Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

Elsevier hereby grants permission to make all its COVID-19-related research that is available on the COVID-19 resource centre - including this research content - immediately available in PubMed Central and other publicly funded repositories, such as the WHO COVID database with rights for unrestricted research re-use and analyses in any form or by any means with acknowledgement of the original source. These permissions are granted for free by Elsevier for as long as the COVID-19 resource centre remains active.
Allied health surge capacity in Australian intensive care units during the COVID-19 pandemic: A cross-sectional survey

Melanie Paykel, DPT a, Emma Ridley, PhD b, Amy Freeman-Sanderson, PhD c, d, e, f, Mahesh Ramanan, MMEd g, h, i, Sarah Booth, MPH i, Katrina Cook, BN j, k, Kelvin Ip, DPT a, Mary De Gori, MBL a, Julia Blackshaw, BSC, BSW; GradDipBus. a, Donna Markham, BOccTher, GAI CD l, Sharon Downie, MPH l, m, 1, Kimberley Haines, PhD a, m, *

a Western Health, Australia; b ANZIC RC, Department of Epidemiology and Preventive Medicine, Monash University, Australia; c University of Technology Sydney, Australia; d Royal Prince Alfred Hospital Sydney, Australia; e Critical Care Division, The George Institute for Global Health, Australia; f Affiliate, Australian and New Zealand Intensive Care Research Centre (ANZIC-RC), School of Public Health and Preventive Medicine, Monash University, Australia; g Queensland Health, Australia; h The George Institute, UNSW, Australia; i School of Medicine, The University of Queensland, Australia; j Caboolture Hospital, Australia; k Metro North Hospital & Health Service, Australia; l Safer Care Victoria, Australia; m The University of Melbourne, Australia

1 Current address: Royal Children’s Hospital.

© 2022 Australian College of Critical Care Nurses Ltd. Published by Elsevier Ltd. All rights reserved.

10.1016/j.aucc.2022.09.001

1. Introduction

The COVID-19 pandemic continues to have an unprecedented impact on public health globally, with over 472 million cases and six million deaths and 5–16% of patients requiring an intensive care unit (ICU) admission.1–4 Within Australia, the evolution of the pandemic initially differed to international experiences. During the
initial COVID-19 wave in April 2020, the number of cases and hospital admissions was lower than anticipated. However, in the second wave (June to September 2020), case numbers significantly increased, with a greater strain on health services, although this was largely contained to Victoria. This pattern of COVID-19 cases in Australia provided policymakers with additional time at the beginning of the pandemic to plan a coordinated national and state-based public health response, including a range of public health measures to reduce infection transmission.

Based on the international COVID-19 experience, it was anticipated that intensive care services in Australia would be placed under immense pressure to care for the sickest patients during the pandemic—within finite resources. Australian ICUs rapidly developed a coordinated and staged surge response to manage this increased bed demand and produced the Australia and New Zealand Intensive Care Society COVID-19 Guidelines. This increased service demand also required significant investment in critical care workforce planning and rapid upsckilling of alternate workforces to ensure adequate medical and nursing workforce capacity.

Surge capacity for medical and nursing staff was estimated at 325% and 365%, respectively, above baseline.3 Equipment and beds were estimated at 120% and 191%, respectively.7 Allied health, the third pillar of health care who typically work in Australian ICUs,3,6 lacked data to describe baseline or ‘usual’ staffing models. This made it impossible to estimate surge capacity for allied health staff in the ICU for the pandemic.7

Given that allied health clinicians are essential team members to care for the critically ill, both during and after the episode of critical illness, such data were necessary to inform allied health surge staffing models. In order to effectively address the healthcare requirements associated with a pandemic across all aspects of patient care, recovery and rehabilitation also need consideration.3,7 The purpose of this cross-sectional survey was to generate new knowledge regarding the ICU allied health workforce models under ‘usual’ conditions and their planned surge capacity for the COVID-19 pandemic in Australia. Such data can be used to inform future pandemic planning and resource allocation. Therefore, the aims of this study were to

1. Determine baseline allied health staffing levels in Australian adult ICUs prior to the COVID-19 emergence pandemic in Australia (6 months prior to 1 March 2020)
2. Describe the allied health pandemic planning and surge response to COVID-19 in Australian ICUs during the early waves of the pandemic (1 March 2020–1 March 2021).

