

REPORT OF AN AD-HOC INTERNATIONAL TASK FORCE TO DEVELOP AN EXPERT-BASED OPINION ON EARLY AND SHORT-TERM REHABILITATIVE INTERVENTIONS (AFTER THE ACUTE HOSPITAL SETTING) IN COVID-19 SURVIVORS (*version April 3, 2020*)

Dear Colleague,

This is an expert-based opinion on early and short-term rehabilitative interventions in COVID-19 survivors after the acute hospital setting.

The text consists of several parts: What do we know?; What don't we know; and a preliminary expert-based conclusion and preliminary clinical recommendations, based on current knowledge.

This is a living document and input from our peers is very welcome. Please use the ERS blog to share your experiences with us.

The authors will try to provide an update of this report at least once every two weeks and more frequent if needed. Finally, this document will result in a guidance for clinicians who want to provide rehabilitative interventions to COVID-19 survivors.

Please contact one of the co-chairs if you like to actively contribute to the next version(s).

Sincerely,

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Disclaimer The content of this expert-based recommendation has been published for a better care for patients with COVID-19. It summarizes and evaluates currently available 'rehab-relevant' evidence with the aim of assisting health professionals in proposing the best rehabilitative interventions for an individual COVID-19 patient. This document should facilitate decision making of health professionals in their daily practice. However, the final decisions concerning an individual patient must be made by the responsible health professional(s) in consultation with the patient with COVID-19 and caregiver, as appropriate. No commercial use is authorized. The document may be translated or reproduced in any form if the main source is acknowledged.

1. What do we know about COVID-19 on April 3, 2020 which may be relevant for rehabilitative interventions?
 - 1.1. On March 11, 2020, the World Health Organization declared the COVID-19 outbreak a pandemic (https://www.who.int/docs/default-source/coronaviruse/situation-reports/20200311-sitrep-51-covid-19.pdf?sfvrsn=1ba62e57_10)
 - 1.2. Globally, COVID-19 is confirmed in 1.016.128 people. (<https://gisanddata.maps.arcgis.com/apps/opsdashboard/index.html#/bda7594740fd40299423467b48e9ecf6>)
 - 1.3. Most people infected with COVID-19 virus have mild disease and recover. Approximately 80% of laboratory confirmed patients have had mild to moderate disease, which includes non-pneumonia and pneumonia cases, 13.8% have severe disease (dyspnoea, respiratory frequency ≥ 30 /minute, blood oxygen saturation $\leq 93\%$, PaO₂/FiO₂ ratio < 300 , and/or lung infiltrates $> 50\%$ of the lung field within 24-48 hours) and 6.1% are critical (respiratory failure, septic shock, and/or multiple organ dysfunction/failure). ([https://www.who.int/publications-detail/report-of-the-who-china-joint-mission-on-coronavirus-disease-2019-\(covid-19\)](https://www.who.int/publications-detail/report-of-the-who-china-joint-mission-on-coronavirus-disease-2019-(covid-19)))
 - 1.4. Consequently, tens of thousands of patients with confirmed COVID-19 are admitted to the hospital worldwide for acute medical care.
 - 1.5. Main signs and symptoms of hospitalized COVID-19 patients are fever, cough, dyspnoea, myalgia or fatigue, high respiratory rate (> 24 bpm) and sputum production. (<https://pubmed.ncbi.nlm.nih.gov/31986264/>)
 - 1.6. Hospitalized COVID-19 patients can have a comorbidity, like renal dysfunction, hypertension, diabetes, coronary heart disease and obesity. (<https://www.ncbi.nlm.nih.gov/pubmed/32171076>; <https://www.ncbi.nlm.nih.gov/pubmed/32109013>; <https://www.icnarc.org/About/Latest-News/2020/03/27/Report-On-775-Patients-Critically-Ill-With-Covid-19>; <https://www.ncbi.nlm.nih.gov/pubmed/32240670>)
 - 1.7. COVID-19 is associated with a high inflammatory burden that can induce vascular inflammation, myocarditis, and cardiac arrhythmias. (<https://www.ncbi.nlm.nih.gov/pubmed/32219363>)
 - 1.8. Approximately 20-25% of the hospitalized COVID-19 patients ultimately need care in the ICU, typically for a prolonged period.
 - 1.9. Most common reasons for admission to the ICU are hypoxemic respiratory failure leading to mechanical ventilation, hypotension requiring vasopressor treatment, or both. (<https://www.ncbi.nlm.nih.gov/pubmed/32227758>)
 - 1.10. Most ICU-admitted patients have (multi) organ failure, including acute respiratory distress syndrome (ARDS, 67%), acute kidney injury (29%), cardiac injury (23%), and liver dysfunction (29%). (<https://www.ncbi.nlm.nih.gov/pubmed/32105632>)

