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Invited Topical Review

Physiotherapy management for COVID-19 in the acute hospital setting and beyond: an update to clinical practice recommendations

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KEY WORDS

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ABSTRACT

This document provides an update to the recommendations for physiotherapy management for adults with coronavirus disease 2019 (COVID-19) in the acute hospital setting. It includes: physiotherapy workforce planning and preparation; a screening tool for determining requirement for physiotherapy; and recommendations for the use of physiotherapy treatments and personal protective equipment. New advice and recommendations are provided on: workload management; staff health, including vaccination; providing clinical education; personal protective equipment; interventions, including awake proning, mobilisation and rehabilitation in patients with hypoxaemia. Additionally, recommendations for recovery after COVID-19 have been added, including roles that physiotherapy can offer in the management of post-COVID syndrome. The updated guidelines are intended for use by physiotherapists and other relevant stakeholders caring for adult patients with confirmed or suspected COVID-19 in the acute care setting and beyond. **[Thomas P, Baldwin C, Beach L, Bissett B, Boden I, Cruz SM, Gosselink R, Granger CL, Hodgson C, Holland AE, Jones AYM, Kho ME, van der Lee L, Moses R, Ntoumenopoulos G, Parry SM, Patman S (2022) Physiotherapy management for COVID-19 in the acute hospital setting and beyond: an update to clinical practice recommendations. *Journal of Physiotherapy* 68:8–25]**

Introduction

Recommendations for physiotherapy management for coronavirus disease 2019 (COVID-19) in the acute hospital setting[1] were produced in March 2020 in response to the emerging pandemic and urgent need for guidance for physiotherapists world-wide. Since then, COVID-19 cases have exceeded 258 million[2] and deaths have exceeded 5.1 million.[2] The experience of healthcare providers and policy-makers in dealing with the pandemic and research specific to the COVID-19 population has evolved rapidly. The aim of this second document is to inform physiotherapists and key stakeholders of relevant changes in the management of COVID-19 and to update recommendations for physiotherapy practice and service delivery[a,b]. The recommendations remain focused on adult patients in acute hospital settings and are structured around: physiotherapy workforce planning and preparation; delivery of physiotherapy interventions, including both respiratory and mobilisation/rehabilitation; and PPE requirements for physiotherapy service delivery. They have also been expanded to address the long-term impacts of COVID-19 and the implications they have for acute hospital physiotherapy services. These recommendations will continue to be updated, as required, in response to future development of evidence necessitating a change in physiotherapy practice for hospitalised adults with COVID-19.

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Methods

Consensus approach

All previous authors were invited to contribute to this update. The skills and experience of the authors were reviewed and an invitation extended to two additional cardiorespiratory physiotherapy experts (LB, AEH) who brought additional expertise in pandemic leadership and models of care (LB) and pulmonary rehabilitation (AEH). A consumer representative with lived experience of COVID-19 (SMC) was also invited to review the recommendations.

The AGREE II framework[3] was used to guide reporting. To guide the revision of original or the development of new recommendations and decision-making, all members of the authorship group assisted in conducting literature searches and reviewing international guidelines. Given the rapid evolution of evidence and wide scope of our guidance, systematic reviews or guidelines were sought for each section wherever possible. However, at times, the most relevant primary studies were chosen using best clinical and methodological judgement.

All authors reviewed the previous recommendations and nominated recommendations that should be revised or revoked. The lead author (PT) circulated a draft document that included previous recommendations and items that were nominated to be revoked, revised or added. All authors had the opportunity to vote to revoke items, or approve new or revised recommendations, with $\geq$ 70% agreement for approval. Votes were conducted independently via return to the lead author. Votes were tallied and any feedback collated and de-identified, then presented back to all authors. All new and revised recommendations were discussed in a follow-up videoconference, where minor alterations in recommendations were made if required.

After the guidelines were developed, a consumer (SMC) was invited to review all recommendations and provide feedback. Endorsement of the revised recommendations was again sought from physiotherapy societies, physiotherapy professional groups and World Physiotherapy.

Epidemiology and key public health measures for COVID-19

While the global number of COVID-19 cases now exceeds 258 million,[2] the weekly incidence of COVID-19 cases and deaths has been gradually declining in all regions, except Europe, since late August 2021.[4] Classifications for disease severity have now been defined by the World Health Organization (WHO)[5] (Table 1). Similar classifications are incorporated within Australian guidelines, which include additional clinical descriptors.[6] In Australia and the United States, the majority of people with COVID-19 have non-severe disease; however, approximately 13% are admitted to hospital and 2% require intensive care unit (ICU) admission.[7,8] Similar rates of severe (14%) and critical (5%) disease have been reported in China.[9] Mortality associated with COVID-19 appears higher in the United States (5%)[8] compared to China (2.3%)[9] and Australia (1%).[7] This may be explained by many factors, including regional differences in population demographics, local healthcare responses and the robustness of data reporting. While at the beginning of the pandemic the incidence of COVID-19 was highest in elderly people aged at least 60 years, a shift has been seen in this second pandemic year with highest case numbers now in individuals aged $<$ 40 years.[10] In 2021, the highest rate of infection in Australia has been in the 20 to 29-year age group and a slightly higher rate of infection is seen among males than females.[7] While higher case numbers are occurring in younger people, hospital admissions remain predominantly in older age groups.[11] Ethnicity may also impact on the severity of COVID-19: for example, patients of Indian and Pakistani origin have been identified as a higher-risk group in the UK.[11]

Genetic lineages of COVID-19 have been emerging and circulating around the world. Several variants currently classified as 'variants being monitored' have had significant and sustained reduction in regional proportions over time or now pose lower risk to public health;[12] this includes the Alpha, Beta and Gamma variants. The Delta variant, which was first detected in India in October 2020, is currently the 'variant of concern'.[12] Variants of concern appear to be significantly more transmissible and are associated with a higher viral load, longer infectious periods, increased risk of severe illness requiring hospitalisation, and mortality.[12,13] The emergence of variants is anticipated to continue and will require ongoing research to understand the consequences of the different variants on initial acuity of presentation, long-term sequalae and trajectories for recovery.

Table 1
World Health Organization categories of COVID-19 disease severity in adults[a].

Category	Definition
Non-severe	Symptomatic patients without evidence of viral pneumonia (ie, no fever, cough, dyspnoea or hyperpnoea) and without hypoxia (ie, $SpO_2 \geq$ 90% on room air)
Severe	Clinical signs of pneumonia (fever, cough, dyspnoea or hyperpnoea)[b] with at least one of the following: - respiratory rate $>$ 30 breaths/min - severe respiratory distress - $SpO_2 <$ 90% on room air
Critical	Requires the provision of life-sustaining therapies such as mechanical ventilation (invasive or non-invasive) or vasopressors with presentations including: - Acute respiratory distress syndrome[179] - Sepsis[180] - Septic shock[180]

COVID-19 = coronavirus disease 2019, CT = computerised tomography, SpO_2 = oxyhaemoglobin saturation.
[a] Adapted from the Clinical management of COVID-19 patients: living guidance.[181]
[b] While the diagnosis can be made on clinical grounds, chest imaging (radiograph, CT scan, ultrasound) may assist in diagnosis.

The cornerstone of disease prevention remains a combination of public health measures for infection control and vaccination. Guidance on public health measures and exposure risk controls have changed since the start of the pandemic, as evidence about the spread of COVID-19 has developed. Early in the pandemic the WHO advised that transmission of the virus between people was primarily through droplet and contact routes;[14] this advice has since changed.[15] There is now substantial evidence supporting the airborne transmission of COVID-19.[15–21] Subsequently, public health recommendations for preventative measures have shifted to include the use of three-layer face masks and ensuring natural ventilation of enclosed spaces, in addition to the standard messaging of physical distancing by at least 1 m and avoiding crowded places.[15,17,22]

The development and testing of safety and efficacy of vaccines for COVID-19 has been instrumental in managing COVID-19. As of 25 November 2021, more than 7.4 billion vaccine doses have been delivered world-wide, with 3.1 billion people being fully vaccinated,[2] which reflects approximately 39% of the world's population.[23] However, there have been and continue to be large differences in vaccine access and rollout across countries.[24] For example, African regions have on average approximately 12.7% of their population fully vaccinated versus European regions, which average approximately 53.7%.[23] The inequitable access to vaccines increases the risk of emergence of new lineages of COVID-19 that may be even more threatening and require ongoing development of vaccines to ensure their effectiveness.