2. Methods

The Checklist for Reporting Results of Internet E-Surveys (Appendix 1) was used to report this study.5

2.1. Study design

We used a cross-sectional, investigator-devised, prospective survey to collect data and designed the survey using established recommendations.2

2.2. Ethical approval and informed consent process

The project was conducted in compliance with all stipulations of the designed protocol and ethical approval under the conditions of Western Health Low Risk Ethics Panel (QA2020.105.71833). Potential participants were provided with an email link to the survey and information sheet, including the estimated time for completion (Appendix 2). On receiving and clicking the link, the participants were directed to information about the study, and in proceeding, informed consent was implied, with no added incentive. Once participants provided their responses and completed the survey, they were unable to withdraw as there was no way of tracking their response, as responses were nonidentifiable. The collected data were only used for the purposes of this study.

Qualtrics, an online survey tool, was used to create and administer the 21-question survey (Appendix 3) and manage the data. The Qualtrics survey link was disseminated via email only for this study.

2.3. Confidentiality and security

This survey was anonymous, with no individually identifiable data collected. All aspects of data handling and storage were in accordance with approved ethical requirements.

2.4. Development and pretesting

The investigator team was representative of the diverse ICU interprofessional team and comprised of allied health, medicine, and nursing clinician-researchers. A bespoke survey was purposely created, as there were no other suitable pre-existing surveys fit for purpose. We piloted this draft survey with a small group of allied health clinicians, incorporated their feedback, and ascertained time for completion. The survey was sent to 14 allied health clinicians for piloting, with a total of four responses received. After pilot testing, the estimated time for completion was approximately 10 min. The majority of questions were multiple choice, for ease of completion, with space to further expand responses as relevant (Appendix 3).

2.5. Recruitment process and description of the sample having access to the questionnaire

A nonprobability sampling design was used as we could not estimate the chance of a given individual being included in the sample. This sampling approach can be used to study groups that may be challenging to identify—which is applicable to Australian allied health ICU clinicians. We established a list of the 157 adult ICUs in Australia. However, of the 157 adult ICUs (public and private), we did not know if allied health staff members were present in all ICUs, and if so, which disciplines.

We used convenience sampling where the survey was distributed via the Australian Government Department of Health Chief Allied Health Officers—an established national network and communication hierarchy that provides access to allied health directors in each state. The chief allied health officers were asked to distribute an explanatory email (Appendix 4) to allied health discipline directors (with the PI carbon copied). The allied health directors were asked to forward the survey (Appendix 5) and participant information form (Appendix 2) to each of the most senior ICU allied health clinician for each discipline at their hospital.

To help determine the sample frame, we asked the allied health directors to reply to the initial email with a simple check-box response (Appendix 6).

2.6. Survey administration

The survey was open and available for a 3-month time period (13 July 2021 to 13 October 2021). This duration of data collection allowed time for the survey to circulate and the participants to respond. A reminder email was sent to the national chief allied health officers, at the halfway mark (Appendix 7), requesting them to send a prompt email with the survey link, to assist with response rate.
For the purpose of this study, allied health professionals were those not considered part of the medical, dental, or nursing professions and who typically present Australian ICUs, based on prior literature.\textsuperscript{10–12} To our knowledge, this included physiotherapy, speech pathology, dietetics, social work, pharmacy, and occupational therapy.

Allied health members from sciences who receive the invitation and wished to participate in this identified as “other”.

Non-ICU allied health clinicians and those who were not involved in pandemic planning were excluded from the study.

