	Too well	Admitted to ICU	Too sick	*P*
Number	1240 (100%)	583 (47.0%)	443 (35.7%)	214 (17.3%)	–
Mean age, years (SD)	85.2 (4.0)	85.5 (3.9)	84.1 (3.3)	86.8 (4.5)	< 0.001
Men, *n* (%)	631 (50.9%)	283 (48.5%)	249 (56.2%)	99 (46.3%)	0.017
Mean Modified Early Warning Score* (SD)	4.8 (3.4)	4.0 (2.6)	5.0 (3.5)	6.9 (4.1)	< 0.001
Service, *n* (%)					
Medical emergency team call	667 (53.8%)	391 (31.5%)	116 (9.4%)	160 (12.9%)	< 0.001
Outreach review	573 (46.2%)	192 (15.5%)	327 (26.4%)	54 (4.4%)	< 0.001
Location, *n* (%)					
Emergency department	264 (21.3%)	74 (6.0%)	155 (12.5%)	35 (2.8%)	< 0.001
Inpatient ward	755 (60.9%)	450 (36.3%)	130 (10.5%)	175 (14.1%)	< 0.001
Operating theatre	171 (13.8%)	59 (4.8%)	108 (8.7%)	4 (0.3%)	< 0.001
Other hospital	50 (4.0%)	NR†	50 (4.0%)	NR†	–
Treatment limitation order in place, *n* (%)					
Before ICU referral	322 (26.0%)	140 (24.0%)	59 (13.3%)	123 (57.5%)	< 0.001
ICU initiated at first review‡	169 (13.6%)	57 (9.8%)	39 (8.8%)	73 (34.1%)	< 0.001
ICU modified at first review§	78 (24.2%)	13 (2.2%)	9 (2.0%)	56 (26.2%)	< 0.001
Subsequent referral, *n* (%)					
To ICU	293 (23.6%)	188 (32.3%)	72 (16.3%)	33 (15.4%)	< 0.001
ICU admission	86 (6.9%)	59 (10.1%)	25 (5.6%)	2 (0.9%)	< 0.001
Hospital referral source, *n* (%)					
Home	1021 (82.3%)	468 (80.3%)	413 (93.2%)	140 (65.4%)	< 0.001
Low-care nursing home	114 (9.2%)	66 (11.3%)	20 (4.5%)	28 (13.1%)	< 0.001
High-care nursing home	105 (8.5%)	49 (8.4%)	10 (2.3%)	46 (21.5%)	< 0.001
Comorbidity, *n* (%)					
Cancer	292 (23.6%)	141 (24.2%)	89 (20.1%)	62 (29.0%)	0.038
Metastatic cancer	94 (7.6%)	52 (8.9%)	17 (3.8%)	25 (11.7%)	< 0.001
Haematological malignancy	44 (3.6%)	21 (3.6%)	13 (2.9%)	10 (4.7%)	0.507
Chemotherapy or radiotherapy	58 (4.7%)	29 (5.0%)	14 (3.2%)	15 (7.0%)	0.085
Dementia	223 (18.0%)	105 (18.0%)	49 (11.1%)	69 (32.2%)	< 0.001
Chronic obstructive pulmonary disease	227 (18.3%)	101 (17.3%)	86 (19.4%)	40 (18.7%)	0.679
Cirrhosis	6 (0.5%)	0	5 (1.1%)	1 (0.5%)	0.022
Heart failure	250 (20.2%)	112 (19.2%)	75 (16.9%)	63 (29.4%)	0.001
Diabetes mellitus, receiving insulin	56 (4.5%)	29 (5.0%)	16 (3.6%)	11 (5.1%)	0.516
Chronic kidney disease, receiving dialysis	27 (2.2%)	14 (2.4%)	5 (1.1%)	8 (3.7%)	0.076
Immunosuppression	50 (4.0%)	29 (5.0%)	14 (3.2%)	7 (3.3%)	0.311

ICU = intensive care unit. NR = not recorded. * See online Appendix, Table 1. † Interhospital transfer patients considered too well or too sick were not recorded. ‡ Patients with no treatment limitations before initial ICU review. § Patients with treatment limitations before referral, which were modified by ICU staff during initial review.