Of critical relevance for healthcare is that COVID-19 in the hospital setting is now becoming a disease predominantly of the unvaccinated. The probability of severe or critical disease from COVID-19 is ameliorated through vaccination,[25,26] with substantially lower rates of emergency department utilisation, hospitalisation and admission to ICU in vaccinated populations.[11,27] However, even after vaccination, there is an elevated risk for hospital admission and death due to COVID-19 for some groups. High-risk groups appear to include: people with Down's syndrome; immunosuppression due to chemotherapy, previous solid organ transplantation (particularly kidney transplantation) or recent bone marrow transplant; HIV and AIDS; liver cirrhosis; neurological disorders, including dementia and Parkinson's disease; and residents in aged-care facilities.[11] Increased susceptibility may also be seen with conditions such as chronic

kidney disease, blood cancer, epilepsy, chronic obstructive pulmonary disease, coronary heart disease, stroke, atrial fibrillation, heart failure, thromboembolism, peripheral vascular disease, and type 2 diabetes.[11]

Medical management of severe and critical COVID-19

Therapies for the management of COVID-19 continue to be evaluated. Some treatments that were initially used have been shown to have no benefit, including azithromycin and hydroxychloroquine.[6] Corticosteroids (eg, dexamethasone) when administered for a period up to 10 days in patients who are receiving supplemental oxygen or are mechanically ventilated may increase ventilator-free days and reduce mortality.[28,29] Other medications, including budesonide, baricitinib, sarilumab, remdesivir, sotrovimab and tocilizumab, may also be considered for their role in reducing the progression or severity of symptoms related to COVID-19.[6] Importantly, variations exist around their indications (eg, whether they are prescribed for patients who do or do not require oxygen or mechanical ventilation) for specific age groups and/or need consideration of risk factors like immunodeficiency.[6]

Among patients with severe COVID-19, the time course of deterioration is often delayed, with the median time from the onset of illness to experiencing dyspnoea being 5 to 8 days and to signs of acute respiratory distress syndrome (ARDS) being 8 to 12 days.[30] This may lead to ICU admission around 9 to 12 days after the onset of illness.[30] Clinicians should be aware of this time course and the potential for patients with COVID-19 to rapidly deteriorate with respiratory failure and sepsis, especially on days 5 to 10 after symptom onset.[6,30]

The basic tenets of providing respiratory support to maintain or achieve oxygen saturation targets are unchanged, although the use of non-invasive ventilation (NIV) is more widely accepted.[6,31] Conventional oxygen therapy devices with low flow rates are still used if oxyhaemoglobin saturations (SpO_2) can be maintained within desired ranges. When clinically indicated for worsening hypoxaemia, NIV and high-flow oxygen devices are often used, with patients located within a negative pressure room whenever possible. Internationally, there is significant variability in guidelines for the application of NIV and high-flow oxygen[32,33] and larger trials comparing the use of high-flow oxygen to different forms of NIV, including continuous positive airway pressure (CPAP), in COVID-19 populations have had varying outcomes.[34,35] As the common presentation of COVID-19 pneumonitis is hypoxaemic respiratory failure (without hypercapnia), CPAP may be recommended rather than other forms of NIV.[6] As more research specific to COVID-19 becomes available, it may guide the selection of therapy for patients with worsening acute respiratory failure. For patients monitored by pulse oximetry, there is new understanding on potential for under-detection of occult hypoxaemia, especially among people with dark skin.[36]

Silent or 'happy' hypoxaemia is a term that has evolved to describe an atypical clinical phenomenon in severe and critical COVID-19 patients where significant hypoxaemia is present, but subjectively patients have a feeling of wellbeing, often with the absence of dyspnoea or respiratory distress.[37] Despite the severe hypoxaemia, patients may be calm, awake and have near-normal lung compliance.[38] The pathophysiological cause of silent hypoxaemia is unclear, but it may be due to intrapulmonary shunting, loss of lung perfusion regulation, endothelial injury and impaired diffusion capacity.[39,40] These patients require close monitoring. Desaturation may be transient but is often prolonged or associated with rapid respiratory decompensation. Silent hypoxaemia appears to be associated with cardiac disease[41] and carries greater mortality.[38,42] There are currently no defined therapeutic approaches for it beyond supportive management via increasing supplemental oxygen; using high-flow oxygen devices and NIV; prone positioning; and mechanical ventilation using the common principles for ARDS ventilation.[38,40] In some centres, patients with severe refractory hypoxaemia may be offered extracorporeal membrane oxygenation.[43]

Prone positioning of mechanically ventilated adults with COVID-19 is used for periods of 12 to 16 hours.[6,44] Additionally, 'awake proning' has evolved during the pandemic, where non-intubated patients with severe COVID-19 who require supplemental oxygen are encouraged to lie prone for prolonged periods to improve oxygenation.[44] Awake proning has previously been used in ARDS patients[45] and in COVID-19 has been used in conjunction with respiratory support such as high-flow oxygen[46] and CPAP using helmet interfaces.[47] While awake proning is recommended and appears to achieve improvements in oxygenation without any serious adverse events, further evaluation is needed as there is significant variability in its application within current publications and its impact on outcomes such as rate of intubation or mortality rates is unclear.[48–51] Early implementation of awake proning, for example within 24 hours of a patient requiring high-flow oxygen, may be an important factor.[52] However, awake proning may be uncomfortable for some patients, leading to low adherence.[47]

Post-COVID conditions

Knowledge is increasing about the long-term impacts of COVID-19, which are referred to as post-COVID conditions,[53] post-COVID syndrome[54] or Long COVID.[55] Post-COVID conditions can affect people with mild disease through to those hospitalised with severe and critical disease.[56] The WHO's definition of post-COVID conditions is symptoms usually occurring 3 months from the onset of COVID-19, that last for $\geq$ 2 months and cannot be explained by an alternative diagnosis.[57] Symptoms may be persistent from the time of the initial COVID-19 infection or be new in onset and can be fluctuating or remitting over time. The incidence of post-COVID conditions appears high and symptoms can have an impact on everyday living.[58] Common symptoms include fatigue, dyspnoea and cognitive dysfunction[57,59] but other symptoms may be present, including cough, loss of taste, cardiac abnormalities (eg, myocarditis, chest pain, autonomic dysfunction), concentration problems, sleep disturbances, post-traumatic stress disorder, muscle pain and headache.[55,59] It is difficult to predict who will experience post-COVID conditions, although it appears to be more likely in females, those of older age or higher BMI, and those with more than five symptoms in the first week.[60]

Recommendations

The original manuscript[1] consisted of 66 recommendations. After review of the original recommendations, two recommendations were revoked (item 3.5: *BubblePEP is not recommended for patients with COVID-19 because of uncertainty around the potential for aerosolisation, which is similar to the caution the WHO places on bubble CPAP*; and item 5.4: *For all confirmed or suspected cases, droplet precautions should be implemented, at a minimum. Staff must wear the following items: surgical mask; fluid-resistant long-sleeved gown; goggles or face shield; and gloves*), 20 recommendations were revised and 30 new recommendations were drafted. After review and voting by all authors, all revised or new recommendations gained consensus. The final 94 recommendations are presented in Boxes 1 to 5 and updated guidance for screening COVID-19 patients is presented in Appendix 1. Endorsements and translations listed in Appendix 2 are current at the time of publication. Appendices 1 to 2 are available on the eAddenda.

Physiotherapy workforce planning and preparation

Box 1 outlines recommendations related to physiotherapy workforce planning and preparation. Surges in hospital admissions due to COVID-19 have required significant organisational change, including within physiotherapy services, with resources being re-distributed across hospitals to bolster services to frontline COVID-19 areas[61,62] and in some cases, restructuring to create extended shift patterns to improve access to physiotherapy services.[62] Physiotherapy services to non-COVID-19 patients have still been essential, contributing to efficiencies in patient flow and discharge, and continuing to provide vital outpatient and ambulatory care services. Services provided by hospital-based outpatient services have been impacted and resulted

Box 1. Physiotherapy workforce planning and preparation recommendations.

	Capacity
1.1	Plan for an increase in the required physiotherapy workforce. For example: • allow additional shifts for part-time staff • offer staff the ability to electively cancel leave • recruit a pool of casual staff • recruit academic and research staff, staff who have recently retired or who are currently working in non-clinical roles • work different shift patterns (eg, 12-hour shifts, extended evening shifts)
1.2	Identify potential additional staff who could be deployed to areas of higher activity associated with COVID-19 admissions (eg, infectious disease ward, ICU and/or high dependency unit and other acute areas). Prioritise staff for deployment who have previous cardiorespiratory and critical care experience.
1.3	Workforce planning should include consideration for pandemic-specific requirements such as additional workload from donning and doffing PPE, and the need to allocate staff to key non-clinical duties such as enforcing infection control procedures.
1.4	Identify hospital-wide plans for allocation/cohorting patients with COVID-19. Utilise these plans to prepare resource plans that may be required. Refer to the original manuscript[1] for an example of a resource plan for ICU physiotherapy.
1.5[b]	Consider organisation of the workforce into teams that will manage patients with confirmed or suspected COVID-19 versus non-infectious patients: • minimise or prevent movement of staff between teams • consider rotating teams after periods between caring for people with COVID-19 versus non-COVID-19 • ensure the teams have an even distribution of skill mix • limit movement of staff across wards within the hospital or across hospital campuses
1.6[a]	Physiotherapy departments should plan for potential changes to workload management including: • furlough of staff who are diagnosed with COVID-19 or have had a close contact exposure to a person with COVID-19 in the community or at work (without appropriate PPE) • shielding of staff who are at higher risk from COVID-19 and require plans to reduce their exposure to patients with confirmed or suspected COVID-19
1.7[a]	When staff are furloughed, consider the ability to provide telehealth or other remote access modalities in order to provide clinical and/or administrative support and reduce the workload of physiotherapy staff within the hospital.
1.8	Senior physiotherapists should be involved in determining the appropriateness of physiotherapy interventions for patients with confirmed or suspected COVID-19 in consultation with senior medical staff and according to a referral guidelines.
	Training and education
1.9	Physiotherapists are required to have specialised knowledge, skills and decision-making to work within ICU. Physiotherapists with previous ICU experience should be identified by hospitals and facilitated to return to ICU.
1.10	Physiotherapists who do not have recent cardiorespiratory physiotherapy experience should be identified by hospitals and facilitated to return to support additional hospital services. For example, staff without acute hospital or ICU training may facilitate rehabilitation, discharge pathways or hospital avoidance for patients without COVID-19.
1.11	Staff with advanced ICU physiotherapy skills should be supported to screen patients with COVID-19 assigned to physiotherapy caseloads and provide junior ICU staff with appropriate supervision and support, particularly with decision-making for complex patients with COVID-19. Hospitals should identify appropriate physiotherapy clinical leaders to implement this recommendation.
1.12[b]	Identify existing learning resources for staff who could be deployed to acute, ICU or rehabilitation areas of the hospital. For example: • PPE training • local ICU orientation programs • cardiorespiratory and/or ICU eLearning packages • educational resources from professional bodies • pulmonary rehabilitation guidelines and resources
1.13[a]	In periods of low community COVID-19 transmission, physiotherapy staff in acute hospital settings should maintain readiness through ongoing education, simulation and revision of COVID-19 protocols.
	Communication and welfare
1.14	Keep staff informed of plans. Communication is crucial to the successful delivery of safe and effective clinical services.
1.15[a]	Physiotherapy managers and clinical leaders should regularly engage with staff to maintain an awareness of staff wellbeing (eg, mental and physical health) during and after the pandemic.
1.16[b]	It should be recognised that staff will likely have an increased workload with a heightened risk of anxiety both at work and home. Staff should be supported during and beyond the pandemic (eg, via access to employee assistance programs, counselling, facilitated debriefing sessions).
1.17	Consider and/or promote debriefing and psychological support; staff morale may be adversely affected due to the increased workload, anxiety over personal safety and the health of family members.
	Staff vaccination and health
1.18[a]	All physiotherapists should be vaccinated for COVID-19 (unless an approved medical exemption applies), including boosters as required.
1.19[a]	Physiotherapists who are providing direct care to patients with confirmed or suspected COVID-19 or who are required to maintain other physiotherapy services during periods of high community COVID-19 transmission (eg, services to medical wards or outpatient services) should be among the healthcare providers who are given priority access to vaccination programs for COVID-19.

