New Zealand's staffed ICU bed capacity and COVID-19 surge capacity

Paul J Young, Alex Psirides, Stephen Streat

Coronavirus disease 2019 (COVID-19) has placed unprecedented demand on healthcare around the world. In 2020, COVID-19 case numbers in many countries required intensive care units (ICUs) to adapt to treat critically ill patients when demand for beds exceeded staffed capacity.[1,2] New Zealand has one of the lowest levels of ICU beds per capita in the OECD at 4 per 100,000 population.[3] This compares to Australia at 9, France at 16, and Germany at 34.[3] In 2018, in New Zealand, 17% of elective surgical operations for which post-operative admission to an ICU was planned were postponed due to the lack of an available ICU bed, compared with 1.7% in Australia.[4] As surges of COVID-19 ICU admissions that exceed capacity are associated with high mortality rates,[1,2] New Zealand's comparatively low ICU capacity is a potential point of vulnerability in our COVID-19 response.

New Zealand's elimination strategy resulted in comparatively small numbers of COVID-19 patients being admitted to ICUs in 2020[5] but has not contained a delta outbreak which began in August 2021. This outbreak is leading to rising case numbers despite severe restrictions and an active vaccination programme. Some Australian jurisdictions experienced similar issues. Australian ICU capacity and capability to accommodate surges in COVID-19 case numbers was recently evaluated and reported,[6] but comparable measures for New Zealand have not been reported. Accordingly, we surveyed senior ICU staff from New Zealand's public hospitals to assess the number of current staffed ICU beds and capacity to staff "surge" ICU capacity (a potentially rapid increase in critical care resources to match exceptional demand). We used the same survey used to evaluate Australian ICU capacity in March 2020[7] and August 2021.[6] In brief, we asked about ICU bed numbers, staffing, surge capacity, and availability of equipment. "Staffed" ICU capacity indicated equipped ICU beds fully staffed with specialised ICU nurses (with a nurse-to-patient ratio of 1:1), whereas "additional physical ICU beds" indicated equipped bed spaces that were not staffed.

We obtained responses relating to all New Zealand public hospitals. Respondents indicated there were 176 staffed ICU beds in 25 ICUs in 24 public hospitals of which 15 were dedicated paediatric ICU beds. An additional 104 physical beds within ICUs that were not staffed were identified. A total of 49 non-negative-pressure and 68 negative-pressure *single* rooms in ICUs were identified nationally with the remaining ICU beds in shared spaces. Areas with high air exchange or negative pressure that could be used to care for critically ill COVID-19 patients exclusively were identified in 64% of hospitals. The total number of ICU beds in such areas nationally was 132. Outside of ICUs, 289 beds that might be used to care for critically ill patients within "surge areas" were identified. Accordingly, a total of 565 beds that, if staffed, could be used to care for critically ill patients were identified nationwide. Respondents indicated a total of 535 ventilators available in their respective hospitals (excluding anaesthetic machines).

Stated numbers of staff available for such surge capacity for a period of one month varied considerably by ICU. A total of 130.6 (range, 0 to 20), 99 (range, 0 to 20), and 356 (range, 0 to 115) full time equivalent (FTE) specialists, junior doctors, and nurses respectively were identified as being able to contribute to surge capacity. Of the 356 FTE nurses, 100 were identified as being able to provide high-dependency care only.

Our data suggest that, when this survey was completed between 15 October and 1 November 2021, New Zealand's staffed ICU bed capacity was approximately 3.5 staffed ICU beds per 100,000 population.[8] In comparison, the most recent Australian survey identified staffed ICU bed numbers varied by state, from 6 to 10.8 per 100,000 population[6]. In Australia, the most recent ICU survey identified 1882.7 FTE ICU nurses (~73/million population[9]) available to staff surge capacity.[6] We identified 356 FTE of nurses (~70/million population[8]) available to staff surge capacity. Based on a pre-pandemic staffing ratio of 5.3 FTE of nurses to staff one ICU bed 24 hours a day, 365 days a year, this would be sufficient to open 67 surge beds. When this surge capacity is added to baseline staffed ICU capacity, the reported maximum total number of ICU beds in New Zealand that could be staffed for a surge before nurse-to-patient ratios would need to be reduced is 243.

These responses from senior clinicians in all New Zealand public hospitals reflect the current real-world capacity and surge capability readily available to them, and allow direct comparison with Australian data obtained using the same methodology.[6] It is possible that respondents were not aware of all non-ICU nursing staff who might potentially contribute to the surge workforce. However, because we used the highest number when a range of potential staff numbers was provided by a respondent, our numbers may overestimate available staffing. We did not account for ventilators that were held in national stores rather than in hospitals and did not consider capacity available in private hospitals.

Despite these issues, our data suggest that New Zealand's public hospital ICU capacity is substantially lower than Australia's on a per capita basis and that our surge capacity is likely to be limited by available nursing staff.

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Author information:
Paul J Young: Co-Clinical Leader, Intensive Care Unit, Wellington Hospital, Wellington; Deputy Director, Medical Research Institute of New Zealand, Wellington; Adjunct Professor (Research), Australian and New Zealand Intensive Care Research Centre, Monash University, Melbourne, Australia; Clinical Assoc Prof, Department of Critical Care, University of Melbourne, Melbourne, Australia.
Alex Psirides: Co-Clinical Leader, Intensive Care Unit, Wellington Hospital, Wellington.
Stephen Streat: Retired Intensivist.
Corresponding author:
Paul J Young
paul.young@ccdhb.org.nz
URL:
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