

Impact of an ageing population on the intensive care unit

Dear Editor,

Intensive care unit (ICU) resources are scarce and expensive, and deciding if intensive care is suitable for older patients involves complex clinical reasoning, ethical challenges and cost considerations. Although some studies show that ICU mortality increases with age, others suggest that age alone is not predictive of poor prognosis, and other factors such as frailty, premorbid functional status and comorbidities could be important.¹⁻⁴

Prior studies on this topic in Singapore are from the late 1990s to early 2000s, and most did not distinguish between the elderly and the very elderly population.^{5,6} There is also a paucity of data on the long-term outcomes of older ICU survivors.^{5,7}

We conducted a retrospective cohort study of medical ICU patients admitted to Tan Tock Seng Hospital between July 2015 and October 2016. Patients were divided into 3 groups: young (<65 years), elderly (65–79 years) and very elderly (≥80 years). The primary outcome measured was hospital mortality. Secondary outcomes measured were ICU mortality, ICU and hospital length of stay, functional status at hospital discharge and 1-year mortality after hospital discharge. We also evaluated factors affecting triage decision-making among the aged. Ethics approval was obtained from the National Healthcare Group Domain Specific Review Board (Reference number 2019/01028).

Differences between age groups were compared using Kruskal-Wallis H test for continuous variables, and Pearson chi-square test or Fisher's Exact test for categorical variables. Multivariable-modified Poisson regression was used to identify factors associated with hospital mortality and 1-year mortality after hospital discharge among the elderly and the very elderly.

Of 874 patients, 361 (41.3%) were young, 360 (41.2%) were elderly and 153 (17.5%) were very elderly. The baseline characteristics of elderly and very elderly differed from the young. The 2 former groups had more comorbidities, poorer premorbid functional status, and were more likely to be admitted for sepsis-related diagnoses. They also had fewer direct ICU admissions from the emergency department, though this did not confer increased hospital mortality in multivariable analysis. Importantly, there was

no difference in the ICU treatment between groups. In fact, there were more elderly and very elderly who received vasopressor/inotropic support (Supplementary Table S1).

In terms of outcomes, hospital mortality increased significantly with age: 34.1% in young, 43.9% in elderly and 55.6% in very elderly patients. ICU mortality also showed an increasing trend with age but did not reach statistical significance: 28.5%, 30.0% and 38.6%, respectively. Similar trends were seen in 1-year mortality after hospital discharge: 16.9%, 22.9% and 28.4%, respectively. There was no difference in median ICU length of stay, but hospital length of stay was longer in elderly (18 days) and very elderly (19 days) compared to young (11 days) patients. Elderly and very elderly also had worse functional status at discharge. There was no difference in the discharge destination among hospital survivors (Supplementary Table S1).

A notable finding in our study was that the elderly and very elderly had significantly higher hospital mortality, despite having similar disease severity as the young. Disease severity was measured by Acute Physiology and Chronic Health Evaluation II modified to exclude age (APACHE IIM) score and Sequential Organ Failure Assessment score. Possible reason for this discrepancy is the non-inclusion of additional risk factors known to influence mortality in the aged, such as functional deficits, delirium, frailty and other geriatric syndromes.^{1,3,8,9} Another limitation of these models is that they are derived exclusively from data obtained from the first 24 hours of ICU admission and do not account for complications that develop subsequently.⁴

As we increasingly recognise the substantial interindividual differences in the ageing process, we begin to understand the poor prognostic discrimination of current models for older patients and the urgent need for further research in this area. A recent publication utilised cluster analysis to identify phenotypes within the geriatric ICU cohort.¹⁰ Unlike prior studies that homogeneously grouped ages ≥65, or included only ages ≥80 or ≥90 years to represent aged ICU population, thus losing depth and breadth in the process, we chose to analyse subgroups of elderly and very elderly separately to determine their prognostic factors. We found that the short-term (hospital mortality) and long-term outcomes (1-year mortality after hospital discharge) were affected by different factors.

For hospital mortality, a higher APACHE IIM score and need for vasopressor/inotropic support were independent predictors of hospital mortality, in both the elderly and the very elderly (Table 1), consistent with previous publications.^{1,2,4-6} We also postulate that the seemingly protective effect of chronic lung disease in the elderly may be a result of a highly selected ICU population, as

Table 1. Multivariable regression analysis for factors associated with hospital mortality and 1-year mortality after hospital discharge among elderly (65–79 years) and very elderly (≥80 years) patients.

