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## Rehabilitation Recommendations for Adult Patients with COVID-19

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# REHABILITATION RECOMMENDATIONS FOR ADULT PATIENTS WITH COVID-19

## RECOMENDACIONES PARA LA REHABILITACIÓN DE PACIENTES ADULTOS CON COVID-19

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### ABSTRACT

**Introduction:** The SARS-CoV-2 coronavirus is a new pathogen causing COVID-19 disease, ranging from an asymptomatic infection to a critical condition dependent on mechanical ventilation. Rehabilitation interventions contribute for the prevention and treatment of related complications and associated disability. **Objectives:** Describe rehabilitation recommendations for adult patients with COVID-19. **Methods:** A literature search was carried out. Databases and portals were consulted using the following terms and their equivalents: SARS-CoV2, COVID-19, rehabilitation, physiotherapy. The search was carried out in Spanish, English, Chinese and Italian languages, with a time window between January 2010 and April 2020. **Results:** 23 publications met the predetermined inclusion and exclusion criteria. Based on the information obtained, recommendations and tables were prepared about the clinical classification of COVID-19, medical behavior to be followed according to severity, general care and rehabilitation interventions in adult patients with COVID-19. **Conclusions:** Rehabilitation interventions are essential and indispensable resources for the multidisciplinary treatment of patients with COVID-19, despite of the low quality of the available evidence.

**Key words:** COVID-19; SARS-CoV-2; Physical medicine and rehabilitation; Respiratory rehabilitation; Respiratory physiotherapy. (source: MeSH NLM).

### RESUMEN

**Introducción:** El coronavirus SARS-CoV-2 es un nuevo patógeno causante de la enfermedad COVID-19, que varía desde una infección asintomática hasta un cuadro crítico dependiente de ventilación mecánica. Las intervenciones de rehabilitación contribuyen a la prevención y tratamiento de las complicaciones relacionadas y la discapacidad asociada. **Objetivos:** Describir las recomendaciones para la rehabilitación de pacientes adultos con COVID-19. **Métodos:** Se realizó una búsqueda en la literatura. Se consultó en bases de datos y portales utilizando los siguientes términos y sus equivalentes: SARS-CoV2, COVID-19, rehabilitación, fisioterapia. La búsqueda se realizó en idiomas castellano, inglés, chino e italiano, con una ventana de tiempo entre enero del 2010 y abril del 2020. **Resultados:** 23 publicaciones cumplieron con los criterios de inclusión y exclusión predeterminados. A partir de la información obtenida se elaboraron recomendaciones y tablas sobre la clasificación clínica de la COVID-19, conducta médica a seguir según gravedad, atención general e intervenciones de rehabilitación en pacientes adultos con COVID-19. **Conclusión:** Las intervenciones de rehabilitación son recursos esenciales e indispensables para el tratamiento multidisciplinario de pacientes adultos con COVID-19, a pesar de la baja calidad de la evidencia disponible.

**Palabras clave:** COVID-19; SARS-CoV-2; Medicina física y rehabilitación; Rehabilitación respiratoria; Fisioterapia respiratoria (fuente: DeCS BIREME).

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## INTRODUCTION

SARS-CoV-2 coronavirus is a new pathogen that emerged in 2019 and caused the COVID-19 disease, which has extended rapidly throughout the world and has become an international public health emergency<sup>(1)</sup>. It is highly contagious, and it differentiates itself from other respiratory viruses in that it can present possible transmission events two to three days after onset of symptoms<sup>(2)</sup>.

It is transmitted through respiratory secretions: rhinorrhea, sneezing and cough droplets that land on surfaces, disseminating in a space of approximately one to two meters distance from the infected person<sup>(3)</sup>. SARS-CoV2 survives at least one day in hard surfaces and up to eight hours in soft surfaces. The virus is transferred through manual contact over a contaminated surface and after a person touches their mouth, nose or eyes. The infected air particles created while sneezing or coughing remain in the air during at least three hours<sup>(4)</sup>. These air particles can be inhaled by another person and deposited in the ocular mucous membranes<sup>(3)</sup>.

People with COVID-19 may present a clinical presentation similar to the flu, with fever (89%), cough (68%), fatigue (38%), sputum production (34%) and/or dyspnea (19%)<sup>(5)</sup>. The severity spectrum of this disease varies from an asymptomatic or mild acute respiratory infection to severe or critical with shock and hypoxic respiratory insufficiency, which could lead to death. The current reports approximate that 80 % of cases are asymptomatic or mild, 15% are severe which require oxygen therapy, and 5% are critical cases that require mechanical ventilation and vital support<sup>(6)</sup>.

Currently, the mortality rate is 3 to 5%. The admission rate into an intensive care unit (ICU) is approximately 5%<sup>(5)</sup>. A little less than half of hospitalized patients (42%) require oxygen therapy<sup>(5)</sup>. According to the emerging data, individuals with greater risk of developing severe or critical COVID-19 clinical presentations, that require hospitalization and/or support in ICU, are mostly depending on a variant, elderly, of masculine sex, with at least one coexisting comorbidity, with more elevated disease severity indices, high levels of D Dimer and/or lymphocytopenia<sup>(5-7)</sup>.

An important percentage of the population seen in the Physical and Rehabilitation Medicine specialty has COVID-19 risk factors. Many of them receive rehabilitation therapy in the emergency department,

critical area or hospitalization floors, finding themselves with greater exposure to infection in the COVID-19 pandemic frame. It is therefore urgent that assistant personnel in charge know the main characteristics of this disease, preventive measures, and risk control. The planning and preparation strategies for assistant resources, and the recommendations for COVID-19 patient care.