Box 1. Continued

1.20[a]	If a physiotherapy staff member is unable to be vaccinated due to an approved medical exemption, they should be reallocated to non-COVID areas.
1.21[a]	Physiotherapists should follow and role model methods for limiting the transmission of COVID-19, including regular hand hygiene, physical distance and wearing of a mask, consistent with public health recommendations.
1.22[a]	All physiotherapists should participate in workplace surveillance testing as per local procedures. For example, rapid antigen saliva testing after working with confirmed or suspected COVID-19 patients.
1.23[b]	Staff who are deemed to be at high risk should not enter COVID-19 areas. When planning staffing and rosters, some people may be at higher risk of developing more serious illness from COVID-19 and should avoid exposure to patients with COVID-19. This includes staff who: • are pregnant • have significant chronic respiratory illnesses • are immunosuppressed • are older (eg, > 60 years) • have severe chronic health conditions such as heart disease, lung disease, diabetes • have a condition causing immunodeficiency
1.24[b]	Be aware of and comply to relevant international, national, state and/or hospital guidelines for infection control in healthcare facilities.
1.25[a]	Hospital services or physiotherapy departments should collect and maintain records on: • staff vaccination status • staff who need to shield from exposure • PPE training and competence • mask fit testing • ICU trained staff • other training (eg, for prone positioning, NIV/CPAP, oxygen therapy)
Equipment	
1.26	Identify additional physical resources that may be required for physiotherapy interventions and how the risk of cross-infection can be minimised (eg, respiratory equipment; mobilisation, exercise and rehabilitation equipment; and equipment storage).
1.27[b]	Identify and develop a facility inventory of respiratory, mobilisation, exercise and rehabilitation equipment and determine process of equipment allocation as pandemic levels increase: • if resources permit, limit the movement of equipment between infectious and non-infectious areas • if resources are limited, equipment can be moved between areas with appropriate cleaning
Clinical education	
1.28[a]	Physiotherapy student placements should continue where this is safe and possible, balancing the short versus long-term risks and benefits to students and the health workforce.
1.29[a]	Physiotherapy students' requirements for vaccination and PPE should align with requirements of physiotherapy staff.
1.30[a]	When demands of the pandemic response require alterations to traditional clinical placements for physiotherapy students and alternative clinical options are offered, they should ensure appropriate learning opportunities, levels of supervision and feedback can be provided, ensuring accreditation standards are met.

CPAP = continuous positive airway pressure, COVID-19 = coronavirus disease 2019, ICU = intensive care unit, NIV = non-invasive ventilation, PPE = personal protective equipment.
[a] New recommendation.
[b] Revised recommendation.

in the rapid uptake of telehealth services, which have proven effective in the delivery of both individual and group services.[63]

Vaccination for COVID-19 is the key mechanism for control of COVID-19, and reductions in both the severity of illness experienced and demand on healthcare services have been observed. Vaccination of healthcare workers in every country has been a key priority for the WHO, even in countries and areas that have reported few cases to date.[64] As vaccine rollouts have been implemented within countries, healthcare workers have often been prioritised, including physiotherapists, particularly those on the frontline. In some countries, full vaccination of healthcare workers has now been mandated.[65]

Health professionals involved in the care of patients with COVID-19 often express concerns about contracting COVID-19 themselves and infecting family members.[66] Genomic analysis of COVID-19 infections in Australian healthcare workers demonstrated that the majority of staff who acquired COVID-19 did so within the workplace.[67] Major contributors to staff acquiring COVID-19 were the mobility of staff and patients between wards and facilities, as well as characteristics and behaviours of individual patients, particularly those with delirium or dementia who are often highly mobile due to wandering behaviours and exhibit aerosol-generating behaviours (eg, coughing, shouting or singing). An additional benefit of vaccination may be its ability to reduce viral transmission, and vaccination of healthcare workers has been associated with a reduction in COVID-19 among members of their households.[68]

For healthcare workers who are pregnant, guidelines continue to recommend the allocation of duties that reduce their exposure to patients with confirmed or suspected COVID-19.[69] Pregnant women are at increased risk of becoming severely unwell from COVID-19 infection in comparison to the general population, with increased risk for hospitalisation, admission to ICU and death.[69–71] Vaccine hesitancy has been observed amongst pregnant women, who are often concerned about possible effects on their unborn children.[72] However, vaccination appears to be safe for a pregnant woman and her child,[70] providing humoral immunity via the transfer of immunoglobulins through the placenta and breastmilk[73] and is strongly recommended.[69,70] Decisions around resource allocation are complex and when local jurisdictions require pregnant healthcare workers to work in high-risk COVID-19 areas, staff should be vaccinated and have full access to PPE. Access to information, wellbeing and support initiatives that are designed specifically for staff who are pregnant are recommended.[66]

During a pandemic, healthcare workers are at higher risk of psychological distress and mental health problems.[74] The demands of

Box 2. Recommendations regarding personal protective equipment for physiotherapists.

2.1[a]	Staff education and training should be responsive to ensure compliance with changes in PPE recommendations as required.
2.2[a]	Only staff who have been trained in the proper application of PPE should care for patients with confirmed or suspected COVID-19.
2.3[a]	Fit testing of face masks that offer airborne protection (eg, N95, FFP3, P2) is recommended, to ensure that staff can identify which size and style of mask is suitable for them.
2.4	All staff must be trained in correct donning and doffing of PPE, including performing a 'fit-check' for masks that offer airborne protection (eg, N95, FFP3, P2). A registry of staff who have completed PPE education and fit testing should be maintained.
2.5[b]	Masks that offer airborne protection (eg, N95, FFP3, P2) rely on a good seal. Beards compromise the ability to achieve an adequate seal and maintain protection from aerosols. Staff should remove facial hair and be clean shaven to ensure good mask fit.
2.6[a]	Physiotherapists should be aware of common skin adverse events from the effects of frequent handwashing and prolonged application of PPE, including contact dermatitis, acne, itching and pressure injuries from masks. Options for reducing adverse events should be available.
2.7[a]	If staff are unable to achieve a fit test with available masks that offer airborne protection, they should be redeployed to non-COVID areas.
2.8[b]	PPE for contact and airborne precautions should be used for suspected and confirmed COVID-19 patients. This includes: • a face mask that offers airborne protection (eg, N95, FFP3, P2) • a fluid-resistant long-sleeved gown • goggles/face shield • gloves
2.9	In addition, the following can be considered: • hair cover for aerosol-generating procedures • shoes that are impermeable to liquids and can be wiped down Use of shoe covers is not recommended, as repeated removal is likely to increase the risk of staff contamination.
2.10	PPE must remain in place and be worn correctly for the duration of exposure to potentially contaminated areas. PPE (particularly masks) should not be adjusted during patient care.
2.11	Use a step-by-step process for donning and doffing PPE as per local guidelines.
2.12[a]	When powered air purifying respirators are being used by hospitals within COVID-19 clinical areas, physiotherapists should have appropriate training on the use of the devices.
2.13[a]	If physiotherapists experience a PPE breach or COVID-19 exposure: • exposure management should be managed according to defined organisational processes • it should be recorded in an organisation's incident management system as an occupational health and safety risk • the physiotherapist's wellbeing should be considered, particularly at the time of the incident and during quarantine or the duration of illness and recovery • on return to work, a refresher infection control and prevention training should be offered to the staff member
2.14	Check local guidelines for information on laundering uniforms and/or wearing uniforms outside work if exposed to COVID-19. For example, changing into scrubs may be recommended in local guidelines and/or staff may be encouraged to get changed out of their uniform before leaving work and to transport worn uniforms home in a plastic bag for washing at home.
2.15	Minimise personal effects in the workplace. All personal items should be removed before entering clinical areas and donning PPE; this includes earrings, watches, lanyards, mobile phones, pagers, pens, etc. Stethoscope use should be minimised. If required, use dedicated stethoscopes within isolation areas. Hair should be tied back out of the face and eyes.
2.16	Staff caring for infectious patients must apply correct PPE, irrespective of physical isolation. For example, in ICU, if patients are cohorted into a pod with open rooms, staff working within the confines of the ICU pod but not directly involved in patient care should also wear PPE. The same applies once infectious patients are nursed on an open ward. Staff then use plastic aprons, a change of gloves and hand hygiene when moving between patients in open areas.
2.17	When a unit is caring for a patient with confirmed or suspected COVID-19, it is recommended that all donning and doffing are supervised by an additional appropriately trained staff member.
2.18	Avoid sharing equipment. Preferentially use only single-use equipment.
2.19	Wear an additional plastic apron if a large volume of fluid exposure is expected.
2.20	If reusable PPE items are used (eg, goggles), these must be cleaned and disinfected prior to re-use.
2.21[a]	When patients with confirmed or suspected COVID-19 are receiving aerosol-generating therapies (eg, high-flow oxygen) or displaying aerosol-generating behaviours (eg, coughing, shouting, crying), consideration should be given to the patient's ability to wear a fluid-resistant surgical mask over their face and oxygen delivery device, particularly when staff are providing treatment within close proximity to the patient.