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 ($P \leq 0.001$).

Table 3. Multivariate analysis of factors associated with mortality*

Factor	Hospital mortality			12-month mortality		
	Odds ratio	95% CI	*P*	Odds ratio	95% CI	*P*
Too well	0.33	0.20–0.55	< 0.001	0.66	0.45–0.97	< 0.001
Too sick	2.78	1.52–5.06	< 0.001	2.95	1.62–5.38	< 0.001
High-care nursing home	0.40	0.21–0.76	0.02	1.35	0.75–2.41	0.15
ICU-initiated treatment limitations	0.45	0.26–0.78	0.004	0.80	0.47–1.35	0.40
Treatment limitations after discharge from ICU or outreach	17.40	10.70–28.30	< 0.001	7.60	5.10–11.20	< 0.001
Subsequent referral	4.14	2.62–6.55	< 0.001	1.64	1.13–2.40	0.001
Cancer	0.90	0.54–1.49	0.68	1.62	1.06–2.48	0.025
Metastatic cancer	1.13	0.53–2.39	0.75	2.04	1.06–3.93	0.03
Chemotherapy or radiotherapy	2.59	1.07–6.26	0.036	1.80	0.84–3.85	0.13
Dementia	0.50	0.31–0.80	0.003	0.86	0.57–1.30	0.48
Chronic obstructive pulmonary disease	0.59	0.38–0.91	0.015	0.58	0.41–0.84	0.003
Heart failure	1.03	0.70–1.53	0.88	1.52	1.07–2.15	0.019
Chronic kidney disease, receiving dialysis	0.63	0.17–2.31	0.48	4.46	1.60–12.46	0.003
Modified Early Warning Score	1.11	1.05–1.18	< 0.001	1.07	1.02–1.13	0.006
Time from admission to ICU referral	1.07	1.04–1.09	< 0.001	1.01	0.99–1.02	0.30

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

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.

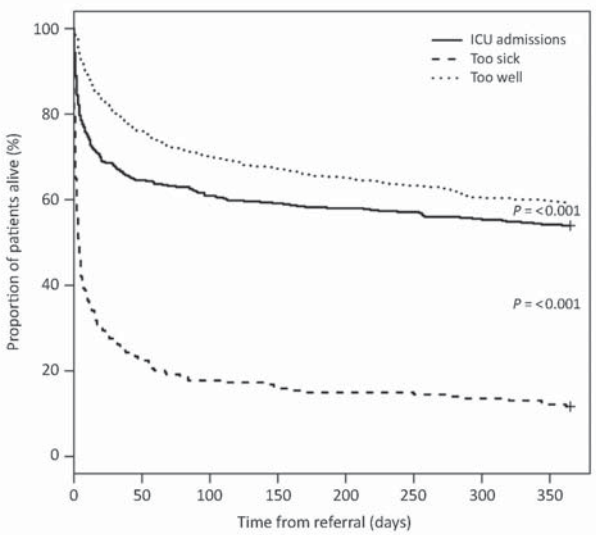
Discussion

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.