## METHODS

A literature review was conducted which provided recommendations for rehabilitation of adult patients with COVID-19. Scientific data bases and portals were consulted, such as PubMed, sCielo, Elsevier, Lilacs, Medigraphic, Informed, and portals from public and private associations and foundations, using the following terms and its equivalents: SARS-CoV2, COVID-19, rehabilitation, physiotherapy. The search was done in Spanish, English, Chinese and Italian, with a window of time between January 2010 and April 2020.

The inclusion criteria were thematic review publications, systematic reviews, meta-analyses, clinical practice guidelines and subject matter experts' comments (in this case, it was required that the document or article have the endorsement of an institution with national or international recognition, as well as the author's employment and academic credentials). We excluded articles with duplicate information, the endorsement of an institution in more extensive studies or those that consisted in case reports or letters to the editor. Articles that contained incomplete or imprecise information were also excluded.

Additional information searches were performed in the bibliographic reference lists of the articles included in the study in order to avoid the loss of relevant information. We also obtained information from the web portals from the World Health Organization (<http://www.who.int>), and the Centers for Disease Control and Prevention (<http://www.cdc.gov>).

## RESULTS

In the course of the initial search, 56 publications were identified in different data bases. After reading the title and summary, 20 of these publications were eliminated due to duplication in different data bases. Once the complete publications were evaluated, 13 were excluded for containing information that did



not correspond with the study objectives. Finally, 23 publications (8-20,22-26,28,-30,33,35) met the predetermined inclusion and exclusion criteria, although in some of these all the required information is not reported. 47.9% corresponded to publications in English<sup>(11)</sup>, 43.5%<sup>(10)</sup> in Spanish, 4.3%<sup>(1)</sup> in Italian and 4.3%<sup>(1)</sup> in Chinese. The most important publications

are summarized in Table 1. Recommendations and tables about COVID-19 clinical classification, medical care that should be followed according to disease severity, general attention and rehabilitation interventions of adult patients with COVID-19 are elaborated from the information obtained.

**Table 1.** Most important identified publications.

Author	Country	Study objective	Methodology	Relevant results	Conclusions
Thomas, et al.	Australia	Describe physiotherapy recommendations for COVID-19 patients in the hospital setting.	Clinical practice guide.	<ul style="list-style-type: none"> <li>• Recommendations for Physiotherapy work force planning and preparation.</li> <li>• Recommendations for physiotherapy interventions, including EPP requirements.</li> </ul>	These recommendations were developed by an international team of experts in intensive care and acute cardiorespiratory care. They have been designed for adult patient exclusive use.
McNeary L, et al.	United States	Help specialists in Physical Medicine and Rehabilitation in hospital rehabilitation centers in patient care during this public health emergency.	Review	<ul style="list-style-type: none"> <li>• Actions to limit spread.</li> <li>• Changes in rehabilitation facilities for acute patients to increase hospital capacity.</li> <li>• Actions according to probable test or known positive test.</li> <li>• Staffing actions.</li> <li>• Acute patient treatment.</li> <li>• Post COVID-19 patient rehabilitation.</li> <li>• Establish a continuity plan.</li> <li>• Consider its facility needs.</li> </ul>	Hospital emergency preparedness frequently do not take into account specific matters in hospital rehabilitation. The CAN model may be used to prepare in case of natural disasters, including COVID-19. Patient and personnel safety must be prioritized with regard to the provision of rehabilitation services in our communities.

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SEPAR Respiratory Physiotherapy Area	Spain	Update SARS-CoV2 physiopathology information and elaborate on the respiratory physiotherapy interventions, especially in three assistance scenarios which have greater relevance: hospitalization admission, ICU admission, and posterior phase after hospital discharge.	Clinical practice guide	<ul style="list-style-type: none"><li>• Updated information about COVID-19</li><li>• Exposure protection and prevention.</li><li>• Respiratory physiotherapy interventions in COVID-19 patients.</li></ul>	The general objectives of the respiratory physiotherapy interventions in COVID-19 patients are: preserve and improve respiratory function, improve associated symptomatology (dyspnea and muscular fatigue), favor drainage of secretions, improve functional capacity, prevent and reduce complications. Improve adaptation to daily activities and improve quality of life.
Chinese Association of Rehabilitation Medicine.	China	Combine expert opinions in the front-line fight against the COVID-9 pandemic to guide pulmonary rehabilitation.	Clinical practice guide.	<ul style="list-style-type: none"><li>• Basic principles in respiratory rehabilitation.</li><li>• Respiratory rehabilitation recommendations for mildly ill patients during hospitalization.</li><li>• Respiratory rehabilitation recommendations for moderately ill patients during hospitalization.</li><li>• Respiratory rehabilitation recommendations for severely or critically ill patients during hospitalization.</li><li>• Respiratory rehabilitation treatment for discharged patients.</li><li>• Traditional Chinese medicine respiratory rehabilitation.</li></ul>	Combining the latest research results and accumulated clinical experience on respiratory rehabilitation and COVID-19 from China and other countries, the respiratory rehabilitation time was added with caution and the respiratory rehabilitation protocol directed at clinical issues in different stages was reviewed, with respect to the first edition.