2.7. Preventing multiple entries from the same individual

Following hand-checking of the data, no set of responses appeared the same. It is understood that no participant completed the survey twice. No techniques to analyse the log file for identification of multiple entries were used.

2.8. Data analysis

Descriptive statistics were used to report demographic and survey data with continuous variables reported as medians (inter-quartile ranges), and categorical variables reported as proportions (%), using IBM SPSS Statistics for Windows, version 22 (IBM Corp: Armonk, NY). Normally distributed data are presented as mean (standard deviation [SD]). Content analysis was used to group responses according to key themes. Sections of qualitative data were cross-referenced independently between the authors to ensure the interpretative rigour of analyses.

3. Results

A total of 40 responses were received via three allied health directors, from three states/territories (Australian Capital Territory [ACT], Northern Territory [NT], and South Australia [SA]) responding directly to the initial email request. However, the exact number of staff who received the survey across Australia and the associated participation rate are unknown. Overall, the results are reported collectively across allied health as a workforce, rather than single-discipline responses.

### Table 1

Demographics.

| Variable          | n 40 (%) |
|-------------------|----------|
| **Discipline**    |          |
| Physiotherapy     | 12 (30)  |
| Occupational therapy | 8 (20)  |
| Dietetics         | 7 (17.5) |
| Speech pathology  | 5 (12.5) |
| Social work       | 4 (10)   |
| Pharmacy          | 3 (7.5)  |
| Other (spiritual care) | 1 (2.5) |
| **State**         |          |
| NSW               | 24 (60)  |
| ACT               | 6 (15)   |
| SA                | 5 (12.5) |
| NT                | 3 (7.5)  |
| WA                | 2 (5)    |
| **Region**        |          |
| Metropolitan      | 17 (42.5)|
| Metropolitan/tertiary | 12 (30) |
| Tertiary          | 6 (15)   |
| Rural/regional    | 3 (7.5)  |
| Rural/regional/tertiary | 2 (5)  |

ACT, Australian Capital Territory; NSW, New South Wales; NT, Northern Territory; SA, South Australia; WA, Western Australia.

3.1. Participant demographics

Of the respondents, the survey reached 10 different allied health professionals including physiotherapy, occupational therapy, speech pathology, dietetics, social work, pharmacy, prosthetics and orthotics, exercise physiologist, spiritual care, and aboriginal liaison services.

Staff from metropolitan (17; 42.5%) or tertiary/metropolitan (12; 30%) hospitals most frequently responded to the survey, with physiotherapists (12; 30%) and occupational therapists (8; 20%) being the most frequent of the disciplines to respond. There were five (12.5%) respondents from rural or regional Australia. The majority of respondents were from New South Wales 24 (60%), and a smaller proportion of respondents were from other states—ACT (6; 15%), SA (5; 12.5%), NT (3; 7.5%), and Western Australia (WA) (2; 5%) (Table 1).

3.2. Baseline allied health staffing levels in Australian adult ICUs prior to the COVID-19

Prior to the COVID-19 pandemic, 75.6% of allied health had a mean (SD) of 1.74 (1.78) full-time equivalent (FTE) staff members designated to the ICU, with a mean of 21.53 (11.4) ventilator bed capacity. A total of 22% of respondents serviced their ICU on a referral-only basis (Table 2).

3.3. Allied health pandemic planning and surge response to COVID-19 in Australian ICUs: Surge planning and decision-making

In preparation for COVID-19, overall, respondents reported they planned to provide a mean (SD) of 2.2 (2.6) FTE (was planned to service an average of 30 planned ICU surge beds [ranging from 3 to 76 planned beds]). The largest response to this question was from physiotherapists (12; 30%) who reported their mean baseline FTE at 2.83 (2.18), with a planned increase of staff FTE up to 6.8 (5.58) for a mean 46 (39.96) ICU bed increase throughout the pandemic. Inconsistent data are gathered from the other disciplines (28), with some respondents unsure of these data (Table 3).