- 1.11. Prognosis of the ICU-admitted patients is poor. About 50% die on the ICU.
(<https://www.ncbi.nlm.nih.gov/pubmed/32227758>; <https://www.ncbi.nlm.nih.gov/pubmed/32105632>)
- 1.12. Overall, 69% of cases, 55% of hospitalizations, 47% of ICU admissions, and 20% of deaths associated with COVID-19 were among adults aged <65 years. (<https://www.ncbi.nlm.nih.gov/pubmed/32214079>)
- 1.13. Fatigue is a highly prevalent symptom in COVID-19 patients (40%).
(<https://www.ncbi.nlm.nih.gov/pubmed/32240670>)
- 1.14. About 75-80% of the hospitalized COVID-19 patients have prolonged ward stays (± 21 days)
(<https://www.ncbi.nlm.nih.gov/pubmed/32240670>).
- 1.15. The duration of contagion, timing of development of immunity and whether individuals can be re-infected are as yet poorly understood.
- 1.16. COVID-19 patients may remain contagious for weeks after being infected.
(<https://www.ncbi.nlm.nih.gov/pubmed/32171076>).
- 1.17. COVID-19 patients may still have the corona virus after symptoms disappear.
(<https://www.ncbi.nlm.nih.gov/pubmed/32200654>)
- 1.18. Suboptimal hand hygiene after contacting with COVID-19 patients was linked to COVID-19 in healthcare workers. (<https://www.ncbi.nlm.nih.gov/pubmed/32179890>)
- 1.19. Many countries have a complete lock down, which most probably prevents participation in a regular pulmonary rehabilitation program in most outpatient centres and/or delivery of in-home physical therapy or other face-to-face treatment by primary care healthcare professionals with COVID-19 survivors in need for rehabilitative interventions.
- 1.20. Active mobilization of the critically ill COVID-19 patient is recommended by WHO when safe to do so.
([https://www.who.int/publications-detail/clinical-management-of-severe-acute-respiratory-infection-when-novel-coronavirus-\(ncov\)-infection-is-suspected](https://www.who.int/publications-detail/clinical-management-of-severe-acute-respiratory-infection-when-novel-coronavirus-(ncov)-infection-is-suspected))
- 1.21. Clinical practice guidelines for (respiratory) physiotherapy management for COVID-19 patients in the acute hospital setting are available.
(<https://www.sciencedirect.com/science/article/pii/S183695532030028X?via%3Dihub>;
<https://www.ncbi.nlm.nih.gov/pubmed/32236089>)