Lazzeri, et al.	Italy	To share information worldwide with physiotherapists involved in the care of patients affected by COVID-19. Taking into account the complexity and frailty of COVID-19 patients, we recommend, when possible, to have as a work group, physiotherapists with experience and/or specialized training in respiratory physiotherapy.	Clinical practice guide	ARIR, in collaboration with AIFI, issued this document to provide a quick reference guide for respiratory physiotherapy to structure treatments in the management of acute stages in patients suffering from severe COVID-19. The main goal of these treatments is to reduce secondary effects in this patient population while maximizing healthcare professional protection.
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### CLINICAL CLASSIFICATION

It is important to know the disease clinical classification in order to determine the level of severity of suspected, probable and confirmed COVID-19 cases, as well as the recommended clinical behavior according to the table (Table 2)<sup>(8,9)</sup>.

**Table 2.** COVID-19 clinical classification and recommended behavior according to severity.

Definition	Mild clinical presentation	Moderate clinical presentation	Severe clinical presentation
Symptoms	Everyone with acute respiratory infection and two or more of the following criteria: <ul style="list-style-type: none"> <li>• Cough.</li> <li>• General malaise.</li> <li>• Sore throat.</li> <li>• Fever.</li> <li>• Nasal congestion.</li> </ul>	Everyone with acute respiratory infection with at least one of the following criteria: <ul style="list-style-type: none"> <li>• Oxygen saturation of (SpO2) ≤ 93%.</li> <li>• Respiratory rate (RR) &gt; 22 x'.</li> <li>• Dyspnea.</li> <li>• Disturbance of consciousness.</li> <li>• Hypotension or signs of shock.</li> <li>• Clinical or radiological signs of pneumonia.</li> <li>• Lymphocytes &lt; 100 cells/μL.</li> </ul>	Everyone with acute respiratory infection with two or more of the following criteria: <ul style="list-style-type: none"> <li>• SpO2 &lt; 90%.</li> <li>• RR &gt; 30 x'.</li> <li>• PaO2/FiO2 &lt; 300.</li> <li>• PaO2 &lt; 60 mmHg.</li> <li>• PaCO2 &lt; 32 mmHg.</li> <li>• Systolic blood pressure (SBP) &lt; 100 mmHg.</li> <li>• Mean arterial pressure (MAP) &lt; 65 mmHg.</li> <li>• Serum lactate &gt; 2 mOsm/L.</li> <li>• Clinical signs of muscular fatigue: use of accessory musculature, thoracic-abdominal imbalance, nasal flaring, etc.</li> <li>• Infiltrates &gt; 50% of pulmonary fields in 24 to 48 hours.</li> </ul>
Recommended behavior	No hospitalization required. Home confinement no less than 14 days and medical follow-up. require hospitalization.	Requires hospitalization.	Requires hospitalization in the intensive care unit (ICU) due to respiratory failure or signs of sepsis.



## GENERAL RECOMMENDATIONS FOR COVID-19 ADULT PATIENT CARE

1. Preventive measures and risk control compliance for patients and assistant personnel in Physical Medicine and Rehabilitation is mandatory<sup>(10)</sup>.
2. It is recommended that rehabilitation interventions in COVID-19 patients be performed in the hospital setting (respiratory management, postural management, early mobilization, etc.)<sup>(11)</sup>.
3. It is recommended to continue with outpatient care in Physical Medicine and Rehabilitation through telemedicine services, whenever possible<sup>(12,13)</sup>.
4. It is recommended to limit assistant personnel to its absolute required minimum for COVID-19 patient care<sup>(14-16)</sup>.
5. It is recommended that assistant personnel enter in areas with suspected, probable, or confirmed COVID-19 cases<sup>(11,17)</sup>. Begin rehabilitation interventions whenever prior medical evaluation indicates them.
6. It is recommended that rehabilitation interventions in COVID-19 patients be in charge of a multidisciplinary rehabilitation team<sup>(16)</sup>.
7. It is recommended to keep a permanent coordination between the rehabilitation team<sup>(14,18)</sup>.
8. It is recommended to evaluate the COVID-19 patient through subjective assessment and basic examination, without direct contact, as a first option<sup>(11)</sup>.
9. It is recommended to offer guidelines to assistant personnel in hospitalization and in the intensive care unit (ICU) in order to have the Physical Medicine and Rehabilitation referral at the appropriate time. The unnecessary COVID-19 patient care will have a negative impact on the EPP supplies<sup>(11,12)</sup>.
10. It is recommended to begin with positional management and nursing care guidelines associated during the acute phase of COVID-19<sup>(11,14,18,19)</sup>.
11. It is recommended to begin with rehabilitation interventions during the COVID-19 acute phase only if the benefit of the same is justified and outweighs the risk. If accepted, it should be defined in an individualized manner<sup>(11,14,18,19)</sup>.
12. It is recommended to begin rehabilitation

interventions for the treatment of non-respiratory comorbidities once the severe or critical form of COVID-19 has been resolved<sup>(16,18)</sup>.

13. One of the main objectives is to minimize the loss of autonomy. If the patient preserves cognitive function and has a Barthel index greater or equal to 65, it is recommended to maximize the use of audiovisual technologies and/or technical means for remote communication and instruction<sup>(20)</sup>.
14. Education and therapeutic guidelines must be offered to the patient, their family and/or caretaker, in respect of:
  - Understanding the disease, condition and/or disability under the perspective of Physical Medicine and Rehabilitation<sup>(18)</sup>.
  - Understanding of the rehabilitation therapeutic plan to reach cooperation and commitment from the patient, their family and/or their caretaker<sup>(18)</sup>.
  - Need for regular rest to guarantee adequate sleep<sup>(18)</sup>.
  - Adopting a balanced diet and abandoning unhealthy habits<sup>(18)</sup>.

