EVIDENCE SYNTHESIS BRIEFING NOTE

TOPIC: EFFECTIVENESS OF REHABILITATION INTERVENTIONS FOR PEOPLE WITH LONG COVID

Information finalized as of July 10, 2021.[a]

This Briefing Note was completed by the Research, Analysis, and Evaluation Branch (Ministry of Health) based on information provided by members of the COVID-19 Evidence Synthesis Network. Please refer to the Methods section for further information.

Purpose: This note provides a summary of research on rehabilitation care models for people experiencing debilitating COVID symptoms, and the effectiveness of rehabilitation interventions.

Key Findings:

- Prevalence of Long COVID: A World Health Organization (WHO) policy brief (February 2021) reported that approximately 25% of COVID-19-positive patients still experience symptoms beyond the acute phase of the disease (4–5 weeks after a positive test), and approximately 10% experience debilitating symptoms 12 weeks after having COVID-19, which may last for several more months.
- Rehabilitation Care Models: Twelve identified care models have been developed and implemented for COVID patients discharged following a hospitalization and patients who had lived with the infection in the community.
  - *Model Components*: The five most commonly identified model components were: 1) Standardized symptom assessment; 2) Referral system; 3) Follow-up system; 4) Telehealth / virtual care; and, 5) Home-based care.
  - *Staffing*: Thirty health care professions and medical specialties were proposed for staffing Long COVID services. The following five were most commonly named: 1) Pulmonary/Respiratory; 2) Cardiovascular; 3) Psychiatry/Psychology; 4) Physiotherapy; and, 5) Occupational therapy.
- Effectiveness of Rehabilitation of Long COVID: Overall, the studies reported that patients with Long COVID who received rehabilitation services improved on exercise tests, quality of life, function (i.e., less fatigue and lower perceived limitations to daily activities due to COVID-19) from baseline to follow-up or compared with a control group.

Limitations:

- Most recent COVID-19 research focuses on the clinical presentations of the disease rather than rehabilitation interventions or service delivery, and the identified rehabilitation care model principles and components were not described in detail in the research literature.
- Results presented in the literature should be interpreted with caution as most studies on rehabilitation programs use uncontrolled before-and-after study designs. Consequently, observed patient improvement might be at least partially due to natural disease progression.

Implications for Ontario:

- Based on the identified research, the SPOR Evidence Alliance suggests that it is possible to design a rehabilitation care model for the Long COVID population that is integrated in the current health care system, has a sustainable and equitable care pathway, and integrates primary care, rehabilitation services and specialty care for medical assessment.

[a] This briefing note includes current available evidence as of the noted date. It is not intended to be an exhaustive analysis, and other relevant findings may have been reported since completion.

Supporting Evidence

Table 1 below summarizes recent research evidence on the prevalence of "Long COVID", describes care models, and summarizes the research on the effectiveness of rehabilitation interventions. Details on models of Long COVID rehabilitation are provided in Table 2 in the Appendix, including a suggested care pathway for Long COVID (Figure 1). The research evidence on the effectiveness of Long COVID rehabilitation programs is provided in Table 3.

Note: The systematic reviews described in this note include preprints that have not been peer-reviewed. The research should not be used to guide clinical practice and should be evaluated with care.

Table 1: Research on Effectiveness of Rehabilitation Interventions for Long COVID

