



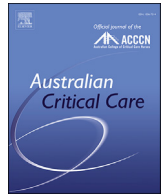
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Editorial

Beyond the ventilator: Rehabilitation for critically ill patients with coronavirus disease 2019



1. Editor preamble

In the last year, we have seen an extraordinary response from health professionals, scientists, healthcare organisations, and policymakers to extend our knowledge and understanding of coronavirus disease 2019 (COVID-19), which focus on prevention, treatment, and health service management. The sickest of these patients require admission to the intensive care unit (ICU), and there has been a proliferation of research and sharing of clinical experiences in this area.¹ *Australian Critical Care* has published a number of COVID-19-specific articles, and we are pleased to provide these in a central location (australiancriticalcare.com) as a virtual special issue. These articles cover important information about COVID-19 and focus on altered coagulation,² nutrition management,³ family presence,⁴ surge capacity for the allied health workforce,⁵ patient and family communication,⁶ and pandemic workforce planning.⁷

The following guest editorial highlights yet another important consideration that extends our focus beyond care in the ICU to highlight important considerations during longer term recovery from critical illness.

2. Clinical vignette

Mr. E.A. is a 40-year-old man with no medical comorbidities, who presented to the hospital with 3 days of respiratory tract symptoms. He was severely hypoxic, requiring intubation and mechanical ventilation. His COVID swab test result was positive and was started on 6 mg of dexamethasone daily. Owing to severe hypoxia, he required prone position ventilation and neuromuscular paralysis. He progressively improved and was extubated on day 7 of ICU admission. After extubation, he had ICU-acquired weakness with peripheral limb weakness. He required assistance for bed mobility, to sit on the edge of the bed and to stand; he was only able to tolerate short periods of standing on the spot owing to dyspnoea and weakness. He was transferred to the ward after 10 days in the ICU. Three weeks later, at discharge from the hospital to home, he had an exercise tolerance of 80 m and was referred for outpatient pulmonary rehabilitation.

3. Introduction

The COVID-19 pandemic has placed unprecedented demand on health services around the world. Although significant effort has focused on ICU capacity and mortality outcomes,⁸ there is a growing need to direct attention to postacute rehabilitation for

these patients and their families. As illustrated by this vignette, COVID-19 can produce significant post-ICU morbidity owing to the use of therapies such as steroids and neuromuscular paralysis, which are risk factors for ICU-acquired weakness. This is further complicated by emerging evidence of a postviral syndrome,⁹ which leads to significant impairments even in young, healthy individuals. This necessitates additional attention to be paid to the postacute outcomes. There may be hidden disability associated with this pandemic that has broader societal and economic implications, particularly for patients who may be unable to return to work. This highlights the need for targeted rehabilitation of critically ill patients with COVID-19.

4. Role and challenges to rehabilitation

Various rehabilitation interventions should be undertaken across the spectrum of care of critically ill patients with COVID-19. This includes interventions within the ICU,^{10,11} in the ward, and in outpatient as well as subacute settings.^{12,13} Although broad recommendations for the multidisciplinary approach to rehabilitation for this population have been described,¹⁴ there are several challenges unique to the Australian context that need to be addressed.

5. Early rehabilitation assessment and intervention and post-ICU follow-up

Unlike patients with stroke or postcardiac surgical complications, in Australia patients with COVID-19 and with post-ICU impairments lack a streamlined assessment and rehabilitation pathway, potentially leading to discharge without appropriate assessment or follow-up by rehabilitation services.¹⁵ Although ICU follow-up services such as clinics and peer support groups for ICU survivors are currently being explored internationally and locally, the implementation of such services is not without barriers, and within the Australian context, access to such programs remains limited.^{16,17} This highlights the need to establish robust processes for early identification and referral of patients, facilitating earlier engagement of rehabilitation services in clinical management of patients within existing generic, clinical pathways.¹⁸

National and statewide rehabilitation planning strategies have fostered closer integration between rehabilitation and acute hospital services, particularly for conditions such as strokes. These existing models could be adapted to identify at-risk critically ill patients with COVID-19 and facilitate review by rehabilitation teams, to

develop an individualised rehabilitation plan, and determine the appropriate rehabilitation setting.¹⁹ Community-based pathways may also be defined, leveraging general practitioners' support, by providing them with the tools and resources to identify, triage, and refer patients requiring rehabilitation.