## REHABILITATION INTERVENTIONS FOR ADULT PATIENTS WITH COVID-19

1. There are multiple objectives<sup>(11,14,16,18)</sup>.
  - Reducing duration of hospital stay.
  - Reducing the weaning time from mechanical ventilation.
  - Dyspnea improvement in moderate and severe cases.
  - Prevention and/or management of complications associated to COVID-19 and mechanical ventilation and prolonged immobilization.
  - Prevention of the consequent dysfunction and/or disability.
  - Improvement of functional capacity and quality of life.
  - Coadjuvant treatment for anxiety and depression.
2. It is recommended that the medical evaluation prior to the start of rehabilitation interventions consider the functional state, level of





- consciousness and respiratory, cardiovascular, and musculoskeletal systems<sup>(18)</sup>.
3. It is recommended to perform pulmonary auscultation with the hospital stethoscope. If not possible, disinfect it before and after each evaluation<sup>(14)</sup>.
  4. It is recommended to assess recent laboratory exams and imaging studies: arterial gas analysis, cardiac markers, D-dimer level, lymphocyte count, prothrombin time, pulmonary radiological progression, etc.<sup>(5-7,14)</sup>.
  5. Oxygen therapy use during patient mobilization is recommended if necessary<sup>(18)</sup>.
  6. Result measures for a more objective assessment are recommended. For example, the Perme Score in a critical COVID-19 patient in ICU<sup>(21)</sup>.
  7. Rehabilitation interventions may be recommended in COVID-19 patients, depending in what phase they are:
    - Seating and semi-seating<sup>(11,18,19,21)</sup>.
    - Prone positioning<sup>(11,14,19,22-25)</sup>.
    - Frequent postural changes<sup>(11,14,18,21)</sup>.
    - Mobilization and transfers<sup>(11,14,18,25)</sup>.
    - Training of periferic musculature<sup>(11,14,18,21)</sup>.
    - Training of respiratory musculature<sup>(14,18,21)</sup>.
      - a. Respiratory exercises<sup>(14,18,21)</sup>.
      - b. Threshold valve for inspiratory muscle training (IMT)<sup>(14)</sup>.
    - Closed circuit secretion suctioning<sup>(11,19)</sup>.
    - Alvelolar recruitment maneuvers<sup>(11,19,22-24,26)</sup>.
      - a. Continuous CPAP<sup>(26)</sup>.
    - Directed coughing maneuvers<sup>(11,14)</sup>.
    - Bronchial drainage techniques.
      - a. Positive expiratory pressure (PEP) devices<sup>(14,18,21)</sup>.
    - Position drainage techniques<sup>(11,14,21)</sup>.
    - Directed coughing instruments.
      - a. Mechanical insufflation-exsufflation<sup>(14,15)</sup>.
    - High frequency osscillating instruments<sup>(14,18)</sup>.
    - Neuromuscular electrical stimulation (NMES)<sup>(14,18,21)</sup>.
  8. Rehabilitation interventions not recommended in COVID-19 patients during the acute phase:
    - Manual mobilization of the thoracic cage<sup>(19,21,24)</sup>.
    - Inspiratory muscle training<sup>(11,19,21,24)</sup>.
    - Incentive spirometer<sup>(11,19,21,24)</sup>.
    - Alveolar recruitment maneuvers<sup>(23,24)</sup>.
      - a. Progressive increments of PEEP<sup>(26)</sup>.
    - Bronchial drainage techniques.
      - a. Positive expiratory pressure instruments (PEP)<sup>(11,19-21,24)</sup>.
    - Respiratory reeducation techniques.
      - b. Diaphragmatic respiration<sup>(19,21,24)</sup>.
      - c. Pursed lip breathing<sup>(19,21,24)</sup>.
    - Pulmonary hyperinflation<sup>(11,14,21)</sup>.
    - High frequency oscillatory devices<sup>(11,14,20)</sup>.
  9. It is recommended to consider safety criteria for the start and suspension of COVID-19 patient rehabilitation interventions (Tables 3 and 4)<sup>(14,18,27)</sup>.