2. What do we know about ARDS survivors, ICU survivors, patients with severe influenza A (H1N1) pneumonitis, hospitalized patients with COPD and pulmonary rehabilitative interventions for them on April 3, 2020?
 - 2.1. For patients with ARDS, prolonged stay in the ICU (mostly including prolonged mechanical ventilation) is known to have significant impact on lung function, and physical functioning (including loss of muscle mass and function, neuropathy and/or myopathy labelled ICU-acquired muscle weakness) and emotional well-being. (<https://www.ncbi.nlm.nih.gov/pubmed/21470008>; <https://www.ncbi.nlm.nih.gov/pubmed/15542793>; <https://link.springer.com/article/10.1007/s00134-020-05944-4>)
 - 2.2. Patients differ in their trajectory of 6-month physical function recovery after the diagnosis of acute respiratory failure: group 1, patients who were discharged with physical function disability that did not improve by 6 months; group 2, patients discharged with physical function disability and showed minimal improvement initially but remained functionally disabled by 6 months; group 3, patients with low physical function at discharge and improved to intermediate physical function; and group 4, patients with intermediate physical function at discharge with rapid improvement to high physical function by 2 months, which was sustained at 6 months. (<https://www.ncbi.nlm.nih.gov/pubmed/30571923>)
 - 2.3. The degree of disability at 7 days of ICU discharge determines the 1-year mortality and recovery trajectory in critically ill medical and surgical patients who survive one or more weeks of mechanical ventilation, including ICU and hospital readmission and specialty use in the first year after ICU discharge. (<https://www.ncbi.nlm.nih.gov/pubmed/26974173>)
 - 2.4. The greatest change in physical function after diagnosis of acute respiratory failure appears to occur in the first 2 months after discharge. (<https://www.ncbi.nlm.nih.gov/pubmed/30571923>)
 - 2.5. Common symptoms reported one year later by ICU survivors, including patient with ARDS, include anxiety (34%), depression (33%) and post-traumatic stress disorder (19%). (<https://www.ncbi.nlm.nih.gov/pubmed/31739086>)
 - 2.6. 31% of the family members of ARDS survivors have post-traumatic stress disorder symptoms 6 months after patient discharge. (<https://www.ncbi.nlm.nih.gov/pubmed/30985448>)
 - 2.7. Significant cognitive abnormalities may be present in long-term ARDS survivors, particularly in memory and executive function. Impairments in cognition appear to be associated with significantly increased anxiety and worse quality of life. (<https://www.ncbi.nlm.nih.gov/pubmed/19144052>)
 - 2.8. Post intensive care syndrome (PICS, including physical, mental and cognitive impairment) is highly prevalent in patients after prolonged mechanical ventilation (56% after 12 months). (<https://www.ncbi.nlm.nih.gov/pubmed/29787415>)
 - 2.9. Mental problems (e.g., anxiety, depression, post-traumatic stress disorder) can occur in family of patients with PICS. (<https://www.ncbi.nlm.nih.gov/pubmed/29787415>)

- 2.10. One year post-ICU discharge, a majority of survivors of A(H1N1)-associated ARDS had psychologic impairment and worse health-related quality of life than a sex- and age-matched general population group. (<https://www.ncbi.nlm.nih.gov/pubmed/22948576>)
- 2.11. A core outcome set for survivors of acute respiratory failure is available, but does not include measures of respiratory function (<https://pubmed.ncbi.nlm.nih.gov/28537429/>)
- 2.12. For patients with chronic obstructive pulmonary disease (COPD), a non-elective, exacerbation-related hospitalization results generally in a significant reduction in quadriceps muscle function, exercise capacity, physical activity, mood status and quality life, which does not spontaneously recover after discharge. (<https://www.ncbi.nlm.nih.gov/pubmed/12947130>; <https://www.ncbi.nlm.nih.gov/pubmed/16537849>; <https://www.ncbi.nlm.nih.gov/pubmed/16840393>)
- 2.13. The benefits of early physical rehabilitation following ICU discharge (mostly home-based and/or solely exercise training) on quality of life and mortality are unclear. (<https://www.ncbi.nlm.nih.gov/pubmed/31182443>)
- 2.14. Outpatient exercise training improves physical capacity, self-efficacy to exercise and readiness to exercise compared to usual care in patients discharged from the hospital following critical illness (mechanically ventilated >96 hours). (<https://www.ncbi.nlm.nih.gov/pubmed/27852953>)
- 2.15. Exercise capacity and quality of life improved significantly following an 8-week pulmonary rehabilitation program in survivors of ARDS due to severe influenza A (H1N1) pneumonitis. (<https://www.ncbi.nlm.nih.gov/pubmed/29676537>)
- 2.16. In patients with COPD, physiotherapy in the respiratory hospital ward, as well as rehabilitative interventions starting early after discharge from the hospital are safe and efficacious, and are recommended by American Thoracic Society (ATS)/European Respiratory Society (ERS). (<https://www.ncbi.nlm.nih.gov/pubmed/20133927>; <https://www.ncbi.nlm.nih.gov/pubmed/27930803>; <https://www.ncbi.nlm.nih.gov/pubmed/24127811>)