6. Education and awareness

Awareness of functional limitations experienced by ICU survivors amongst both critical and noncritical care clinicians remains limited, and this knowledge gap likely extends to critically ill patients with COVID-19.²⁰ Numerous accessible, open-access information-sharing platforms for COVID-19 have been developed in Australia and may be leveraged for this purpose. For example, the National COVID-19 Clinical Evidence Taskforce (<https://covid19evidence.net.au/>) has established a platform for ready access to evidence for the management of COVID-19, and further enhancements to this platform by the consideration of postacute care are possible.

7. Health service transition communication

There is a considerable gap in communication and information sharing between acute and community or subacute services, particularly in the areas of timeliness of communication and the quality of information provided.²¹ Information on factors increasing the risk of post-ICU impairments such as prolonged mechanical ventilation is crucial to helping postacute care clinicians identify at-risk patients.

Efforts to improve this communication gap include digital health solutions such as MyHealthRecord. Although this platform has seen considerable challenges since its inception, it has seen increased use during the COVID-19 pandemic.²² This highlights an opportunity for enhancing and promoting pre-existing infrastructure and platforms for communication between acute care and community clinicians, with an enhanced emphasis on information on the functional status of patients discharged with COVID-19.

8. Access to rehabilitation and government support

Access to rehabilitation services within the public sector is dependent on the identification of highly specific diagnoses within a case-mix-based funding model. This provides limited flexibility for access to rehabilitation services for complex conditions such as postintensive care syndrome. Similar limitations apply to access to government support programs such as the National Disability Support Scheme, despite these patients potentially experiencing significant disability.²³

Models of government support and funding need to be reviewed for postacute care of these patients and may involve improving access to return to work and employment support programs. These would be delivered with the aim of facilitating an improved quality of life for patients, an earlier return to economic productivity, and a reduction in the long-term burden on the health and welfare system.

9. Research

Finally, there is a need for further research efforts on the long-term outcomes of these patients, to contribute to our understanding of the impact of the novel disease, and to inform the development of effective policies and interventions. Australia benefits from a robust research infrastructure with numerous partnerships between academic centres, health services, and professional bodies. For example, the Australian and New Zealand Intensive

Care Society Clinical Trials Group, in partnership with Monash University, has recently endorsed the COVID-Recovery study to examine the functional outcomes of critically ill patients with COVID-19.

10. Conclusion

Although many nations are struggling with the immediate impact of the COVID-19 global pandemic, there is significant concern with regard to the long-term morbidity of critically ill patients with COVID-19. The elevated likelihood of an increased incidence of post-ICU morbidity, coupled with challenges in the ability to effectively rehabilitate them, necessitates early attention by authorities at all levels to maximise patient opportunities for meaningful outcomes.