**Table 3.** Safety criteria for the start of rehabilitation interventions.

Respiratory	Cardiovascular	Neurological	Others
<ul style="list-style-type: none"> <li>• Fraction of inspired oxygen (FiO<sub>2</sub>) ≤ 0.60.</li> <li>• SatO<sub>2</sub> ≥ 90%.</li> <li>• FR ≥ 5 o ≤ 40 x'.</li> <li>• Positive end-expiratory pressure (PEEP) ≤ 10 cmH<sub>2</sub>O.</li> <li>• Permeable airway.</li> <li>• Supine position</li> <li>• ≥ 24 hours.</li> </ul>	<ul style="list-style-type: none"> <li>• SBP ≥ 90 mmHg and ≤ 180 mmHg.</li> <li>• MAP ≥ 65 mmHg and ≤ 110 mmHg.</li> <li>• HR ≥ 40 x' and ≤ 120 x'.</li> <li>• Serum lactate ≤ 4 mmol/L.</li> <li>• Absence of signs of shock</li> <li>• Absence of active or recent hemorrhage.</li> <li>• Absence of recent arrhythmia.</li> <li>• Absence of acute myocardial ischemia</li> <li>• Absence of complicated deep venous thrombosis (DVT) and pulmonary thromboembolism (PTE).</li> <li>• Absence of aortic stenosis.</li> </ul>	<ul style="list-style-type: none"> <li>• Richmond Agitation-Sedation Scale (RASS) between -2 and +2.</li> <li>• Intracranial Pressure (ICP) &lt; 20 cm H<sub>2</sub>O.</li> <li>• Absence of delirium.</li> <li>• Absence of craniotomy with recent subgaleal suction drain placement.</li> </ul>	<ul style="list-style-type: none"> <li>• Body temperature &lt; 38.5 °C.</li> <li>• Hemoglobin &gt; 7 gr/dL.</li> <li>• Platelets &gt; 20,000 cells/mm<sup>3</sup>.</li> <li>• Leukocytes between 4,300 and 10,800 cells/mm<sup>3</sup>.</li> <li>• Blood glucose &gt; 70 and &lt; 200 mg/dL.</li> <li>• Absence of unstable fracture or open abdominal wound.</li> <li>• Absence of new and progressive damage to renal and hepatic function.</li> </ul>

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**Table 4.** Safety criteria for the suspension of rehabilitation interventions.

Respiratory	Cardiovascular	Neurological	Others
<ul style="list-style-type: none"> <li>• SatO<sub>2</sub> &lt; 90%.</li> <li>• SatO<sub>2</sub> decrease &gt; 4%.</li> <li>• RR &lt; 5 or &gt; 40 x'.</li> <li>• Accidental extubation.</li> <li>• Patient-mechanical ventilator asynchrony.</li> </ul>	<ul style="list-style-type: none"> <li>• SBP &lt; 90 mmHg or &gt; 180 mmHg.</li> <li>• MAP &lt; 65 mmHg, &gt; 110 mmHg or with a variation of &gt; 20%.</li> <li>• HR &lt; 40 x' or &gt; 120 x'.</li> <li>• Signs of shock.</li> <li>• Arrhythmia onset.</li> <li>• Acute myocardial ischemia onset.</li> </ul>	<ul style="list-style-type: none"> <li>• RASS &lt; -2 or &gt; +2.</li> <li>• ICP &gt; 20 cm H<sub>2</sub>O.</li> <li>• Hyperactive delirium, agitation, or coma.</li> <li>• Uncontrolled convulsions.</li> </ul>	<ul style="list-style-type: none"> <li>• Body temperature &gt; 38.5 .</li> <li>• Pain, fatigue or dyspnea.</li> <li>• Radiologic progression of thoracic image &gt; 50% in the last 24 to 48 hours.</li> <li>• Accidental removal of vascular Access or other instruments.</li> <li>• Patient refusal to continue with rehabilitation.</li> </ul>



10. It is recommended to forego rehabilitation interventions in high risk of viral transmission (Table 5)<sup>(11,14,15,19,20,24,25)</sup>.
11. The use of strategies for risk reduction of COVID-19 during rehabilitation interventions is recommended:
  - Use of filters of high efficacy and failed attempts at “weaning” during invasive mechanical ventilation<sup>(14)</sup>.
  - Use of double nozzle, high efficacy filter and adequate sealant of interphase during non-invasive mechanical ventilation<sup>(14)</sup>.
  - Use of closed circuit during secretion aspirations<sup>(14)</sup>.
  - Use of a lower Flow rate or same as 30 liters per minute during CNAF<sup>(14)</sup>.
  - Use of disposable surgical mask during CNAF, which should be changed every 6-8 hours<sup>(19,24)</sup>.
  - Use of individual hospital space with negative pressure and closed doors<sup>(11,17)</sup>.
  - Early intubation during cardiopulmonary resuscitation<sup>(14)</sup>.

**Table 5.** Rehabilitation interventions with high viral transmission risk.

<ul style="list-style-type: none"> <li>• Non-invasive mechanical ventilation.</li> <li>• Nebulization.</li> <li>• High Flow oxygen therapy with Venturi mask or nasal cannula.</li> <li>• Secretion aspiration.</li> <li>• Aerosol therapy.</li> <li>• Inspiratory muscle training.</li> <li>• Pulmonary hyperinflation.</li> <li>• Positional drainage techniques.</li> <li>• Bronchial drainage techniques.</li> <li>• Directed coughing devices.</li> <li>• Positive expiratory pressure devices.</li> <li>• High frequency oscillation devices.</li> <li>• Endotracheal intubation and extubation.</li> <li>• Percutaneous and surgical tracheotomy.</li> <li>• Bronchoscopy.</li> <li>• Cardiopulmonary resuscitation.</li> </ul>
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12. Tiered strategy for ventilation support in ARDS from COVID-19<sup>(24)</sup>
    - a. Conventional oxygen therapy.
    - b. High flow oxygen therapy (HFO) with high flow nasal cannula (HFNC).
    - c. Non-invasive mechanical ventilation (NIMV): CPAP/BIPAP.
    - d. Invasive mechanical ventilation (IMV) with pulmonary protection.
- insufficiency and shock due to vasopressors. (28) The majority are admitted with multiorgan dysfunction syndrome, including acute respiratory distress syndrome (67%), acute renal failure (29%), hepatic insufficiency (29%), and cardiac insufficiency (23%). 30 The prognosis is poor and half pass away<sup>(29)</sup>.
- The stage and prolonged mechanical ventilation in ICU contribute in generating complications in the critical COVID-19 patient, such as the post-intensive care syndrome (PICS) with an impact in the physical, cognitive and mental function, polyneuropathy and/or associated myopathy, intensive care unit acquired weakness (ICU-AW), etc.<sup>(14, 31)</sup>.