Scientific Evidence	**Prevalence of Long COVID** • A recent systematic review and meta-analysis (June 2021) on the prevalence of post-COVID-19 symptoms in hospitalized (N=15,244) and non-hospitalized (N=9,011) COVID-19 survivors reported that post-COVID-19 symptoms are present in more than 60% of patients infected by SARS-CoV-2. ○ Prevalence: At least one post-COVID-19 symptom was exhibited at 30 days (63.2% of sample), 60 days (71.9%), or ≥90days (45.9%) after onset/hospitalization. ○ Symptoms: Fatigue and dyspnea (shortness of breath) were the most prevalent symptoms. Other post-COVID-19 symptoms included cough (20-25%), anosmia (loss of smell; 10-20%), ageusia (loss of taste; 15-20%), or joint pain (15-20%).[1,b] **Rehabilitation Care Models for Long COVID** • A SPOR Evidence Alliance (EA) rapid systematic review (June 2021) identified recent international studies (N=12) describing care models for Long COVID that have been developed for COVID patients discharged following a hospitalization and patients who had lived with the infection in the community (United States [US], United Kingdom [UK], Germany, Spain, and Italy). See Table 2 for details. ○ Key Principles: Over half the studies included in the review reported on care model principles (22 care model principles were identified in the literature). The five most common were: 1) Multidisciplinary teams (92%); 2) Integrated care (67%); 3) Self-management (58%); 4) Coordination of care (58%); and, 5) Evidence-based care (58%). According to the review, the identified principles were not described in detail, nor were details of how they were implemented presented, limiting the evaluation of outcomes. ○ Care Model Components: The review identified 10 distinct care model components most frequently described in the research literature. The five most commonly named were: 1) Standardized symptom assessment (92%); 2) Referral system (83%); 3) Follow-up system (83%); 4) Telehealth / virtual care (83%); and, 5) Home-based care (58%). According to the SPOR EA review, the descriptions of the identified components did not describe how they were implemented, limiting the evaluation of outcomes. ○ Staffing: The models included access to specialized medical services. Thirty health

[b] This systematic review includes 29 studies and four preprints studies that have not been peer-reviewed. The research should not be used to guide clinical practice and should be evaluated with care.[1]

care professions and medical specialties were proposed for staffing Long COVID services. The following 10 were most commonly named in the research literature: 1) Pulmonary/Respiratory (100%); 2) Cardiovascular (92%); 3) Psychiatry/Psychology (83%); 4) Physiotherapy (83%); 5) Occupational therapy (75%); 6) Social work (75%); 7) Neurology (75%); 8) Primary care (58%); 9) Nutrition (58%); and 10) Speech and language therapy team (50%).

- Proposed Care Pathway: Based on the identified research findings on care models for Long COVID, and the frequency of their occurrence, the SPOR EA systematic review proposed a care pathway for people hospitalized with COVID and people who had COVID in the community. The pathway integrates: 1) Rehabilitation services; 2) Primary care; and, 3) Specialty care for medical assessment (e.g., investigation of organ impairment). The entry into a care pathway would be made possible through the use of a centralized referral system that facilitates post-COVID assessment and triage. For a detailed map of the pathway, see Figure 1.
- Impact and Costs: The impact and costs of these identified rehabilitation care models for Long COVID have not yet been reported in the research literature.[2]

Effectiveness of Long COVID Rehabilitation Programs

- This briefing note summarizes recent study results on Long COVID from a living systematic review;[3,c] one randomized controlled trial (RCT);[4] and three observational studies.[5–7] Details of the single studies are outlined in Table 3.

Feasibility of Rehabilitation Programs

- A Swiss study (2021) reported that a comprehensive outpatient pulmonary rehabilitation program is feasible and can confer benefits to patients recovering from COVID-19. The protocol included: Twice weekly (60- to 90-minute) interval-based aerobic cycle endurance and resistance training sessions at intensities of 50% peak work rate; education; and physical activity coaching.[7]

Health Impacts of Rehabilitation Programs

- Four recent single studies (2021) assessed physical therapy and pulmonary rehabilitation (PR) programs that were delivered either in-person at outpatient clinics or virtually (United States [US], United Kingdom [UK], Switzerland, China). Overall, the studies reported that patients with Long COVID who received rehabilitation improved on exercise tests, quality of life, function (less fatigue and lower perceived limitations to daily activities due to COVID-19) from baseline to follow-up or compared with a control group.[4–7]
  - Pulmonary PR Programs: Physiotherapy-led, comprehensive outpatient PR programs led to a reduction in the number of patients with perceived limitations in their performance of daily life activities due to COVID-19.[7] In addition, studies demonstrated that PR programs led to improved strength and cardiopulmonary endurance among discharged COVID-19 patients. For example:
    - *Overall Strength and Cardiopulmonary Endurance*: A US-based strength and cardiopulmonary endurance rehabilitation program (30–60 mins. per session) improved sit-to-stand scores and step test results among COVID patients who engaged in virtual therapy and at-home physical therapy.[5]

[c] Reviewers continue to monitor the literature for new eligible publications.