Decision-making regarding discipline surge planning was predominantly based on discussion with the ICU, allied health division, and/or respective discipline departments. Available funding to increase services to the ICU was the main limiting factor reported. Across the respondents, an average of 7.5 additional FTE was made available for redeployment (Table 2).

3.4. Staffing considerations

The majority (58%) of planned staff members to work in the ICU during surge were from their internal hospital staff pool. However, it was acknowledged by respondents that further ICU upskilling would be required for this workforce. The majority of respondents (78%) did not consider external workforce to help supplement ICU staff. However, a smaller proportion of respondents (20%) considered other external staffing options such as ex-employees or locum staff pools. Two percent of respondents did not provide a response.

With regard to training, face-to-face and/or simulated training or on-the-job training were the most common modes of upskilling staff, supplemented by self-directed learning.

3.5. Surge planning implementation

During the peak of the pandemic in the study reporting period, an average of 3.68 FTE was utilised, with 42% of respondents not requiring additional staffing FTE to meet service demand.

During COVID-19, there were many changes to the usual model of care, including ward-/ICU-based care, restriction into the ICU,
FTE, full-time equivalent; ICU, intensive care unit.

With regards to equipment to fulfill their clinical duties, 65% of participants felt this was adequate, whilst 35% did not. Lack of equipment was described as inadequate access to technological equipment such as computers, headsets, and iPads.

3.6. Infection control and staff well-being

Implementation of various measures to reduce COVID-19 transmission amongst team members was reported; the measures included self-declaration and screening of infection status, use of personal protective environment, and split teams in different office spaces. The majority of participants (78%) reported feeling somewhat to very safe working in the ICU during COVID-19, as measured on a four-point scale.

Despite implemented strategies, few (12.5%) staff members were furloughed and mostly impacting fewer than five staff members and only one outbreak that impacted more than 10 staff members.

There were both formal and informal strategies to support well-being, including formal staff or peer support programs and informal team Zoom meetings.

4. Discussion

4.1. Key findings

In this national survey of allied health clinicians, we found that surge planning was mostly based upon discussion within the ICU, allied health department, and/or respective disciplines with available funding acting as the main limiting factor for availability of resources and implementation. Whilst we noted a coordinated approach for surge planning amongst medical and nursing workforces, the approach to allied health staffing and associated decision-making appeared to be ad hoc at a local level. Internal redeployed allied health staff members were critical to supplement this workforce. The impact of redeployment on these staff members is an area that warrants further exploration given emerging data that psychosocial outcomes can be worse for these staff members, and well-being and training strategies may need to be employed to ensure ongoing flexibility of this workforce for any future surges. Internal staff members undertook ICU upskilling via on-the-job, simulation-based training and self-directed learning in order for disciplines to meet the proposed surge demand, noting limitations in having a readily available ICU workforce. The majority of staff felt ‘somewhat’ to ‘very safe’ working in ICU during the COVID-19 pandemic.

4.2. Comparison with studies

It was estimated that Australian ICUs could nearly triple intensive care bed capacity in response to predicted increased demand associated with COVID-19 in March 2020. It was highlighted that maximal surge could result in ICU equipment shortage and would require a large increase in workforce, with these estimates derived from existing registries. However, similar data and estimates of allied health surge capacity were unavailable for pandemic workforce planning as the Australian and New Zealand Intensive Care Society (ANZICS) Critical Care Resources registry holds limited data regarding baseline allied health staffing in the ICU.

Pre-existing data in the study by Litton et al were supplemented by a survey of ICU surge capacity distributed to each ICU in Australia via the ANZICS registries mailing list, ICU directors, or, when unavailable, the nurse unit manager. No allied health surge capacity...
could be estimated in the absence of these questions from the supplementary survey. Similarly, to our survey, this study was developed with feedback by other ICU clinicians and contained questions on the incremental capacity to increase ICU beds, equipment, and workforce.