## REHABILITATION OF ADULT PATIENTS WITH COVID-19 IN ICU

Approximately 20-25% of hospitalized patients with COVID-19 require ICU care, generally for a long period of time<sup>(28)</sup>. The main reasons are respiratory

1. It is recommended to identify and move better qualified assistant personnel, with greater experience in emergency services or critical areas and trained in cardiorespiratory rehabilitation for the critical COVID-19 patient care, as often as possible, to provide a rapid and adequate decision

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- making and providing supervision and support to the assistant personnel with less experience<sup>(11)</sup>.
2. It is recommended to mainly assess the clinical and ventilatory parameters during the medical evaluation of the critical patient with COVID-19.<sup>(14)</sup>. The periferic muscular strength can be assessed bilaterally with the Medical Research Council sum score (MRC-SS) scale<sup>(14)</sup>.
  3. The use of established protocols in critical areas related to rehabilitation interventions is recommended<sup>(11,14,16,17,19)</sup>.
  4. It is recommended to not perform rehabilitation interventions during the hemodynamic or respiratory unstable periods in the critical patient with COVID-19<sup>(15,18,20)</sup>.
  5. It is recommended to limit rehabilitation interventions in the absolute required minimal and avoid the added work of respiratory work in the critical patient with COVID-19<sup>(11,14,19)</sup>.
  6. A daily Schedule of the rehabilitation interventions based on the clinical and functional state of the critical patient with COVID-19 is recommended<sup>(14)</sup>.
  7. It is recommended to start rehabilitation interventions in the critical patient with COVID-19 at least 48 hours after IMV<sup>(14)</sup>.
  8. The majority of consensus about early mobilization include passive mobilization in the non-compliant patient, passive and active postural changes, active-assisted to active-resistant mobilization, verticalization in an inclined plane, seating within and outside the bed, standing, transferring to the chair and planned and progressive gait training assistance<sup>(14,21)</sup>.
  9. It is recommended to assess the progression of the critical patient with COVID-19 in the early mobilization protocol according to the security criteria<sup>(14)</sup>.
  10. It is recommended to perform rehabilitation services in a critical patient with COVID-19 and PEEP>10 cmH<sub>2</sub>O first evaluating the clinical stability through a rehabilitation team consensus<sup>(25)</sup>.
  11. The rehabilitation treatment is secure in select patients with artificial airway passage (endotracheal tube or tracheostomy cannula with in situ filter)<sup>(14)</sup>.
  12. 12. Electrophysiological studies and muscular ultrasounds under the care of the physiatrist

doctor in ICU may be performed, but they are of limited reproducibility in the COVID-19 pandemic<sup>(14)</sup>.

### Positioning and postural changes

1. It is recommended to gradually elevate the head of the bed 30 - 60° until reaching a seated or semi-seated position<sup>(11,18,19,21)</sup> and placing a pillow underneath the popliteal fossa to relax the abdomen and the lower extremities<sup>(18)</sup>.
2. The prone position in severe ARDS (PaO<sub>2</sub>/FiO<sub>2</sub> < 150) is recommended within the first 48-72 hours post- endotracheal intubation, during 12-16 hours per day<sup>(11,19,22-25,34)</sup>.
3. The prone position requires the participation of at least 3-5 people and requires special attention to TET and the peripheral paths<sup>(11,14,34)</sup>.
4. Prone position success criteria<sup>(19,24,34)</sup>.
  - PaO<sub>2</sub>/FiO<sub>2</sub> ≥ 150.
  - PEEP ≤ 10 cm H<sub>2</sub>O.
  - FiO<sub>2</sub> ≤ 0.60.

During at least 4 hours in post- intervention supine position.

5. Criteria for suspension of prone position:<sup>(19,24,34)</sup>
  - Decrease of PaO<sub>2</sub>/FiO<sub>2</sub> > 20%.
6. Contraindications for the prone position:<sup>(4,34)</sup>
  - MAP < 60 mmHg.
  - PIC > 25 mmHg.
  - Weight > 135 kg, massive hemoptysis, hemodynamic instability, facial or cervical trauma, vertebral instability, fracture (vertebral, pelvic or extremities), uncontrolled convulsions, extensive burns, etc.
7. Criteria for discontinuing the prone position:<sup>(34)</sup>
  - Improvement in the gaseous exchange and respiratory mechanism: alveolar recruitment, static compliance, ventilatory efficiency, etc.
  - Improvement in the clinical patient progress.
8. Potential complications of the prone position: migration from TET or peripheral paths, increase in intraabdominal pressure, occlusion of airway by secretion increase, edema or facial UPP, brachial plexus lesion, etc.<sup>(34)</sup>
9. Prescribing frequent postural changes are recommended.<sup>(11,14,18)</sup>



10. Postural drainage techniques are recommended. (11,14,21)
11. Modification of the ventilation/perfusion relation provokes a change (improvement or deterioration) of SatO2 and other criteria, therefore, after each postural change there will be a careful clinical evaluation and supervision.<sup>(14)</sup>

**Early mobilization**

1. Bed and bedside interventions are recommended (14,18).
2. Mobilization interventions that may be recommended in the critical patient with COVID-19:<sup>(11,14,18,25)</sup>
  - Passive, active-assisted, active or resisted mobilization.
  - Transfers
3. Seating (inside and outside the bed), standing, assisted gait training, neuromuscular facilitation, etc.
4. It is recommended that mobilization interventions in the critical patient with COVID-19 have a duration of 30 minutes maximum per session<sup>(18,25)</sup>.
5. The use of NMES is recommended, its application in lower extremities together with an early mobilization protocol may be considered as a complementary intervention to prevent ICU-AW (14,18,21).
6. It is recommended to apply material of individual use, for example, elastic bands (Theraband®) instead of weights<sup>(11,33)</sup>.