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References

- [1] Ranse J. Research in the contest of coronavirus disease 2019: considerations for critical care environments. *Aust Crit Care* 2020;33(4):309–10.
- [2] Collett LW, Gluck S, Strickland RM, Reddi BJ. Evaluation of coagulation status using viscoelastic testing in intensive care patients with coronavirus disease 2019 (COVID-19): an observational point prevalence cohort study. *Aust Crit Care* 2020. <https://doi.org/10.1016/j.aucc.2020.07.003>. Published online July 21.
- [3] Chappel LS, Fetterplace K, Asrani V, Burrell A, Cheng AC, Collins P, et al. Nutrition management for critically and acutely unwell hospitalised patients with coronavirus disease 2019 (COVID-19) in Australia and New Zealand. *Aust Crit Care* 2020;33(5):399–406. <https://doi.org/10.1016/j.aucc.2020.06.002>. Published online July 1.
- [4] Bloomer MJ, Bouchoucha S. Australian College of Critical Care Nurses and Australasian College for Infection Prevention and Control position statement on facilitating next-of-kin presence for patients dying from coronavirus disease 2019 (COVID-19) in the intensive care unit. *Aust Crit Care* 2020. <https://doi.org/10.1016/j.aucc.2020.07.002>. Published online July 16.
- [5] Ridley EJ, Freeman-Sanderson A, Haines KJ. Surge capacity for critical care specialised allied health professionals in Australia during COVID-19. *Aust Crit Care* 2020. <https://doi.org/10.1016/j.aucc.2020.07.006>. Published online August 13.
- [6] Freeman-Sanderson A, Rose L, Brodsky MB. Coronavirus disease 2019 (COVID-19) cuts ties with patients' outside world. *Aust Crit Care* 2020;33(5):397–8. <https://doi.org/10.1016/j.aucc.2020.08.001>. Published online September 1.
- [7] Marshall AP, Austin DE, Chamberlain D, Chappel LS, Cree M, Fetterplace K, et al. A critical care pandemic staffing framework in Australia. *Aust Crit Care* 2020. <https://doi.org/10.1016/j.aucc.2020.08.007>. Published online Oct 8.
- [8] Burrell AJ, Pellegrini B, Salimi F, Begum H, Broadley T, Campbell LT, et al. Outcomes of COVID-19 patients admitted to Australian intensive care units during the early phase of the pandemic. *Med J Aust* 2020 Sep 16:1.
- [9] Perrin R, Riste L, Hann M, Walther A, Mukherjee A, Heald A. Into the looking glass: post-viral syndrome post COVID-19. *Med Hypotheses* 2020 Nov;144:110055.
- [10] Colbenson GA, Johnson A, Wilson ME. Post-intensive care syndrome: impact, prevention, and management. *Breathe* 2019 Jun 1;15(2):98–101.
- [11] Anekwe DE, Biswas S, Bussières A, Spahija J. Early rehabilitation reduces the likelihood of developing intensive care unit-acquired weakness: a systematic review and meta-analysis. *Physiotherapy* 2020 Jun 1;107:1–10.
- [12] Chan KS, Zheng JP, Mok YW, Li YM, Liu YN, Chu CM, et al. SARS: prognosis, outcome and sequelae. *Respirology* 2003 Nov;8(Suppl):S36–40.
- [13] Hsieh M, Lee W, Cho H, Wu M, Hu H, Kao K, et al. Recovery of pulmonary functions, exercise capacity, and quality of life after pulmonary rehabilitation in survivors of ARDS due to severe influenza A (H1N1) pneumonitis. *Influenza Other Respir Viruses* 2018 Sep;12(5):643–8.
- [14] Korupolu R, Francisco GE, Levin H, Needham DM. Rehabilitation of critically ill COVID-19 survivors. *J Int Soc Phys Rehabil Med*. 2020;3(2):45. https://doi.org/10.4103/jisprm.2020.8_20.
- [15] Govindan S, Iwashyna TJ, Watson SR, Hyzy RC, Miller MA. Issues of survivorship are rarely addressed during intensive care unit stays. Baseline results from a statewide quality improvement collaborative. *Ann Am Thorac Soc* 2014 May;11(4):587–91.

- [16] Cook K, Bartholdy R, Dohren GV, Tabah A, Haines K, Rai S, et al. A national survey of intensive care follow-up clinics in Australia. *Aust Crit Care* 2020 Jan 1;33:S10–1.
- [17] Haines KJ, McPeake J, Hibbert E, Boehm LM, Aparanji K, Bakhru RN, et al. Enablers and barriers to implementing ICU follow-up clinics and peer support groups following critical illness: the thrive collaboratives. *Crit Care Med* 2019 Sep;47(9):1194–200.
- [18] New PW, Poulos CJ. Functional improvement of the Australian health care system — can rehabilitation assist? *Med J Aust* 2008 Sep 15;189(6):340–3.
- [19] Poulos CJ, Magee C, Bashford G, Eagar K. Determining level of care appropriateness in the patient journey from acute care to rehabilitation. *BMC Health Serv Res* 2011 Oct 31;11:291.
- [20] Elliott D, Davidson JE, Harvey MA, Bemis-Dougherty A, Hopkins RO, Iwashyna TJ, et al. Exploring the scope of post-intensive care syndrome therapy and care: engagement of non-critical care providers and survivors in a second stakeholders meeting. *Crit Care Med* 2014 Dec;42(12):2518–26.
- [21] Schwarz CM, Hoffmann M, Schwarz P, Kamolz L-P, Brunner G, Sendlhofer G. A systematic literature review and narrative synthesis on the risks of medical discharge letters for patients' safety [Internet]. *BMC Health Serv Res* 2019 Mar 12 [cited 2020 Sep 18];19. Available from: <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6417275/>.
- [22] Australian Digital Health Agency Healthcare providers use of technology surges in the face of COVID-19 [Internet]. [cited 2020 Sep 18]. Available from: <https://www.digitalhealth.gov.au/news-and-events/news/media-release-healthcare-providers-use-of-technology-surges-in-the-face-of-covid-19>.
- [23] Hodgson CL, Udy AA, Bailey M, Barrett J, Bellomo R, Bucknall T, et al. The impact of disability in survivors of critical illness. *Intensive Care Med* 2017;43(7):992–1001.

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