3. What don't we know about COVID-19 survivors on April 3, 2020, which may be relevant for rehabilitative interventions?
 - 3.1. Considering the high number of hospitalized COVID-19 patients and the high burden this causes on hospital staff and facilities: do current COVID-19 patients receive appropriate rehabilitative interventions during their stay in the hospital (with or without ICU stay) to reduce or even prevent a physical and/or emotional deterioration?
 - 3.2. What proportion of COVID-19 survivors have (extra-pulmonary) physical, functional, emotional and/or social treatable traits, which justify rehabilitative interventions, both upon discharge and in the short term?
 - 3.3. What types of patients will exist post COVID-19 (e.g., good recovery, ongoing frailty, persistent respiratory impairment) and in what proportions?
 - 3.4. What is the proportion of patients that will need informal caregiving support to recover from COVID-19?
 - 3.5. What is the impact of a COVID-19-related prolonged ward stay on physical and emotional functioning?
 - 3.6. What are the opportunities to intervene early, immediately post-acute hospital discharge?
 - 3.7. What are the safety concerns for early rehabilitation interventions after the acute hospital settings for patients and healthcare professionals?
 - 3.8. For how long after discharge from the hospital are COVID-19 survivors contagious?
 - 3.9. What are the opportunities to intervene in the short term after the contagious period (starting 6-8 weeks post-discharge)?
 - 3.10. What level of personal protective equipment is necessary for providing rehabilitative interventions to COVID-19 survivors, depending on timing of rehabilitation relative to the acute illness and in different settings (e.g., ICU, hospital ward, outpatient rehabilitation centre, home)?
 - 3.11. Within what timeline is it safe for healthcare professionals to provide face-to-face rehabilitative interventions for patients with COVID-19 in the home setting after discharge?
 - 3.12. Can we predict which patients will recover independently and who might need more support? (e.g., primary care physiotherapy, occupational therapy, etcetera or a comprehensive interdisciplinary pulmonary rehabilitation program)
 - 3.13. How do rehabilitative interventions need to be set up for COVID-19 patients who are still infected/contagious?
 - 3.14. Is it safe for COVID-19 survivors to do work outs/physical training in the home setting (through telecommunication or alone), in the absence of any formal assessment?