**Respiratory physiotherapy:**

1. We can consider the existence of 2 COVID-19 "phenotypes":<sup>(4,35)</sup>
  - Type L (Low) or "ARDS with predominant alteration of VPH reflex" : low elasticity, low VA/Q relation, low pulmonary weight and low recruitment capacity.
  - Type H (high) or "classic ARDS": high elasticity, high pulmonary weight, high recruitment capacity and high right or left shunt.
2. An adequate corporal hydration and airway humidification is recommended in the critical patient with COVID-9 in IMV, since due to the

ventilatory support algorithm they will receive passive humidification with HME type filters and will require PEEP and elevated FiO2 in certain moments during the process, which favors the presence of viscous secretions and difficult mobilization<sup>(14)</sup>.

3. Inspiratory muscle training and the use of phonation valves or intentional escape for phonation is not recommended until the critical patient with COVID-19 has overcome the acute phase and the transmission risk has been reduced<sup>(11,19,24)</sup>.
4. Inspiratory muscle training in the critical patient with COVID-19 may be recommended through diverse methods: diaphragmatic exercises, threshold valve for inspiratory muscle training (Threshold IMT®), biofeedback, adjustment of mechanical ventilator sensitivity, flow resistance and decrease in pressure support (PS)<sup>(14)</sup>.
5. The use of closed-circuit aspiration of secretions and manual thoracic compressions during expiration phase is recommended only in the critical patient with COVID-19 and exudative consolidation, mucous hypersecretion and/or secretion retention or difficulty in eliminating them, due to the high viral transmission risk<sup>(11,14,18,19,20)</sup>.
6. Alveolar recruitment maneuvers (40 cmH2O during 40 seconds) are recommended in the critical patient with COVID-19 and severe ARDS and refractory hypoxemia due to COVID-19 in low VM under a specialized monitoring due to the possible complications during the intervention: volutrauma, barotrauma and cardiovascular instability (decrease in arterial pressure and cardiac output)<sup>(11,14,19,22,26)</sup>.
7. Mechanical insufflation-exsufflation (In-Exsufflator Cough Assist®) is recommended only in select critical patients with COVID-19, with disposable circuits and at least 2 antibacterial filters in both ends, since it has shown to lower the rates of intubation and the time spent in ICU. The device should remain in the hospital as often as possible<sup>(14,15)</sup>.
8. Absolute contraindications for mechanical insufflation-exsufflation in the critical patient with COVID-19:<sup>(14)</sup>

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- Flail chest.
  - Undrained pneumothorax.
  - Cardiovascular instability.
9. Relative contraindications for mechanical insufflation-exsufflation in the critical patient with COVID-19:<sup>(14)</sup>
- Emphysematous bullae.
  - Cranioenchephalic traumatism.
10. The periodic verification of the endotracheal cuff pressure in the critical patient with COVID-19 in IMV: 25 - 30 cmH<sub>2</sub>O is recommended<sup>(24)</sup>.
11. The manual mobilization of the thoracic cage, diaphragmatic breathing or pursed lips breathing is not recommended in the critical patient with COVID-19 because it could represent an additional burden in the respiratory work and its efficacy in critical patients has not been determined<sup>(19,21,24)</sup>.
12. The manual hyperinflation in the critical patient with COVID-19 is not recommended due to that it generally implies the disconnection or opening of the mechanical ventilator circuit. It could be recommended in patients with pulmonary volume alteration, atelectasis, or reduction in respiratory flow. IMV should be applied without interruption and with a resuscitation bag preferably with PEEP valve<sup>(11,14)</sup>.
13. Positive expiratory pressure techniques (BubblePEP) are not recommended in the critical patient with COVID-19 since its efficacy has not been determined in critical patients<sup>(11,19,20,21,24)</sup>.
14. The use of oscillating devices of high frequency are not recommended in the critical patient with COVID-19 due to the high risk of viral transmission. If they are used, they must be disinfected<sup>(11,14,18,20)</sup>.
15. The use of incentive spirometer is not recommended in the critical patient with COVID-19 because it could represent an additional burden in respiratory work and its efficacy has not been determined in critical patients<sup>(11,19,21,24)</sup>.