COVID-19 = coronavirus disease 2019, ICU = intensive care unit, PPE = personal protective equipment.
[a] New recommendation.
[b] Revised recommendation.

dealing with a public health emergency, of indefinite duration, may result in many changes, including higher workloads, being displaced from normal work areas, compassion fatigue, lost opportunities, less interaction with colleagues and isolation from family. For example, in ICUs, 51% of physicians have had severe burnout during the pandemic compared with pre-pandemic rates of 25 to 30%.[75,76] In United States

Box 3. Whom should physiotherapists treat?

3.1[b]	The respiratory infection associated with COVID-19 is mostly associated with dry and non-productive cough; lower respiratory tract involvement usually involves pneumonitis rather than exudative consolidation. In these cases, respiratory physiotherapy interventions for airway clearance are not indicated.
3.2	Respiratory physiotherapy interventions in hospital wards or ICU may be indicated for patients who have confirmed or suspected COVID-19 and concurrently or subsequently develop exudative consolidation, mucous hypersecretion and/or difficulty clearing secretions.
3.3[a]	Physiotherapists have a role in identifying patients with COVID-19 who may require additional respiratory support, including high-flow nasal oxygen, NIV/CPAP or the use of prone positioning. Their role may also include initiating and managing these interventions.
3.4	Physiotherapists will have an ongoing role in providing interventions for mobilisation, exercise and rehabilitation (eg, in patients with comorbidities creating significant functional decline and/or (at risk of) ICU-acquired weakness).
3.5[b]	Physiotherapy interventions should only be provided when there are clinical indicators, so that staff exposure to patients with COVID-19 is minimised: • unnecessary review of patients with COVID-19 within their isolation room/areas may increase the risk of transmission • in situations where PPE supply is limited, it may also have a negative impact on PPE supplies
3.6	Physiotherapists should meet regularly with senior medical staff to determine indications for physiotherapy review in patients with confirmed or suspected COVID-19 and screen according to set/agreed guidelines (Appendix 1 provides a suggested framework).
3.7[a]	Resources should be prepared by physiotherapists for patients with COVID-19 (eg, handouts, information sheets) with consideration to the cultural and/or linguistic groups within a community and translations made available.
3.8	Physiotherapy staff should not be routinely entering isolation rooms, where patients with confirmed or suspected COVID-19 are isolated or cohorted, just to screen for referrals.
3.9	Options for screening of patients via subjective review and basic assessment whilst not being in direct contact with the patient should be trialled first, whenever possible (eg, calling the patients' isolation room telephone and conducting a subjective assessment for mobility information and/or providing education on airway clearance techniques).

COVID-19 = coronavirus disease 2019, CPAP = continuous positive airway pressure, ICU = intensive care unit, NIV = non-invasive ventilation.
[a] New recommendation.
[b] Revised recommendation.

healthcare workers, 49% of 20,947 respondents across 42 organisations reported burnout during COVID-19.[77] Levels of stress were higher in female workers, those with fewer years in their role and those working in inpatient settings.[77] Among physiotherapists, burnout has also significantly increased during the COVID-19 pandemic,[78,79] with reports suggesting that physiotherapists who experience the greatest levels of burnout are those working directly with COVID-19 patients and/or working in ICU.[78,79] While anxiety can be high amongst staff who have direct contact with people who have COVID-19, staff who believe that their health service's response and staff support strategies are effective may experience lower levels of depression, anxiety and stress.[66] Additionally, staff who feel valued by their organisation have significantly lower levels of burnout.[77]

Physiotherapy department clinical leaders and managers should be aware of the impact of workloads and stress on their teams during the pandemic, including themselves. The mental health of staff can be protected if strategies are implemented to keep staff informed about their health service responses to the pandemic. Regular, effective and timely communication of health service information is important. The importance of timely communication through briefings (daily, if necessary), the dissemination of information in real-time via group messaging and feedback mechanisms for staff create a continuous cycle that is imperative during the pandemic. Ensuring that staff feel prepared also arises through the completion of relevant education, orientation and competencies for tasks that are required during the pandemic.[80] As workloads increase, staff can be supported by reinforcing teams and checking that staff maintain appropriate shift patterns and have the ability to take regular breaks, especially during service redesign.

Staff support and wellbeing initiatives must be used, including opportunities to debrief, practise/foster gratitude and recognise and/or reward staff for achievements. Managers and clinical leaders should regularly check in on the health and wellbeing of their staff,[81] particularly staff working on the front-line teams during the pandemic and those who may be furloughed. Social support from supervisors and colleagues can help to build resilience and reduce stress.[74] At an organisational level, formalised peer support or organisational support is critical. Providing healthcare workers with the resources to manage the risk of infection may also reduce anxiety (eg, having vaccination programs, adequate training for PPE and guidelines to direct patient care).[74] The psychological distress from working during a pandemic can persist for 2 to 3 years after the outbreak;[74] therefore, monitoring and support mechanisms should continue beyond the outbreak period.[81]

Allied health student placements have been demonstrated to have at least a neutral or positive impact on patient activity and clinical time.[82] They are essential to ensuring the future workforce and also inspire and influence career decisions.[83] During the pandemic, physiotherapy student clinical placements have been profoundly impacted.[84] They may have been disrupted by the changing requirements of healthcare facilities, the need to limit access to hospitals from all but essential healthcare staff and the redeployment of clinical educators to support frontline clinical roles. The impact from lost clinical placements and/or modified physiotherapy placements as a result of COVID-19 is not collectively known. In addition to placement time, students may have been unable to complete or pass practical competency assessments that are required for registration. It is unknown whether these disruptions will result in an impact on service quality delivered by graduating workforces in coming years.

The continuation of clinical placements requires careful consideration of factors such as student safety (including access to PPE and mask fit testing where required), enacting current public health directives (eg, physical distancing, limiting travel, conflicts between concurrent or essential employment and placement), insurance and implications for future workforce planning.[85,86] Placement of students within clinical areas where there is high likelihood of exposure to patients with confirmed or suspected COVID-19 is often not recommended[87] unless there are critical workforce shortages.[88] However, continuation of placements within clinical areas that may benefit from the presence of students is recommended.[85,87] Inclusion of students within the healthcare system during the pandemic may assist in overcoming workforce shortages[85] and will also ensure that

Box 4. Recommendations for physiotherapy respiratory interventions.