- 3.15. How will the COVID-19 survivors respond to a moderate-to-high intensity physical training stimulus?
- 3.16. When can the regular outpatient pulmonary rehabilitation facilities re-open again? (safety for patients and staff, availability of staff)
- 3.17. When can face-to-face treatment by primary care physiotherapist, occupational therapist, etc. re-start again?
- 3.18. What proportion of COVID-19 survivors have persistent respiratory symptoms (i.e., dyspnoea, cough, chest tightness), which may be related to persistent (and perhaps even progressive) impairment of lung function and/or cardiac function?
- 3.19. Is there an available scaling system to triage COVID-19 patients for rehabilitative care at the time of discharge from the hospital ?
- 3.20. When will the Core Outcome Set for COVID-19 become available? (<https://www.covid-19-cos.org/>)
- 3.21. What proportion of COVID-19 survivors have resting hypoxemia and/or exercise induced oxygen desaturation?
- 3.22. What are the long-term psychological and cognitive impairments among survivors of respiratory failure/ARDS due to COVID-19 and their caregivers?
- 3.23. Are COVID-19 patients who were not treated in the hospital also in need of rehabilitative interventions?
- 3.24. When will COVID-19 testing become broadly available before the start of rehabilitative interventions, to minimize the risk of contamination?
- 3.25. A lock down acts as a public health measure to reduce the spread of infection. However, does a lock down result in a need for rehabilitative interventions in COVID-19 patients treated in the home setting (not hospitalized)?
- 3.26. A lock down acts as a public health measure to reduce the spread of infection. However, does a lock down further increase the need for rehabilitative interventions in COVID-19 patients discharged from the hospital, e.g. due to sedentary behaviour, social isolation?
- 3.27. What is the expected impact of rehabilitative interventions in COVID-19 survivors? Will the safety and efficacy be comparable to those observed in patients with chronic obstructive pulmonary disease (COPD), (severe) asthma, idiopathic pulmonary fibrosis (IPF), lung cancer, etcetera?

4. What are the preliminary expert-based conclusion and preliminary clinical recommendations on April 3, 2020 regarding early and short-term rehabilitative interventions (after the acute hospital setting) for COVID-19 survivors?
 - 4.1. Under normal circumstances, the main aim of the healthcare professionals (including physiotherapists, nurses, occupational therapists, etc.) in the regular hospital ward, is to prepare a safe discharge to the patient's home-environment as early as possible (to free-up hospital beds), including assessment of the accessibility of the patient's home, stair climbing, swallowing, and cognitive functioning.
 - 4.2. At discharge from the hospital, an individual assessment of rehabilitation needs should be documented, including immediate needs (e.g., safe mobility, symptom control (dyspnoea, fatigue, pain?), need for supplemental oxygen, adequate nutrition, sufficient psychological/social support) and short term/medium needs (e.g., improved physical and emotional functioning, return to work).
 - 4.3. Physiotherapists may contribute to a sensible triaging of patients to the appropriate level of support after discharge from the hospital and/or in the weeks following discharge.
 - 4.4. At the moment of admission to a (combination of) rehabilitative intervention(s), possible cardiac problems during the hospital stay (e.g., arrhythmia, myocarditis) should be passed along.
 - 4.5. As advanced equipment to assess functional capacity of the patients may not be available, physiotherapists need to consider easily applicable tests, such as the Short Physical Performance Battery, 30 Seconds Sit-to-Stand test, handgrip dynamometer test and/or a manual muscle strength test.
 - 4.6. Assessment and subsequent treatment of the emotional and neuropsychological impact of COVID-19 is warranted, especially in view of the prolonged in hospital isolation these patients will experience.
 - 4.7. Loss of weight and muscle mass must be assessed and subsequently treated during comprehensive rehabilitation in COVID-19 survivors.
 - 4.8. Consider routine follow-up in COVID-19 survivors when non-contagious (e.g., 6-8 weeks after discharge) or when local infection control policies permit, to address any unmet rehabilitation needs for individual patients. Assessment should at least include measures that allow understanding of persistent physiological limitations (e.g., lung function, exercise and functional capacity, muscle function, balance) and patient-reported outcomes (e.g., symptoms and health-related quality of life).
 - 4.9. Families of COVID-19 survivors should be offered psychosocial support.
 - 4.10. During the first 6-8 weeks in patient's home-environment, (presumably) infectious patients are recommended to do only low-intensity physical activity/exercises (including functional strengthening; consider using ≤ 3 points for dyspnoea and/or fatigue on modified 0-10 points Borg scale), if a formal exercise assessment has not taken place yet. Using ICT-solutions for safe communication between patient and healthcare professional, like video calling, should be considered.