	▪ *Strength/Walking*: Two studies on at-home and virtual ('RehabApp') rehabilitation programs reported that aerobic exercises and strength training significantly improved performance on walking tests among discharged COVID-19 patients.[4,6] ▪ *Fatigue*: A single UK study (2021) that evaluated a rehabilitation program featuring exercise and education showed improvement in fatigue and other clinical outcomes, including symptoms of breathlessness (dyspnea), exercise capacity and cognition.[6] ▪ *Mental Health:* The single UK study (2021) that evaluated a rehabilitation program featuring exercise and education improved mental health outcomes (i.e., anxiety, depression) though results were not statistically significant.[6] ○ Physical Therapy and Mobility: A single US-based study (2020) examined the impact of physical therapy (PT) visit frequency and duration on patients' mobility status at hospital discharge: ▪ *Frequency*: Increased PT visit frequency was associated with higher mobility scores and increased probability of discharging home; ▪ *Duration:* Longer mean visit duration was associated with improved mobility, and greater probability of discharging home (effects were less pronounced).[3,8]
International Scan	**Definition of Long COVID** • While a World Health Organization (WHO) report (March, 2021) states there is no internationally agreed upon definition of Long COVID,[9] it has been generally defined as the persistence of any COVID signs and symptoms that continue or develop between four and 12 weeks after acute COVID-19, including both ongoing symptomatic COVID-19 and post–COVID-19 syndrome.[10–12] **Prevalence of Long COVID** • A WHO policy brief (February 2021) reported that approximately 25% of COVID-19-positive patients still experience symptoms beyond the acute phase of the disease (four to five weeks after a positive test), and approximately 10% experience debilitating symptoms 12 weeks after having COVID-19, which may last for several more months.[13]

Methods

The COVID-19 Evidence Synthesis Network is comprised of groups specializing in evidence synthesis and knowledge translation. The group has committed to provide their expertise to provide high-quality, relevant, and timely synthesized research evidence about COVID-19 to inform decision makers as the pandemic continues. The following members of the Network provided an evidence synthesis product that were used to develop this Evidence Synthesis Briefing Note:

- Ontario Health. (June 23, 2021). *Benefits of Rehabilitation for People with Long COVID: An Expedited Summary of the Evidence (Confidential Draft)*. Ontario Health; and
- Evidence Synthesis Unit, Research Analysis and Evaluation Branch, Ontario Ministry of Health.

For more information, please contact the Research, Analysis and Evaluation Branch (Ministry of Health).

APPENDIX

Table 2: Models of Long COVID Rehabilitation

Jurisdiction, Review Type, Sample & Year	Study Purpose	Rehabilitation Models	Implementation of Rehabilitation Models
• International (US, United Kingdom, Germany, Spain, Italy) • Rapid Systematic Review • N=12 • 2021 (June)	• Purpose: Examine international care models for Long COVID including rehabilitation services.	• Review identified 12 care models for Long COVID that cover follow-up of patients discharged following a hospitalization and patients who had lived the infection in the community. • Elements of Care: Most reported elements included: ○ A coordination unit; ○ Primary care pathways (N=9 of 12); ○ Access to multidisciplinary rehabilitation; and ○ Specialized medical services (N=8 of 12). • Staffing: Thirty healthcare professions and medical specialties were proposed for staffing Long COVID services. For example: ○ Pulmonary/Respiratory (N=12); ○ Cardiovascular (N=11); ○ Psychiatry/Psychology (N=10); ○ Physiotherapy (N=10); ○ Occupational therapy (N=9); ○ Social work (N=9); ○ Neurology (N-9); ○ Primary care (N=7); ○ Nutrition (N=7); and ○ Speech and language therapy team (N=6). • Care Model Principles: Key principles were named in over half the studies. For example: ○ Multidisciplinary teams (N=11); ○ Integrated care (N=8);	• The impact and costs of these care models have not yet been reported.[2]