	Personal protective equipment
4.1[b]	It is strongly recommended that standard and airborne precautions are utilised during respiratory physiotherapy interventions for patients with confirmed or suspected COVID-19.
	Cough etiquette
4.2	Both patients and staff should practice cough etiquette and hygiene. During techniques that may provoke a cough, education should be provided to enhance cough etiquette and hygiene: • ask the patient to cover their mouth by coughing into their elbow or sleeve or into a tissue. Tissues should then be disposed and hand hygiene performed • In addition, if possible, physiotherapists should position themselves $\geq$ 2 m from the patient and out of the likely path of dispersion
	Aerosol generation
4.3	Many respiratory physiotherapy interventions are potentially aerosol-generating procedures. While there are insufficient investigations confirming the aerosol-generating procedures of various physiotherapy interventions, the combination with cough for airway clearance makes all techniques potentially aerosol-generating procedures. These include: • cough-generating procedures (eg, cough or huff during treatment) • positioning or gravity-assisted drainage techniques and manual techniques (eg, expiratory vibrations, percussion and manually assisted cough) that may trigger a cough and sputum expectoration • use of positive pressure breathing devices (eg, inspiratory positive pressure breathing, mechanical insufflation-exsufflation devices, intra/extra pulmonary high-frequency oscillation devices (eg, The Vest, MetaNeb, Percussionaire)) • PEP and oscillating PEP devices • bubble PEP • nasopharyngeal or oropharyngeal suctioning • manual hyperinflation • open suction • saline instillation via an open-circuit endotracheal tube • inspiratory muscle training, particularly if used with patients who are ventilated and disconnection from a breathing circuit is required • sputum inductions • any mobilisation or therapy that may result in coughing and expectoration of mucus Therefore, there is a risk of creating an airborne transmission of COVID-19 during treatments. Physiotherapists should weigh-up the risk versus benefit in completing these interventions and use standard and airborne precautions.
4.4[b]	Where aerosol-generating procedures are indicated and considered essential they should be undertaken in a negative pressure room. Access to negative pressure rooms may not be available when cohorting is required due to the volume of patients presenting with COVID-19. Physiotherapists should weigh up the risk versus benefit in completing these interventions within cohorted areas.
4.5[b]	The decision to commence humidification, NIV, high-flow oxygen or other aerosol-generating procedures should be made in agreement with the multi-professional team and potential risks minimised. This may include consulting to develop work unit instructions/procedures to guide physiotherapy treatments, alleviating the need to gain medical approval for every individual patient.
4.6[b]	Do not use saline nebulisation: nebulisation is considered to be aerosol-generating.
	Airway clearance techniques
4.7	Positioning, including gravity-assisted drainage: • Physiotherapists can continue to advise on positioning requirements for patients.
4.8	Respiratory equipment for airway clearance: • where respiratory equipment is used, whenever possible use single-patient-use disposable options (eg, single-patient-use PEP devices) • re-usable respiratory equipment should be avoided where possible
4.9	There is no evidence for incentive spirometry in patients with COVID-19.
4.10[b]	Mechanical aids for airway clearance: • mechanical insufflation/exsufflation, NIV, inspiratory positive pressure breathing devices and intra/extra pulmonary high-frequency oscillation devices may be used, if clinically indicated and alternative options have been ineffective • consult with both senior medical staff and infection prevention and monitoring services within local facilities prior to use If used, ensure machines can be decontaminated after use and protect machines with viral filters over machine and patient ends of circuits): • use disposable circuits for these devices • maintain a log of devices that includes patient details for tracking and infection monitoring (if required) • use contact and airborne precautions
4.11[b]	Hyperinflation for airway clearance in patients on mechanical ventilation and/or with a tracheostomy: • hyperinflation techniques should only be used if indicated (eg, for suppurative presentations in ICU) • application of hyperinflation techniques should carefully consider the patient's presentation and clinical management (eg, lung-protective ventilation for acute respiratory distress syndrome) • if indicated, use ventilator hyperinflation rather than manual hyperinflation, which involves disconnection/opening of a ventilator circuit • ensure local procedures are in place for hyperinflation techniques

Box 4. Continued

	Techniques for the management of hypoxaemia
4.12[a]	Physiotherapists may be involved in the initiation and management of high-flow nasal oxygen, NIV and continuous positive pressure breathing for the management of hypoxaemia. Application of these devices by physiotherapists should be in accordance with local guidance for respiratory support decision-making, infection control and escalation procedures in the event of deterioration.
4.13	Prone positioning: • Physiotherapists may have a role in the implementation of prone positioning in ICU. This may include leadership within ICU 'prone teams', providing staff education on prone positioning (eg, simulation-based education sessions) or assisting in turns as part of the ICU team.
4.14[a]	• When prone positioning is used, physiotherapists should review patients regularly to advise on positioning strategies to prevent potential adverse effects of prone, including pressure injuries and neurological damage. Patients should be screened after prone turns and at discharge from ICU for potential neurological damage associated with the use of prone.
4.15[a]	• In patients who have not yet been intubated, physiotherapists can facilitate awake proning when indicated (eg, in patients with severe COVID-19 who are receiving any form of supplemental oxygen therapy).
	Request for sputum samples
4.16	Sputum inductions should not be performed in patients with confirmed or suspected COVID-19.
4.17	For sputum samples in non-intubated patients, first ascertain whether the patient is productive of sputum and able to clear sputum independently. If so, physiotherapy is not required for a sputum sample. If physiotherapy interventions are required to facilitate a sputum sample, PPE for contact and airborne precautions should be worn. The handling of sputum samples should adhere to local policies. Generally, once a sputum sample has been obtained the following points should be followed: • all sputum specimens and request forms should be marked with a biohazard label • the specimen should be double-bagged and placed in the first bag in the isolation room by a staff member wearing recommended PPE • specimens should be hand-delivered to the laboratory by someone who understands the nature of the specimens. Pneumatic tube systems must not be used to transport specimens
	Tracheostomy management
4.18[b]	The presence of a tracheostomy and related procedures are potentially aerosol generating. These include: • open suction of the tracheostomy • manual hyperinflation as an airway clearance technique • weaning from mechanical ventilation to humidified oxygen circuits • cuff deflation trials • inner cannula tube changes/cleaning • use of speaking valves and leak speech • use of IMT During their infectious period, patients with COVID-19 and a tracheostomy should be managed within an isolation room: • PPE for contact and airborne precautions is required • closed, in-line suction is recommended • if tracheostomy-related procedures are clinically indicated (eg, for airway clearance, to facilitate weaning or communication), the risks versus benefits should be considered. It is important to consider the role these procedures have for facilitating weaning and decannulation. • when patients are weaned off the ventilator, consider the use of a fluid-resistant surgical mask placed over the tracheostomy and any oxygen delivery device to reduce aerosol and droplet dispersion. When patients with a tracheostomy have completed their isolation period, they are considered to be non-infectious and airborne precautions for COVID-19 are no longer required.
	Lung ultrasound
4.19[a]	Where physiotherapists have the education and competence to perform lung ultrasound, it may be used as an assessment modality in patients with COVID-19.

COVID-19 = coronavirus disease 2019, ICU = intensive care unit, IMT = inspiratory muscle training, NIV = non-invasive ventilation, PEP = positive expiratory pressure, PPE = personal protective equipment.
[a] New recommendation.
[b] Revised recommendation.

the newly graduated workforce is prepared for pandemic responses.[86] Physiotherapy clinical placements have occurred with students assisting in the management of patients with COVID-19.[89] As the pandemic response evolves, the potential contribution of students to the direct care of patients with COVID-19 and risks need to be evaluated by universities and healthcare providers.

As a result of COVID-19, innovation in education and clinical placement models is required.[87] Within some physiotherapy disciplines, virtual placements and telehealth have been used and tools that are used to assess student competencies on clinical placement have been modified to encompass these areas.[84,90] However, telehealth has been less applicable to placements in acute hospital settings and there remains potential to investigate alternative placement models for acute care and cardiorespiratory skills training. Maintaining clinical placements within clinical areas away from the frontline COVID-19 response is paramount for cardiorespiratory physiotherapy. If workload and staffing pressures require different supervision models, they should ensure appropriate learning opportunities, levels of supervision and feedback can be provided so that students do not get lost in the chaos of the pandemic.[91] New recommendations related to physiotherapy clinical education are presented in Box 1, items 1.28 to 1.30.

Delivery of physiotherapy interventions, including PPE requirements

When the original recommendations[1] were first prepared early in the pandemic, transmission of COVID-19 between people was

Box 5. Recommendations for physiotherapy mobilisation, exercise and rehabilitation interventions.

Personal protective equipment	
5.1[b]	PPE for contact and airborne precautions should be used when providing mobilisation, exercise and rehabilitation. Physiotherapists are likely to be in close contact with the patient (eg, for mobilisation, exercise or rehabilitation interventions that require assistance). Mobilisation and exercise may also result in the patient coughing or expectorating mucus, and there may be circuit disconnections with ventilated patients. Refer to local guidelines regarding ability to mobilise patients outside of their isolation room. If mobilising outside of the isolation room, ensure that the patient is wearing a fluid-resistant surgical mask.
Screening	
5.2	Physiotherapists will actively screen and/or accept referrals for mobilisation, exercise and rehabilitation. When screening, discussion with nursing staff, the patient (eg, via phone) or family is recommended before deciding to enter the patient's isolation room. For example, to try to minimise staff who come in to contact with patients with COVID-19, physiotherapists may screen to determine an appropriate aid to trial. A trial of the aid may then be performed by the nursing staff already in an isolation room, with guidance provided, if needed, by the physiotherapist who is outside the room.
5.3[a]	Physical assessment including (but not limited to) manual muscle testing, functional assessment of bed mobility, transfers and gait should be considered in patients who have had severe disease with prolonged bed rest and/or critical disease where the presence of weakness and functional limitation may be increased.
5.4[b]	Physiotherapy interventions should be considered when there is a clinical indication (eg, to address functional decline due to illness or injury, frailty, multiple comorbidities, advanced age; or the prevention or recovery from ICU-acquired weakness).
Mobilisation and exercise prescription	
5.5	Early mobilisation is encouraged. Actively mobilise the patient early in the course of illness when safe to do so.
5.6	Patients should be encouraged to maintain function as able within their rooms: • sit out of bed • perform simple exercises and activities of daily living
5.7[b]	Mobilisation and exercise prescription should involve careful consideration of the patients' physiological state and reserve (eg, degree of respiratory and haemodynamic dysfunction). This includes consideration of: • the presence and severity of hypoxaemia • exertional hypoxaemia • cardiac impairments • autonomic dysfunction and orthostatic intolerance • post-exertional symptom exacerbation
Mobility and exercise equipment	
5.8	The use of equipment should be carefully considered and discussed with local infection monitoring and prevention service staff before being used with patients with COVID-19 to ensure it can be properly decontaminated.
5.9	Use equipment that can be single patient use. For example, use elastic resistance bands rather than distributing hand weights.
5.10	Larger equipment (eg, mobility aids, ergometers, chairs, tilt tables) must be easily decontaminated. Avoid use of specialised equipment, unless necessary, for basic functional tasks. For example, stretcher chairs or tilt tables may be deemed appropriate if they can be decontaminated with appropriate cleaning and are indicated for progression of sitting/standing.
5.11	When mobilisation, exercise or rehabilitation interventions are indicated: • plan well • identify/use the minimum number of staff required to safely perform the activity • ensure that all equipment is available and working before entering rooms • ensure that all equipment is appropriately cleaned or decontaminated • if equipment needs to be shared among patients, clean and disinfect between each patient use • specific staff training for cleaning of equipment within isolation rooms may be required • whenever possible, prevent the movement of equipment between infectious and non-infectious areas • whenever possible, keep dedicated equipment within the isolation zones, but avoid storing extraneous equipment within the patient's room
5.12	When performing activities with ventilated patients or patients with a tracheostomy, ensure that airway security is considered and maintained (eg, a dedicated airway person to prevent inadvertent disconnection of ventilator connections/tubing).