## REHABILITATION OF HOSPITALIZED ADULT PATIENTS WITH COVID-19

1. Interventions that could be recommended in the hospitalized patient with COVID-19:<sup>(1,14,18,19,21)</sup>
- Seated or semi-seated position (30° - 60°).
  - Postural changes every 4-6 hours.
  - Passive, assisted-active, or resisted mobilization.
  - Transfers.
  - Seating (in or out of bed), standing, assisted gait training, neuromuscular facilitation, etc.
  - Aerobic, strength, flexibility and/or balance exercises.
  - Respiratory physiotherapy.
  - Education and therapeutic guidelines.
2. Recommendations on rehabilitation intervention intensity in the hospitalized patient with COVID-19:
- Between rest (1 METs) and mild physical activity ( $\leq 3.0$  METs).<sup>(18,25)</sup>
  - Modified Borg Scale  $\leq 3/10$ .<sup>(18,25)</sup>
  - It is advisable that fatigue not exist the day after.<sup>(18,25)</sup>
3. Recommendations on the frequency of rehabilitation interventions in the hospitalized patient with COVID-19:
- 1 - 2 sessions per day.<sup>(18)</sup>
  - Start minimum 1 hour after meals<sup>(18)</sup>.
4. Recommendations on the duration of rehabilitation interventions in the hospitalized patient with COVID-19:
- 15 - 45 minutes per session<sup>(18)</sup>.
5. Additional security criteria for the suspension of rehabilitation interventions in the hospitalized patient with COVID-19:
- Borg Scale  $\geq 4/10$ .<sup>(18,25)</sup>
6. Additional contraindications of the rehabilitation interventions in the hospitalized patient with COVID-19:
- SatO<sub>2</sub>  $\leq 95\%$ .<sup>(18)</sup>
  - Body temperature  $> 38$ .<sup>(18)</sup>



7. It is recommended to perform rehabilitation interventions in the hospitalized patients with COVID-19 through telerehabilitation, whenever possible, or keeping the recommended distance with the patient, family member or caretaker.<sup>(11,18,20,33)</sup>.
8. It is recommended to prioritize rehabilitation interventions in hospitalized patients with COVID-19 that are elderly, fragile, with multiple comorbidities or with prolonged hospital stay<sup>(14)</sup>.
9. Prone position may be recommended in the hospitalized patient with COVID-19 who is not intubated and with mild or moderate ARDS to help secretion drainage, recruit dorsal pulmonary regions and improve ventilation/perfusion relation<sup>(14)</sup>.
10. The type, intensity, frequency, and duration of the intervention will be chosen according to the clinical and functional state of the hospitalized patient with COVID-19 and their prior physical condition. Simple exercises will be started (knee and hip flexion, arm flexion and abduction, etc.) to later progress to more complex exercises<sup>(14)</sup>.
11. It is recommended to avoid long periods in decubitus and stasis in the critical patient with COVID-19. Se recomienda evitar largos períodos de decúbito e inmovilidad en el paciente hospitalizado por COVID-19<sup>(18,20)</sup>.
12. Remote supervision of SatO2, RR, BP, and HR are recommended and the respiratory muscle work of the hospitalized patient with COVID-19<sup>(14)</sup>.
13. The early mobilization of the hospitalized patient with COVID-19 is recommended, assessing the risk of thromboembolism, and once the prophylactic treatment is determined, evaluate the associated signs and symptoms to avoid possible derived complications<sup>(14)</sup>.
14. The use of individual therapeutical material is recommended in the hospitalized patient with COVID-19<sup>(11,33)</sup>.
15. The use of larger therapeutic equipment (assistant gait equipment, ergometers, chairs, verticalization tables, etc.) is recommended in the hospitalized patient with COVID-19 whenever its easy and appropriate disinfection is possible<sup>(11,33)</sup>.
16. The use of specialized therapeutic equipment (for example, Transmotion/Oxford® chairs) are not recommended in the hospitalized patient with COVID-19 except when the risk/benefit is justified in the functional task training or transfer progression and whenever its easy and appropriate disinfection is possible<sup>(11)</sup>.
17. The use of secretion drainage techniques are recommended (aspiration, postural drainage techniques, assisted cough maneuvers, etc.) only in the hospitalized patient with COVID-19 and exudative consolidation, mucosal hypersecretion, and/or secretion retention or difficulty in eliminating them, due to the high risk of viral transmission. Also in those with prior respiratory pathologies (cystic fibrosis, bronchiectasis, etc.) or respiratory muscular dysfunction (neuromuscular diseases, etc.) that have been used to prevent associated complications. It is recommended that the hospitalized patient with COVID-19 carry them out in an autonomous and supervised manner with the help of educational resources like brochures or videos through telerehabilitation<sup>(11,14,21)</sup>.
18. The use of positive expiratory pressure (Threshold® PEP) is recommended in the hospitalized patient with COVID-19 to prevent alveolar closure and improve the functional residual capacity, dyspnea control and gas interchange. The device will be individualized and non-transferable and must be used with an antibacterial and antiviral filter<sup>(14,18,21)</sup>.
19. The mechanical insufflation-exsufflation (In-Exsufflator Cough Assist®) use is recommended, with disposable circuits and at least 2 antibacterial filters in both ends, in the hospitalized patient with COVID-19. The device should be left in the hospital whenever possible<sup>(14)</sup>.



## CONCLUSION

1. Rehabilitation interventions are essential and indispensable resources for the multidisciplinary treatment of adult patients with COVID-19, despite the low quality of available evidence.
2. The COVID-19 pandemic is challenging the health systems in the world. Its rapid expansion has generated an important overload in hospitals and health centers. The patient volume affects the availability of hospital beds and mechanical ventilators. Since it is a new disease, little evidence is available to direct the approach of these cases.

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The current protocols have been created based on the experience of health professionals that manage these patients in different parts of the world. This is the best evidence available during these times and based on these they have created recommendations on the clinical management and Physical Therapy and Rehabilitation interventions.

3. Due to this, some recommendations may need to be modified or others may need to be added, which is why we will be watching out for the new publications that will emerge.

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