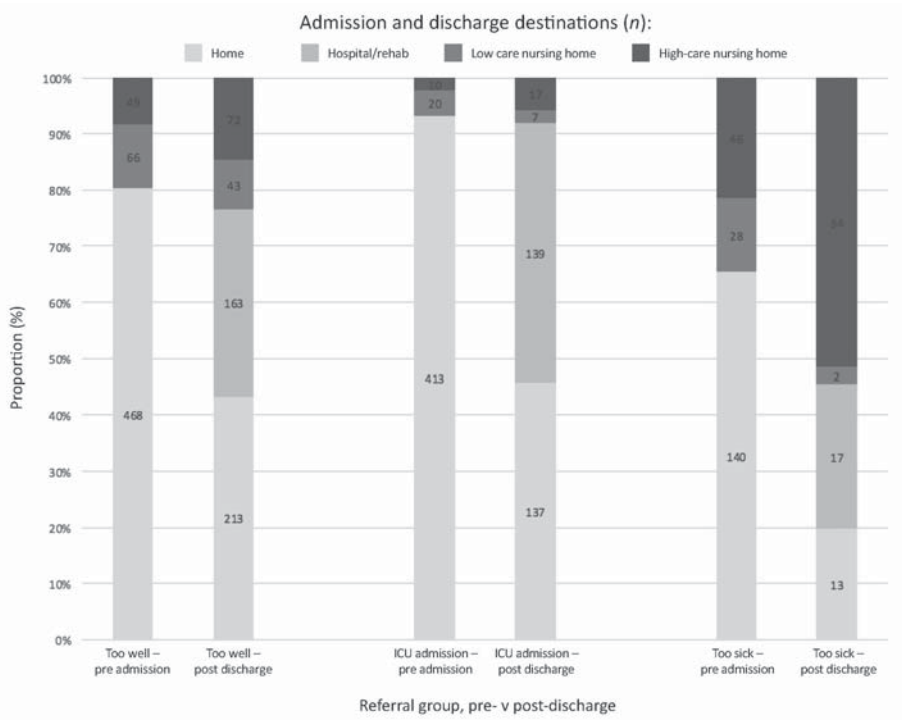
Figure 2. Kaplan–Meier curve showing the proportion of patients alive 12 months after ICU referral



ICU = intensive care unit.

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.

Figure 3. Comparison of residence of survivors before admission and after discharge, by referral group



ICU = intensive care unit.

This highlights the requirement for discussions before acute deterioration to provide information on long-term outcomes and achieve true informed consent.

All variables associated with being considered too well for ICU admission were also associated with being too sick. This suggests that factors including being older, being referred from the ward, living in a nursing home or having metastatic cancer resulted in dichotomy to the too-well or too-sick groups. This is consistent with a degree of distributive justice being applied. High-care nursing home patients had low hospital mortality, although represented only 8.5% of referrals. This is consistent with selection bias from patients, families and ward teams before ICU involvement.

Dementia was associated with hospital survival, reflecting the selection of patients with otherwise good health. Chronic obstructive pulmonary disease predicted hospital and 12-month survival. We suspect a low referral threshold, based on abnormal vital signs and blood gas abnormalities, and high survival after short-term ventilation. Being treated with chemotherapy or radiotherapy was an independent predictor of hospital mortality. As expected, cancer and metastatic cancer were predictors of 12-month mortality.

We used the MEWS to compare the degree of physiological derangement at first review. However, the MEWS was not designed to assess patients receiving organ 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,[7,11] 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.[7] 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.[1,3]

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.[1,2,12] The ICU mortality was lower than previously reported, despite a higher intubation rate.[12] This is consistent with the observation that treatment intensity and ICU survival rates are increasing in very old patients.[13,14] The ANZICS database[1] 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[8] 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[15,16] and the predicted mortality rate based on the reported Simplified Acute Physiology Score II.[17] 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.[2,8,15-19]

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.[9]

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.

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Competing interests

None declared.