Jurisdiction, Review Type, Sample & Year	Study Purpose	Rehabilitation Models	Implementation of Rehabilitation Models
		○ Self-management (N=7); ○ Coordination of care (N=7); ○ Evidence-based care (N=7); ○ Patient education (N=6); ○ Patient-centered care (N=5); ○ Shared care (N=5); ○ Case management (N=5); and ○ Research partnerships (N=5). • Care Model Components: The most frequent components were: ○ Standardized symptom assessment (N=11); ○ Referral system (N=10); ○ Follow-up system (N=10); ○ Telehealth / virtual care (N=10); ○ Home-based care (N=7); ○ Social determinants assessment (N=6); ○ Patient support groups (N=5); ○ Clinical information system (N=4); ○ Triage system (N=4); and ○ Promotion of COVID-19 rehabilitation (N=1).	

Table 3: Research Evidence on Effectiveness of Long COVID Rehabilitation Programs[d,e]

Jurisdiction, Sample, & Year	Study Purpose & Design	Type of Rehabilitation/ Control Group	Timing & Duration	Eligibility Criteria	Results & Outcome Measures
• United States (US) • N=106 • 2021	• Purpose: Evaluate impact of a rehabilitation program on strength and cardiopulmonary endurance in patients discharged home with persistent COVID-19 symptoms. • Study Design: Prospective cohort study. ○ *Setting*: Academic medical centre. ○ *Study Period*: April–July 2020. ○ *Follow-up Time*: Two weeks.	• Four participant groups: ○ Virtual physical therapy (VPT), (N = 44) ○ Home physical therapy (HPT), (N = 25) ○ Independent exercise program (IE), (N = 17) ○ No therapy (N = 20) • The three therapy programs included the following exercises, in sequential order, to observe a rise and fall of cardiac performance measures: ○ Diaphragmatic breathing; ○ Incentive spirometry; ○ Sit to stand; ○ Standing marching; ○ Shoulder 'scaption';[f] ○ Standing heel raises; ○ Sidestepping; and ○ Wall push-ups.	• Duration: 30–60 mins. per session; number of sessions were determined by the physical therapist who patients saw once or twice per week.	• Discharged from the hospital with persistent symptoms of weakness, fatigue, shortness of breath that interfered with daily activities. • Difficult weaning from supplemental oxygenation. • Discharge from acute rehabilitation unit with need to continue physiatry-led care.	• Results: At follow-up: ○ 65% of patients in the VPT group and 88% of patients in the HPT group met the clinically meaningful difference for improvement in sit-to-stand scores, compared with 50% and 17% of those in the IE group and no-exercise group. ○ The clinically meaningful difference for improvement in the step test was met by 74% of patients in the VPT group and 50% of patients in the HPT, IE, and no-exercise groups. • Outcome Measures: ○ 30-second sit-to-stand test. ○ Two-minute step test. ○ Return to work.[5]
• US • N=312 • 2020 (September)	• Purpose: Examine impact of physical therapy (PT) visit frequency on patients' mobility status at hospital	• Physical therapy visits; no other details provided.	• Not reported.	• Patients were included if they had been: ○ Confirmed positive for COVID-19 either during hospitalization or that resulted in a	Results: • Average number of completed visits was three visits (range: 1 to 5) over six days;

[d] This is a preliminary report that has not been peer-reviewed and should not be regarded as conclusive, guide clinical practice/health-related behaviour.
[e] Abbreviations: 6MWT, 6-minute walk test; CAT, COPD assessment test; EQ-5D, EuroQol 5D; ESWT, endurance shuttle walk test; FACIT, Functional Assessment of Chronic Illness Therapy; FEV1, forced expiratory volume; FVC, forced vital capacity; GP, general practitioner; HADS, hospital anxiety and depression score; ISWT, incremental shuttle walk test; min, minute; mMRC, modified medical research council dyspnea scale; MoCA, Montreal Cognitive Assessment test for dementia; PCFS, Post–COVID-19 Functional Status Scale; PCR, polymerase chain reaction; s, second; VAS, visual analogue scale.
[f] Scaption is the action of lifting one's arms from your sides and bringing them forward at a 30- to 45-degree angle (Healthline, n.d.).