COVID-19 = coronavirus disease 2019, ICU = intensive care unit, PPE = personal protective equipment.
[a] New recommendation.
[b] Revised recommendation.

believed to be primarily through droplet and contact routes,[14] but there was concern regarding its potential for airborne spread. Subsequently, the recommendations[1] referred to both droplet and airborne precautions, depending on the type of physiotherapy being provided. For example, airborne precautions were recommended for respiratory physiotherapy due to: the close proximity of therapists to patients; use of techniques that are commonly considered aerosol-generating, including airway suctioning, NIV, tracheostomy procedures and manual ventilation;[92] and uncertain but possible aerosol generation caused by other respiratory techniques and coughing. More recently, coughing has been shown to produce higher aerosol emissions than breathing on CPAP (with an exhalation port filter in situ) or via high-flow nasal cannula.[93] Evidence for the aerosol-generating properties of patient care activities and subsequent transmission risk to healthcare workers is limited to a small number of studies, which are generally of low quality.[93,94] While further evaluation of aerosol-generating potential of activities, including physiotherapy techniques, is required, there is now substantial

evidence indicating airborne transmission of COVID-19;[16–20] thus, recommendations have been revised to reflect the use of airborne precautions during all direct physiotherapy interactions with people with confirmed or suspected COVID-19 (Box 2).

Face masks that offer airborne protection (eg, N95, FFP3, P2) have been shown to provide adequate protection against respiratory viruses when there is a good fit and adequate seal. Due to the pandemic, there is increased awareness of the role of mask fit testing, which is increasingly recommended for healthcare workers as a necessary occupational health and safety standard.[95] Mask fit depends on a variety of factors, including an individual's face shape and size, as well as brand and size of mask used.[96,97] Without proper fit testing, many staff may have insufficient airborne protection.[97] Fit testing does incur costs associated with proper testing equipment and staff, PPE usage and time for the testing and education of staff. However, the benefit is considered to outweigh the high cost of staff sick leave and furloughing due to viral exposure.[96] Fit checking, where people test the seal of a mask after its application by inhaling and exhaling quickly, should not be confused with the process of fit testing. Fit checking remains an important step with the application of face masks that offer airborne protection, but is not a reliable test to guide mask fitting.[95,96] It is important for organisations and/or departments to be aware of levels of staff PPE training and fit testing compliance in order to appropriately safeguard staff and fit testing should be repeated annually.[98,99]

Powered air-purifying respirators (PAPRs) are a type of face mask with a small fan assembly that takes ambient, potentially contaminated air and passes it through high-efficiency, particulate-absorbing viral filters before delivering the clean air to the user's face. PAPRs may be used for several reasons, including as an alternative for providing a high level of respiratory protection in individuals who fail fit testing, when performing aerosol-generating procedures (eg, intubation), or when viral exposure time is prolonged (eg, a shift performed within a COVID-19 isolation room). Although PAPRs may be more comfortable to wear due to improved heat tolerance, they may restrict mobility and impede communication[100] and there is no evidence to indicate that they reduce healthcare worker infection due to COVID-19 or other airborne diseases.[100,101] Fit testing specific to PAPR devices is also required, and education in correct donning and doffing procedures is essential, as there is a high risk of self-contamination during removal of the PAPR device.[102] Access to PAPR devices may be limited due to their high cost and associated expenses for training, cleaning and maintenance. Variations in the use of PAPR devices between centres and/or their use by physiotherapists has not been reported. When they are used by a healthcare facility, it is recommended that physiotherapists are PAPR fit tested and have appropriate training on the use of the devices and their don/doff procedures (Box 2, item 2.12).

Prolonged application of PPE and frequent hand hygiene can lead to adverse events such as contact dermatitis, acne and itching. Masks that offer airborne protection increase the risk of these conditions occurring over the nasal bridge and cheeks, and the duration that PPE is worn appears to be the most common risk factor.[103,104] Hydrocolloid dressings can be used to prevent the development of adverse skin reactions related to masks.[103,104]

While limited, evidence continues to grow to support the original recommendation[1] that spontaneously breathing patients with confirmed or suspected COVID-19 should be encouraged to wear a fluid-resistant surgical mask to reduce the risk of transmission to other contacts.[19,21,22,105,106] This has not always been reflected in hospital guidelines, where the wearing of masks was predominantly encouraged during transport for retrievals or movement between clinical areas. However, even asymptomatic patients with COVID-19 can have high viral load in the upper and lower respiratory tract[107] and asking patients to cover their nose and mouth with a surgical mask when staff are in the room has been recommended by several organisations.[108,109] Significant reductions in aerosol dispersion occur when masks are worn over the top of conventional oxygen or high-flow nasal cannula or when patients cough[105] and may improve arterial oxygenation.[109] Although the mainstays of protection for healthcare workers remain vaccination, PPE for contact and airborne precautions, fit testing and hand hygiene, encouraging patients to wear a surgical mask continues to be a recommended practice for physiotherapists (Box 2, item 2.21).

All patients with confirmed or suspected COVID-19 continue to be placed in isolation rooms or cohorted into COVID-19 designated areas. The risk of patients who present with non-COVID-19 conditions also being COVID-19 positive will increase when community transmission is high. At these times, staffing models may change; for example, physiotherapists who are treating patients with confirmed or suspected COVID-19 may be instructed to avoid treating non-COVID patients in the same shift (ie, establishing COVID and non-COVID physiotherapy teams). Hospitals may require staff to adhere to the separation of COVID and non-COVID teams, for example by providing separate tea and meeting rooms and change facilities. It is important to consider the need to maintain skill mix between separated teams, so that if one team is furloughed, staff replacing them may have the skills required to maintain services in critical areas.

The isolation period for people who have been hospitalised with severe COVID-19 varies depending on local hospital guidelines and the severity of illness experienced. For adults who have not required hospital admission, isolation can be discontinued 10 days after symptom onset and $\geq$ 24 hours after resolution of fever along with improvement in other symptoms.[110] When hospitalisation, ICU, NIV or other ventilatory support has been required, or patients are severely immunocompromised, a longer period of isolation of up to 20 days after symptom onset and after resolution of fever and improvement in other symptoms is recommended.[110] When patients are removed from isolation, although the virus may still be detectable in some patients, airborne PPE are no longer required as infectiousness is considered unlikely.[110]

Guidelines for PPE and environmental protections continue to evolve, and it is important for physiotherapists to be aware of changes and practices within their healthcare setting. Heating, ventilation and air-conditioning systems and ventilation in general are considered to be engineering controls that can reduce the risk of COVID-19 transmission[111] and many hospitals are reviewing and/or upgrading their heating, ventilation and air-conditioning systems. The use of portable high-efficiency particulate air filters has been demonstrated to significantly reduce the time required for aerosols to be cleared from a patient's room.[112] Personal ventilation hoods have also evolved and have been shown to reduce aerosol counts by $>$ 98% during nebulisation and NIV.[113,114]

If a direct exposure to COVID-19 or breach of PPE occurs, assessment of the breach and risk categorisation should be performed and the incident should be recorded in a hospital's incident management system as an occupational health and safety risk.[31] For periods of staff illness or post-exposure management, staff wellbeing should be considered, and psychosocial support provided if required during quarantine or for the duration of their illness and recovery. On return to work, a refresher infection control and prevention training should be offered for the staff member.

Recommendations for physiotherapy management principles – respiratory care

While many patients with COVID-19 have a non-productive cough,[115] some may develop suppurative presentations with a large secretion load and/or thick and viscous respiratory secretions.[116,117] With severe COVID-19 infection, elevated plasma levels of pro-inflammatory cytokines trigger and the overexpression of mucin may result in mucus hypersecretion, with alterations in the composition and impairments in mucociliary clearance leading to airway obstruction and/or ARDS and thrombosis.[118,119] A higher proportion of patients with viscous sputum has been reported in critical COVID-19[120] and researchers are beginning to evaluate the potential role of therapies like mucolytics.[117]

Physiotherapy respiratory interventions for the primary purpose of airway clearance are recommended only in severe and critical COVID-19 when there is evidence of pneumonia and difficulties with

Box 6. Recommendations for recovery after COVID-19.