Factors associated with hospital mortality						
	Elderly (65–79 years)			Very elderly (≥80 years)		
	Adjusted RR	95% CI	P value	Adjusted RR	95% CI	P value
Age (continuous)	1.022	0.997–1.048	0.082	0.994	0.953–1.036	0.766
Sex						
Female	Ref	Ref	Ref	Ref	Ref	Ref
Male	0.982	0.793–1.217	0.872	0.916	0.704–1.192	0.514
Race						
Chinese	Ref	Ref	Ref	Ref	Ref	Ref
Non-Chinese	0.855	0.669–1.093	0.211	0.893	0.632–1.261	0.520
Comorbidities						
Atrial fibrillation	1.401	1.108–1.772	0.005	1.010	0.734–1.391	0.951
Chronic lung disease	0.579	0.385–0.869	0.008	0.780	0.552–1.102	0.159
APACHE IIM score	1.018	1.002–1.033	0.023	1.036	1.041–1.058	0.001
Vasopressor/inotropic support	4.025	2.465–6.575	<0.001	1.966	1.115–3.467	0.019
Factors associated with 1-year mortality after hospital discharge						
	Elderly (65–79 years)			Very elderly (≥80 years)		
	Adjusted RR	95% CI	P value	Adjusted RR	95% CI	P value
Age (continuous)	1.027	0.961–1.097	0.438	1.056	0.938–1.188	0.367
Sex						
Female	Ref	Ref	Ref	Ref	Ref	Ref
Male	2.793	1.205–6.594	0.017	1.906	0.786–4.622	0.154
Race						
Chinese	Ref	Ref	Ref	Ref	Ref	Ref
Non-Chinese	1.027	0.627–1.683	0.847	1.224	0.548–2.732	0.622
BMI category, kg/m ²						
Normal (18.5–22.9)	Ref	Ref	Ref	Ref	Ref	Ref
Underweight (<18.5)	0.554	0.207–1.480	0.239	7.681	3.146–18.750	<0.001
Overweight (23.0–27.4)	0.328	0.132–0.817	0.017	1.768	0.635–4.922	0.275
Obese (≥27.5)	1.341	0.541–3.321	0.526	0.598	0.157–2.277	0.451
Charlson comorbidity index	1.119	1.010–1.240	0.031	1.415	1.209–1.656	<0.001
Ambulatory status at hospital discharge						
Independent	Ref	Ref	Ref	NA	NA	NA
Assisted	1.893	0.934–3.837	0.077	NA	NA	NA
Chair or bedbound	3.229	1.614–6.659	0.001	NA	NA	NA

APACHE IIM: Acute Physiology and Chronic Health Evaluation II modified to exclude age; BMI: body mass index; CI: confidence interval; ICU: intensive care unit; NA: not applicable; RR: relative risk; Ref: reference. Bold values are significant at $P < 0.05$. Ambulatory status at hospital discharge could not be determined for the very elderly as there were no patients in the reference group (i.e. independent).

patients with advanced lung conditions had early end-of-life discussion and were managed in the general ward.

As for 1-year mortality after hospital discharge, body mass index (BMI) and Charlson comorbidity index were found to be independent predictors (Table 1). In the very elderly, low BMI (underweight) conferred higher mortality, whereas in the elderly, high BMI (overweight) conferred lower mortality. Whether there was truly a difference with BMI by age group is uncertain, as our multivariable models were developed separately for each age group and the patient population was small. BMI is a surrogate of nutritional status and may correlate with the degree of sarcopaenia—both are risk factors for mortality in the aged. Additionally, we found that being chair/bedbound at hospital discharge was independently associated with 1-year mortality. This highlights the importance of addressing physical dependency as another potentially modifiable risk factor.

Our study had several limitations. First, it was a single-centre study involving medical ICU, and results may not be generalisable. Second, it was a retrospective study, and data on baseline cognition, frailty, functional status scores and decision to withhold or withdraw life-sustaining treatment in the ICU were not available. Last, we did not evaluate other long-term outcome measures as described in post-intensive care syndrome.

In conclusion, the ageing population represents an emerging challenge for the healthcare system. The result of this study is a crucial first step in raising awareness on the short- and long-term outcomes and prognostic factors (especially treatable traits) in aged ICU patients. Ultimately, the goal is to create true ICU survivors, and not victims.

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