To the best of our knowledge, this is the one of the first studies to attempt to capture baseline data and pandemic surge plans for allied health in Australian ICUs. This is important to help inform future surge planning and health policy—to ensure that patients admitted to ICUs have access to allied health therapies to support their acute care needs and recovery post ICU discharge.

Our survey also explored staffing considerations, surge planning and implementation, infection control, and well-being, aligning with ANZICS recommendations for workforce and staffing in the COVID-19 pandemic.15

4.3. Study strengths and limitations

The study design was rigorous based upon the Checklist for Reporting Results of Internet E-Surveys and with input from national allied health disciplines, including physiotherapy, speech pathology, and dietetics, nursing, and medical. Due to limited resources available to disseminate the survey, communication via the National Chief Allied Health Officers was the chosen means of dissemination and recruitment. Despite this targeted approach, the survey response rate was low. The timing of survey administration was during the Delta COVID-19 wave when health services in some states were under extreme pressure. This resulted in a lack of feedback regarding the success of the survey administration and distribution from allied health directors, and therefore, we are unable to report on this.

Although the study was designed to be low burden for participants, the timing of survey distribution aligned with the COVID-19 Delta surge, particularly in New South Wales and Victoria in 2021, likely limiting survey uptake. While our response rate was low, this demonstrates the ongoing need for a coordinated approach to understanding allied health staffing in Australian ICUs and establishment of research infrastructure to better routinely capture data. Our study demonstrated the challenges associated with capturing and ICU allied health professionals in Australia, which may have been magnified during the pandemic. One of the challenges in reaching ICU allied health professionals is that allied health professionals are often employed separate to the ICU with no recommended standardised FTEs or therapist-to-patient ratios and therefore can be a hard-to-reach group. Allied health staffing related to the ICU is likely to be variable across Australia and subsequently is hard to quantify. An alternative recruitment strategy, to better capture national data, may have been promotion of the survey via professional societies such as ANZICS, social networks, and critical care special interest groups. Future work should be undertaken to integrate a coordinated approach to communicate with and capture ICU allied health data. For example, the ANZICS Point Prevalence Program via ANZICS CORE could be an ideal existing infrastructure to help begin this coordinated effort to reach allied health.

4.4. Implications for clinicians, educators, and administrators

This study explores the impact of COVID-19 in the early “Alpha” phase, which had less impact on Australian healthcare systems than initially anticipated—likely as a result of successfully implemented public health measures to reduce disease burden. Following survey dissemination, Australia was faced with subsequent Delta and Omicron COVID-19 waves where surge plans were likely adapted and/or implemented. Research conducted during or following the Delta and Omicron COVID-19 waves may produce significantly different survey responses. The above suggestions are important to consider in order to better understand the impact on ICU allied health workforce at this time.

With the majority of staff relying on internal staff redeployment and ICU upskilling in the lead up to the surge response, allied health hospital teams should consider coordinated ICU training models in the future, especially in disciplines that predominantly rely on face-to-face interaction. Increased availability and access to technological devices (laptops, iPads, and headsets) should also be considered10,16 especially for disciplines that can work remotely from the ICU. Staff responses were based upon the responses from senior staff members and therefore may not highlight the perceptions of the allied health ICU team at all staffing levels.

The research highlights that there was limited ability for allied health staff to plan at a national level for a pandemic of this magnitude. Subsequently this was done at local health service levels. At the time of survey administration, pressure within the health system impacted the response rate. A key recommendation from this work is that there needs to be greater infrastructure established to facilitate operational planning. Further, such infrastructure would ensure a coordinated mechanism to conduct research to gather these important data in both ‘usual’ and pandemic conditions—similarly to that which is available for medical and nursing workforces.

A major implication of these findings is that the baseline rate of allied health staffing in ICUs remains unknown and the variability across allied health and within the specific disciplines is undetermined. Further research infrastructure to capture ICU allied health workforce data is urgently needed to guide future pandemic preparedness and decision-making.