6.1[a]	Physiotherapists should encourage physical activity and support healthy lifestyle programs for patients, the general community and people recovering from COVID-19.
6.2[a]	Physiotherapists should support multi-professional rehabilitation programs for people recovering from COVID-19 along the trajectory from acute illness, through to the ambulatory settings and onwards into the community.
6.3[a]	Increased demand for outpatient and community rehabilitation services, particularly pulmonary and cardiac rehabilitation programs should be anticipated, and health services should aim to increase modalities to make access available to the post COVID-19 population.

COVID-19 = coronavirus disease 2019.
[a] New recommendation.

secretion clearance.[1] On bronchoscopic evaluation of patients with COVID-19, mucus secretions were common (82%) but evidence of mucous plugging was less frequent (18%).[121] This supports the principle that not all severe or critical COVID-19 patients will require respiratory physiotherapy, and a personalised approach is recommended with screening performed to determine which patients may benefit from physiotherapy (Box 3, and Appendix 1 on the eAddenda). Several reports reflect the role that respiratory physiotherapy has had during COVID-19 in the acute hospital setting for ward and ICU patients.[122–126]

Physiotherapists may take an active role in the prone positioning of patients,[127] including awake proning. When prone positioning is used, physiotherapists should review patients regularly to advise on positioning strategies to prevent potential adverse effects, including pressure injuries[128,129] and neurological damage.[130] Patients should be screened after prone turns for pressure injuries and observed for potential neurological damage associated with the use of prone positioning. While awake proning may be a strategy used to improve arterial oxygenation, not all patients tolerate it for prolonged periods and trial of different positions like side lie, semi-recumbent, sitting, forward lean, prone and semi-prone may identify positions that maximise arterial or peripheral oxygenation and comfort for individuals.[131–133]

The use of inspiratory muscle training (IMT) in patients with COVID-19 has been reported.[126,134] In a pilot study, 2 weeks of IMT significantly improved dyspnoea, quality of life and exercise tolerance relative to usual care.[134] Larger studies evaluating the role of IMT are needed. The Italian consensus on pulmonary rehabilitation in COVID-19[135] recommends that IMT should not be used routinely, but should be administered in patients with respiratory muscle weakness and persistent dyspnoea. It may also be considered for patients with a tracheostomy as they progress to decannulation.[135] Disposable, single patient use respiratory devices are recommended for people with COVID-19, including IMT devices.[135]

Clinical decision making about pulmonary pathology in critically ill patients often relies on portable chest radiographs and less frequently on computed tomography (CT). Lung ultrasound (LUS) continues to emerge as a useful tool in practice, due to its accuracy in diagnosing pulmonary conditions.[136,137] In the era of COVID-19, ICUs may be reluctant to transport COVID-19 patients to CT, due to both the risk of transmission and their acuity. The advantage of LUS is its portability and bedside application, which negates the need to transport the patient outside the ICU for a CT scan. Use of LUS can assist with the diagnosis of COVID-19 and assist with clinical decision making for clinicians regarding therapy such as the need for prone positioning and the need for intubation.[138,139] Further, LUS is being used as an assessment tool by physiotherapists who have appropriate training.[140] Where physiotherapists have the education and competence to perform LUS, it may be used as an assessment modality in patients with COVID-19 (Box 4, item 4.19).

Physiotherapy management principles – mobilisation, exercise and rehabilitation interventions

Mobilisation, exercise and rehabilitation continue to be recommended for patients with severe and critical COVID-19[44] and has been widely implemented,[62,125,126,133,141–143] so only one new recommendation has been added (Box 5, item 5.3). Immobility and the development of muscle weakness and functional limitations appear common amongst hospitalised patients with severe and critical COVID-19.[142,144,145] While mobilisation, exercise and rehabilitation are an essential part of care, the ideal frequency, intensity, volume and type are unknown. One retrospective study suggested that a higher frequency and longer duration of physiotherapy for hospitalised patients with COVID-19 are associated with improved levels of mobility at hospital discharge and increased likelihood of discharge home.[142] However, increased frequency of physiotherapy may not influence changes in muscle strength[144] and further research and evaluation are needed.

In ICU and acute care settings, the safety and feasibility of early mobilisation, exercise and rehabilitation interventions are well established.[146,147] While guidelines for commencing these interventions exist, it is important to consider certain characteristics specific to COVID-19.

Cardiac dysfunction is a known complication of COVID-19 and may include signs of heart failure, cardiogenic shock, arrhythmia and myocarditis.[148] Physiotherapists should be aware that cardiac dysfunction may occur during their interventions and screen for identified cardiac dysfunction prior to implementing mobility, exercise and rehabilitation interventions. This includes ensuring awareness of known and/or provisional diagnoses of cardiac abnormalities and ongoing investigations (eg, cardiac-specific biomarkers like troponin and NT-proBNP). Additionally, physiotherapists should utilise clinical surveillance during physiotherapy interventions to prevent exacerbating cardiac signs and symptoms and/or to be aware of and identify possible new presentations of cardiac dysfunction. Autonomic dysfunction and orthostatic intolerances may also be present.[149] Interventions should not push patients to the point of symptom exacerbation (both during and after the exertion) or fatigue.

Table 2
The International Classification of Functioning, Disability and Health related to COVID-19. Factors to consider by physiotherapists[a].

Body structure and function	Activities (examples)	Participation (examples)
Dyspnoea	Unable to walk long distances	Unable to perform activities of daily living and/or return to work
Persistent cough	Unable to perform activities that trigger coughing	Emotional impact, social isolation, reduced productivity[182]
Weakness	Unable to stand for long periods	Reduced health-related quality of life
Fatigue	Unable to do household tasks (cleaning, shopping)	Difficulties with community activities
Pain (headache, chest and musculoskeletal pain)	Unable to participate in physical and recreational activities	Altered family roles and relationships
Poor memory, executive functioning and problem solving	Unable to concentrate on a task and unable to multitask	Return to work or studies (school, university, personal development courses) may be limited or impossible
Nightmares, flashbacks to ICU, anxiety, depression	Unable to sleep	Emotional impact, unable to enjoy usual activities, work or community roles

ICU = intensive care unit.
[a] Adapted from the Australian and New Zealand Intensive Care Society's COVID-19 Guidelines.[31]

Table 3
Assessment that may be considered by physiotherapists for patients with COVID-19 during transitions of care: ICU discharge[a], hospital discharge[b] and 6 to 8 weeks after COVID-19 infection[c].

Clinical area	Assessment items
Respiratory	Oxygen therapy requirements
	SpO_2 at rest and with exercise
	Dyspnoea at rest and with exertion
	Cough
	Presence of sputum and indications for airway clearance techniques
Physical	Autonomic dysfunction and orthostatic intolerances
	Post-exertional symptom exacerbation
	Muscle strength
	Physical function
	Exercise capacity/endurance (eg, 6-minute walk test)
	Level of mobility, walking aids required, walking distance and assistance required
	Balance
	Safety on stairs
	Ongoing rehabilitation needs
	Pain
	Pelvic floor and continence[183]
Other	Fatigue – activity-related or general malaise
	Sleep
	Delirium
	Cognitive function, including memory and concentration
	Social supports
	Return to work, family roles and recreational activities
	Consider referral to other healthcare professionals if indicated

SpO_2 = oxyhaemoglobin saturation.
[a] Clinical handover should occur with the ward staff about ongoing concerns at ICU discharge.
[b] Prepare a discharge letter to the primary health practitioner if patients require ongoing need for support.
[c] People with persistent symptoms post COVID-19 should be reviewed, either in person or via telehealth. Communicate with primary care practitioner regarding rehabilitation needs and ongoing support.

The presentation of silent hypoxaemia in acutely unwell patients is important for physiotherapists to consider, particularly during mobilisation, exercise and rehabilitation interventions. In the absence of evidence-based guidelines that may improve patient outcomes, caution is required and strategies should be used to attenuate desaturation associated with mobilisation, exercise and rehabilitation strategies. In addition to identifying how different positions – for example, side lie, semi-recumbent, sitting, forward lean, prone and semi-prone – may affect arterial or peripheral oxygenation and comfort for individuals,[131–133] functional activities, mobility and exercise should be trialled when deemed safe. A graduated and/or paced approach is recommended: for example, in a patient with critical COVID-19 who is on high-flow oxygen, first assessing the effect of a stepping transfer from bed to chair on dyspnoea, SpO_2 and blood pressure and allowing a period of observation or recovery before allowing the patient to walk or perform more vigorous activities.