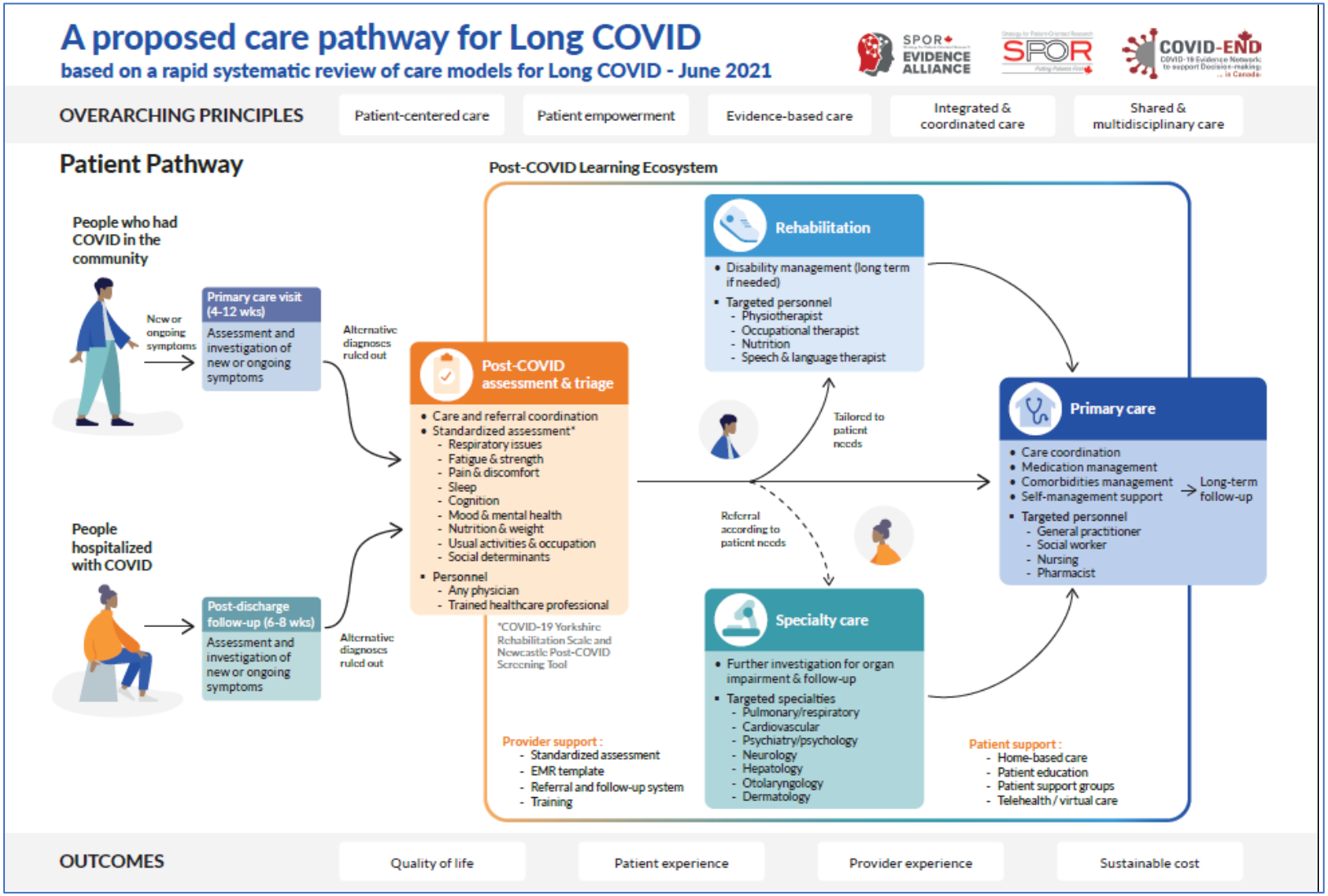
Jurisdiction, Sample, & Year	Study Purpose & Design	Type of Rehabilitation/ Control Group	Timing & Duration	Eligibility Criteria	Results & Outcome Measures
	discharge and probability of discharging home. • Study Design: Retrospective cohort study: ○ *Setting:* 11 acute care facilities in the Cleveland Clinic Health System.			hospitalization; ○ Discharged from the hospital by June 10, 2020; and ○ Evaluated by a physical therapist during their hospital stay.	• Frequency of physical therapy visits was 0.5 visits/day (i.e., one visit, every other day). • Increased physical therapy visit frequency was associated with: ○ Higher mobility scores at hospital discharge; and ○ Increased probability of discharging home. • Longer mean visit duration was associated with: ○ Improved mobility at discharge; and ○ Greater probability of discharging home (effects were less pronounced). • Outcome Measures: These included: ○ Mobility Status at Discharge (i.e., 6-Clicks mobility; Johns Hopkins Highest Level of Mobility); and ○ Discharge to home versus to a facility.[3,8]
• United Kingdom • N=30 • 2021	• Purpose: Evaluates COVID-19 rehabilitation program featuring exercise and education: ○ *Study Design*: Prospective cohort study, before–after comparison. ○ *Setting*: Single centre. ○ *Study Period*: Not provided.	Outpatient pulmonary rehabilitation: • Aerobic exercise (walking/treadmill based). • Strength training of upper and lower limbs. • Educational discussions with handouts (breathlessness, cough, fatigue, fear and anxiety, memory and concentration, taste and smell, eating well, getting moving again, sleeping well, managing daily activities and returning to work).	