5. Conclusions

In this study, we found that allied health staff members in Australian ICUs had planned to increase their baseline staffing in response to prepare for surge conditions; however, implementation of these plans was limited in early 2020. Interprofessional decision-making for surge planning was based upon discussion with the ICU team and guided by national guideline development. These findings are limited by the methodological design of survey-based research and a low response rate. Further studies are required to better understand how the allied health ICU team operates under usual conditions and the COVID-19 surge response that occurred later in 2020–2021.

Conflict of interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Funding

This work was not funded.

Credit authorship contribution statement

Melanie Paykel: Conceptualisation, Methodology, Software, Validation, Formal analysis, Investigation, Resources, Data curation, Writing original draft, Writing — review and editing, All visualisation, Project administration. Emma Ridley: Conceptualisation, Methodology, Software, Formal analysis, Writing original draft, All visualisation. Amy Freeman-Sanderson: Conceptualisation, Methodology, Software, Formal analysis, Writing original draft, All visualisation. Mahesh Ramanan: Conceptualisation, Methodology,
Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.aucc.2022.09.001.

References

[1] Grasselli G, Pesenti A, Cecconi M. Critical care utilization for the COVID-19 outbreak in Lombardy, Italy: early experience and forecast during an emergency response. JAMA 2020;323(16):1545—6.

[2] Guan WJ, Ni ZY, Hu Y, Liang WH, Ou CQ, He JX, et al. Clinical characteristics of coronavirus disease 2019 in China. N Engl J Med 2020;382(18):1708—20.

[3] Litton E, Bucci T, Chavan S, Ho YY, Holley A, Howard G, et al. Surge capacity of intensive care units in case of acute increase in demand caused by COVID-19 in Australia. Med J Aust 2020;212(10):463—7.

[4] Medicine JHU. Coronavirus resource center United States. 2022. https://coronavirus.jhu.edu/.

[5] Philip K. Allied health: untapped potential in the Australian health system. Aust Health Rev 2015;39(3):244—7.

[6] Berney S, Haines K, Denhe L. Physiotherapy in critical care in Australia. Cardiopulm Phys Ther J 2012;23(1):19—25.

[7] Ridley EJ, Freeman-Sanderson A, Haines KJ. Surge capacity for critical care specialised allied health professionals in Australia during COVID-19. Aust Crit Care 2021;34(2):191—3.

[8] Eysenbach G. Improving the quality of web surveys: the checklist for reporting results of internet E-surveys (CHERRIES). J Med Internet Res 2004;6(3):e34.

[9] Burns KE, Duffett M, Kho ME, Adhikari NK, Sinuff T, et al. A guide for the design and conduct of self-administered surveys of clinicians. CMAJ (Can Med Assoc J) 2008;179(3):245—52.

[10] Freeman-Sanderson ARE, Booth S, Haines K. Rehabilitation of the critically ill: the role of allied health professionals. ICU Manag Practice 2020;20(4).

[11] Grenvik A. Role of allied health professionals in critical care medicine. Crit Care Med 1974;2(1):6—10.

[12] Turnbull C, Grimmer-Somers K, Kumar S, May E, Law D, Ashworth E. Allied, scientific and complementary health professionals: a new model for Australian allied health. Aust Health Rev 2009;33(1):27—37.

[13] Marshall AP, Austin DE, Chamberlain D, Chapple LS, Cree M, Fetterplace K, et al. A critical care pandemic staffing framework in Australia. Aust Crit Care 2021;34(2):123—31.

[14] Thomas P, Baldwin C, Bissett B, Boden I, Gosselink R, Granger CL, et al. Physiotherapy management for COVID-19 in the acute hospital setting: clinical practice recommendations. J Physiother 2020;66(2):73—82.

[15] Australian and New Zealand Intensive Care Society. ANZICS COVID-19 guidelines. Melbourne: ANZICS; 2020 [ANZI_3367_Guidelines_V2.pdf (anzics.com.au)].