In patients who have hypoxaemia and/or are receiving high levels of oxygen, have exertional hypoxaemia or silent hypoxaemia, several strategies may prevent desaturation. Interventions should be carefully graduated, commencing with low-intensity activities (eg, exercise performed in bed, simple limb exercises, or a passive transfer via slide board to a chair). Supplemental oxygen concentration and/or flow may be increased prior to mobilisation to maintain SpO_2 within targeted ranges (eg, 92 to 96% in most patients, or 88 to 92% in patients with hypercapnia due to chronic respiratory disease[6]). Short intervals of exercise or mobilisation and recovery can be used rather than continuous interventions and demand moderated by exercising partitioned muscle mass (eg, single limb exercises).[150] Ventilation with NIV should be considered, particularly if it is already in use and with consideration to environmental controls[135] and all patients should be informed about performing activities conservatively and at a safe pace that is manageable for their energy levels and within the limits of current symptoms.[149]

Performing activities at the bedside rather than moving away from the bed may be an important safety strategy for this patient group. Patients should be closely monitored (eg, dyspnoea/exertion, SpO_2, blood pressure, heart rate) during exercise, mobilisation and rehabilitation interventions and for a period afterwards due to the potential for later deterioration. Patients should not be pushed to the point of fatigue. Commencement of interventions in patients who are already below their targeted SpO_2 ranges should be avoided or limited to only essential functional activities (eg, transfer to a commode).

Recovery after COVID-19

Recommendations for recovery after COVID-19 is a new category within the physiotherapy recommendations and reflects the increasing awareness and evaluation of the long-term impairments that result from COVID-19 (Box 6). Many patients who are discharged from hospital after COVID-19 will have ongoing symptoms and functional impairment.[58] To address post-COVID conditions, it is important that patients are assessed for ongoing or new symptoms prior to hospital discharge, to identify potential therapies or health services that can be organised. Whether hospitalised or not, people who have had COVID-19 should also be evaluated at an appropriate period after initial infection to monitor and address symptoms of post-COVID conditions.

Table 2 provides examples of the impact that post-COVID conditions may have on function and participation. Muscle weakness, fatigue, impaired concentration and dyspnoea are commonly reported symptoms.[58] People may experience post-COVID conditions, regardless of whether they have been hospitalised or received home-based care.[151] Reduced functional capacity is common in COVID-19 ICU survivors[152] and inpatient rehabilitation may be required for some people.

At discharge from acute care, all patients and caregivers should be provided with advice and written information on recovery following COVID-19.[153] This should include what to expect during recovery, how to self-manage symptoms, and how to contact a health professional if they are worried about new, ongoing or worsening symptoms. Systematic screening of patients at 6 to 8 weeks after COVID-19 infection is useful to identify those patients with persistent symptoms who may require additional management.[154] Earlier review may be considered in patients who had critical COVID-19, were admitted to ICU and those with significant physical function limitations at hospital discharge. Persistent symptoms vary widely and are not always related to respiratory or physical function (eg, sleep disturbance, impairment of smell, memory and concentration[151]), so a multidisciplinary approach to care is frequently required. Internationally, resources have been created to assist people in recovery after COVID-19[155–158] and guidelines and screening tools have also emerged during the pandemic to guide multidisciplinary resource planning after hospital discharge.[31,149,154,159]

For physiotherapists, a suggested approach for screening across the continuum of hospital admission to discharge and return to the community is outlined in Table 3. Physiotherapy management of patients with impairments in physical function should include referral to inpatient or outpatient rehabilitation services, as clinically indicated. Rehabilitation programs should be individualised and adapted to the needs of the patient. In some cases, specialist rehabilitation services (eg, neurological rehabilitation) may be required. Patients may also integrate into existing services, like ICU follow-up clinics.

Large population studies are required to investigate the long-term impact of severe COVID-19 on pulmonary function and exercise capacity.[58] Emerging reports indicate that reductions in pulmonary function and exercise capacity are common. When monitored for periods up to 6 months after COVID-19 infection, changes in diffusing capacity for carbon monoxide and/or forced vital capacity were common[160–163] and 6-minute walk test results were significantly lower[163] than expected in 23 to 27% of patients.[160,161] Alterations in lung function, exercise capacity, and symptoms may be similar to individuals with interstitial lung disease and exercise-induced desaturation may be more severe than seen in people with chronic

obstructive pulmonary disease.[164] However, exercise-induced desaturation appears to occur in a small proportion (2 to 9%) of survivors of severe COVID-19.[161,163]

Pulmonary rehabilitation models have been shown to be effective in chronic lung disease[165–167] and may reduce symptoms such as dyspnoea and fatigue,[165,167] which are common to post-COVID conditions. They are often applied in traditional outpatient models but are evolving, with efficacy shown with alternative models, including telerehabilitation.[168] The use of pulmonary rehabilitation models that have been adapted for COVID-19 appear to show potential benefit, including the implementation of inpatient pulmonary rehabilitation models[169] and outpatient-based pulmonary rehabilitation.[170,171] Telerehabilitation after hospitalisation has also shown benefits in exercise capacity, muscle strength and physical components of quality of life in COVID-19.[172] Other models of rehabilitation (eg, cardiac rehabilitation) and types of physical activity may be utilised and options will vary depending on the individual factors, including age, access to services, degree of disability and identified risk factors.

Regardless of the model used for exercise-based rehabilitation, programs that include or are designed specifically for people with COVID-19 should incorporate disease-specific education on post-COVID conditions, screening related to specific complications and monitoring for post-exertional symptom exacerbation. When prescribing physical interventions to people who have post-COVID conditions, they should be screened for new or worsened cardiac impairment, post-exertional symptom exacerbation, exertional oxygen desaturation, autonomic dysfunction and orthostatic intolerance.[149]

Providing guidance for exercise training to people post-COVID should always be done with caution, as it is possible for symptoms to be exacerbated. This may include worsening of fatigue, cognitive dysfunction or any other symptoms experienced following COVID-19.[149] Where post-exertional symptom exacerbation is identified, adaptations may include the "Stop. Rest. Pace" approach, activity management or pacing.[149] Patients should be encouraged to contact their healthcare team if they experience any 'red flag' symptoms with exercise, including new or worsening breathlessness, chest pain, tachycardia, palpitations, confusion, difficulty speaking or understanding speech, or weakness in their face, arm or leg.[173]

There is a need to recognise the demand that respiratory pandemics are likely to place on rehabilitation teams as people move along the disease trajectory from acute and inpatient care, through to the ambulatory settings and onwards into the community.[174] To be effective in reducing disability-related outcomes, COVID-19 interventions, including rehabilitation programs, must be considered as part of early planning and additional resources allocated as part of the pandemic response.[174]

While not yet part of any international or national guidance on prevention, there is increasing understanding of the role of health and lifestyle risk factors in the susceptibility to COVID-19 infection and severity. Physical activity is a modifiable risk factor and contributor to the disease burden for multiple chronic conditions, and physiotherapists play an important role in health promotion. Having a higher habitual level of physical activity can lower a person's risk of acquiring community-acquired infectious diseases.[175] Regular physical activity before vaccinations may also increase the subsequent level of antibody produced.[175] Physical inactivity has been identified as a strong predictor of the impact of severe COVID-19 infection, with people who were inactive prior to the pandemic at greater risk of hospitalisation, ICU admission and death.[176] Physiotherapists must promote effective health education programs, including smoking cessation, nutrition, weight control and physical activity, to improve the health of their community and potentially minimise the impact of the pandemic.[177,178]

Strengths and limitations

The original recommendations[1] were developed using COVID-19 clinical practice guidelines from reliable resources and organisations, combined with the clinical and academic expertise of the international authorship panel. The overwhelming uptake and adoption of the publication is testament to its strengths and resonance within the physiotherapy community world-wide. At the time of preparation of this manuscript, the original manuscript[1] had been downloaded more than 180,000 times, endorsed by 10 organisations and translated into 26 languages.

While more is being learnt about COVID-19, and an exponential rise in research specific to COVID-19 is now presenting, physiotherapy-specific publications are limited and often confined to observational reports or audits. Information from these resources has been used whenever possible, but further evidence describing the role of physiotherapy world-wide and/or clinical studies are needed. A further limitation is the focus of the recommendations on adult acute hospital settings. Definitions for COVID-19 disease severity exist for children and differ to that of adults.[5] The long-term implications of COVID-19 are also now being documented, with the potential role of outpatient or community-based rehabilitation becoming apparent and specific recommendations in this context have been incorporated into the updated recommendations.

Footnotes: [a] These updated recommendations are intended for use in adults only. This document has been constructed using existing medical guidelines, relevant literature and expert opinion. The authors have made considerable effort to ensure that the information contained with the recommendation is accurate at time of publication. The information provided in this document is not designed to replace local institutional policies, override public health directives or replace clinical reasoning for individual patient management. The authors are not liable for the accuracy, information that may be perceived as misleading, or completeness of information in this document.

[b] These recommendations have been endorsed by American Physical Therapy Association, APTA Acute Care Academy, Associação Brasileira de Fisioterapia Cardiorrespiratória e Fisioterapia em Terapia Intensiva, Association of Chartered Physiotherapists in Respiratory Care, Australian Physiotherapy Association, AXXON Physical Therapy in Belgium, Canadian Physiotherapy Association, Cardiopulmonary Rehabilitation Group of the South African Society of Physiotherapy, Hong Kong Physiotherapy Association, International Confederation of Cardiorespiratory Physical Therapists, Japanese Society of Cardiovascular Physical Therapy, Japanese Society of Intensive Care Medicine, Japanese Society of Physical Therapy for Diabetes Mellitus, Japanese Society of Respiratory Physical Therapy, Physiotherapy New Zealand, Société de Kinésithérapie de Réanimation, and World Physiotherapy.

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