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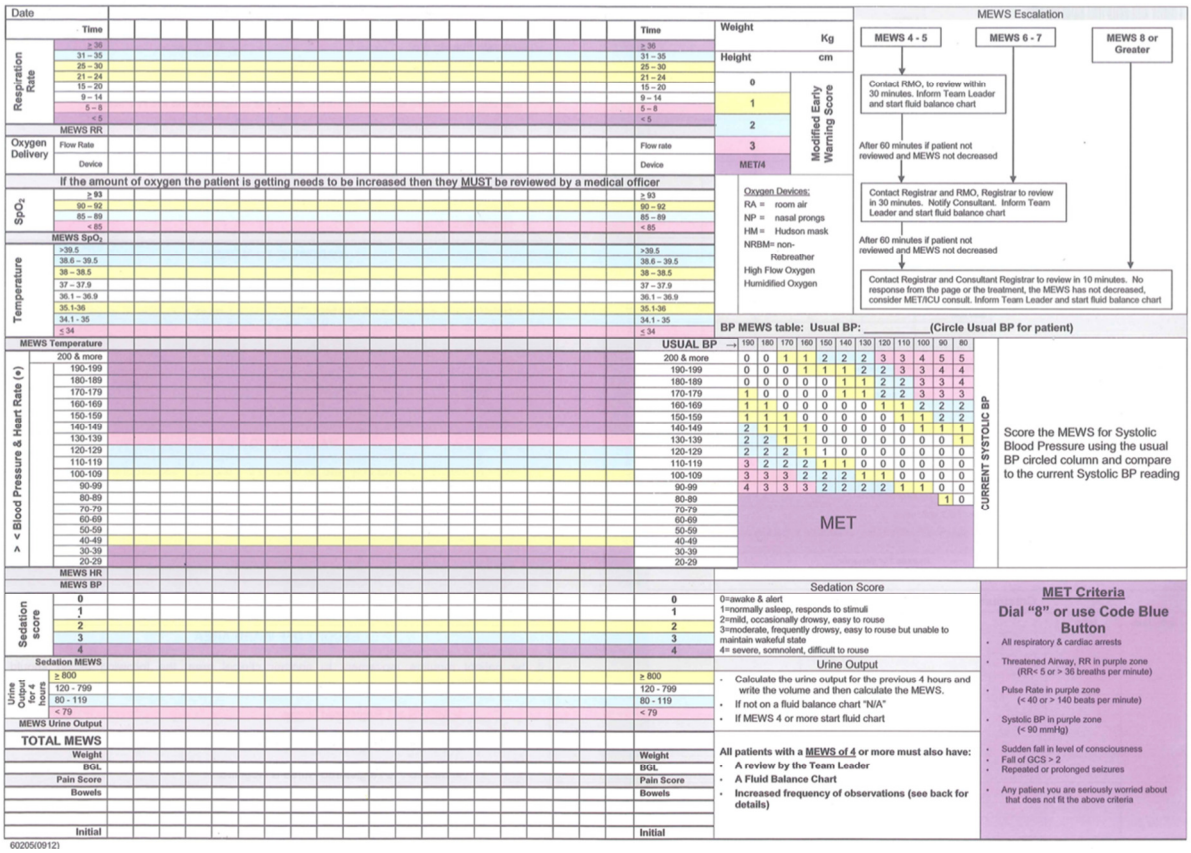
Appendix

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

Too Well				Not Appropriate			
Factor	**Odds Ratio**	**95% CI**	***p***	**Factor**	**Odds Ratio**	**95% CI**	***p***
Age (years)	1.11	1.06-1.16	<0.001	Age (years)	1.12	1.05-1.18	<0.001
Ward referral	6.64	4.62-9.54	<0.001	Ward referral	8.47	4.81-14.91	<0.001
Low care nursing home	3.01	1.61-5.61	<0.001	Treatment limitations	7.07	4.19-11.93	<0.001
High care nursing home	4.94	2.26-10.82	<0.001	ICU initiated treatment limitations	13.87	8.04-23.93	<0.001
Metastatic cancer	2.98	1.56-5.67	0.01	Low care nursing home	2.59	1.19-5.62	0.02
				High care nursing home	8.6	3.66-20.2	<0.001
				Metastatic cancer	5.16	2.26-11.75	0.01
				Heart failure	1.72	1.01-2.91	0.02
				Chronic kidney disease on dialysis	5.17	1.26-21.2	0.03