- 4.11. Patients who are sent from hospital to a (inpatient) rehabilitation centre can start a multidisciplinary patient-centric program, using known pulmonary rehabilitation concepts (<https://www.ncbi.nlm.nih.gov/pubmed/24127811>). Be aware of the fact that a pre-rehabilitation assessment, including formal lung function and exercise testing is most probably not feasible at the start and cannot be performed in patients who are still infectious. Therefore, exercise training may have to start with relatively simple graded functional and strengthening exercises, using no or minimal equipment.
- 4.12. The regular exercise training principles that are normally used in patients with chronic lung diseases (COPD, asthma, IPF, etc.) can be considered in non-infectious COVID-19 survivors, including transcutaneous SpO₂-monitoring, and, subsequent supplementary oxygen if needed.
- 4.13. For COVID-19 patients who have only been treated at home (no COVID-19-related hospitalization), but who seem to be in need of rehabilitative interventions: (presumably) infectious patients are recommended to do only low-intensity physical activity/exercises during the first 6-8 weeks in patient's home-environment (including functional strengthening; consider using ≤ 3 points for dyspnoea and/or fatigue on modified 0-10 points Borg scale), if a formal exercise assessment did not take place yet. Using ICT-solutions for safe communication between patient and healthcare professional, like video calling, should be considered.
- 4.14. To prevent a possible further spreading of the COVID-19 virus:
- 4.14.1. During treatment of (possibly) infectious/contagious COVID-19 patients: wear appropriate personal protective equipment, including impermeable gowns, gloves, face masks and protection glasses (for more details, please also see: <https://www.sciencedirect.com/science/article/pii/S183695532030028X?via%3Dihub>)
 - 4.14.2. Until further evidence becomes available, do not start COVID-19 group training sessions to prevent possible re-infection
 - 4.14.3. Do not do home visits of infectious COVID-19 survivors for the sole purpose of rehabilitation in patients who are independently mobile and rehabilitation is not urgent
 - 4.14.4. Home visits (with appropriate personal protective equipment) may be justifiable in COVID-19 survivors to ensure safe discharge to the home environment, in order free up necessary beds in the hospital
 - 4.14.5. Do not do lung function testing and maximal/submaximal exercise testing in infectious COVID-19 survivors within the first 6-8 weeks after discharge
 - 4.14.6. Do not use non-invasive ventilator support during physical training in infectious COVID-19 survivors
- 4.15. Make sure that if you start face-to-face treatment of infectious COVID-19 survivors that this is safe for yourself and for the patient and his/her environment:
- 4.15.1. Use personal protective equipment to prevent infection of yourself according to the requirements for patient's current hospital setting and personal protective equipment availability
 - 4.15.2. Do not do one-on-one treatment if adequate personal protective equipment is not available
 - 4.15.3. Start the therapy in the room of the patient, do not bring the patient to the general gym area
 - 4.15.4. Clean all used (hand-held) equipment for physical training after its use thoroughly, consistent with local infection control requirements

- 4.15.5. Consider the use of daily neuromuscular electrical stimulation (NMES) in very weakened patients with inactivity-induced atrophied lower-limb muscles, and keep the apparatus in the room of the patient after its use
- 4.16. Exercise training and/or physical activity coaching in non-infectious COVID-19 patients with residual lung function impairment should be done by a health professional with previous experience in rehabilitation of patients with respiratory limitations.
- 4.17. As in regular pulmonary rehabilitation, physiotherapy alone seems insufficient to also address nutritional, emotional and social treatable traits of COVID-19 survivors in the post-hospitalization/ICU phase.
- 4.18. Monitoring of pre-existing comorbid conditions in COVID-19 survivors during rehabilitation is warranted to guarantee safety of the rehabilitative interventions, and to optimize health of these patients. This may require availability of a multidisciplinary team of medical specialists.
- 4.19. Going forward, availability of incremental data regarding the impact, course and outcomes of COVID-19 and treatment interventions for it, will help to inform future decision-making regarding rehabilitative interventions for survivors of COVID-19.

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