• Post COVID-19 infection. • Two sessions per week for six weeks.	• COVID-19 patients treated either in hospital or followed in the community. • Self-identified rehabilitation needs (physical or psychological symptoms affecting daily activities). • No acute symptoms. • Medically stable. • Referred either at hospital discharge or referred by general physician (GP).	• Results: Participants improved by: ○ 112 m on the Incremental Shuttle Walking Test (ISWT); and ○ 544 seconds on the Endurance Shuttle Walking Test (ESWT); ○ HADS anxiety and depression scores improved but results were not statistically significant. • Outcome Measures: ○ ISWT/ ESWT. ○ Chronic obstructive pulmonary disease (COPD) Assessment Test (CAT).

Jurisdiction, Sample, & Year	Study Purpose & Design	Type of Rehabilitation/ Control Group	Timing & Duration	Eligibility Criteria	Results & Outcome Measures
		• Borg breathlessness scale, perceived exertion, and symptoms used to determine exercise progression.			○ Functional Assessment of Chronic Illness Therapy (FACIT). ○ Hospital Anxiety and Depression Scale (HADS). ○ EQ-5D (Mobility, self-care, usual activities, pain/discomfort, anxiety/depression). ○ Montreal Cognitive Assessment Test for Dementia (MoCA).[6]
• Switzerland • N=12 • 2021	• Study Purpose: Evaluate a physiotherapy-led, comprehensive outpatient pulmonary rehabilitation (PR) program. • Study Design: Prospective cohort ○ *Setting*: Single centre. ○ *Sample*: Convenience sample. ○ *Study Period*: April to June 2020.	• Outpatient pulmonary rehabilitation: ○ Aerobic cycle endurance (30 mins); and ○ Resistance training (30–40 mins). • Intensity adjusted progressively, reaching a perceived exertion of between four and six on the modified Borg Scale (0–10).	• Expected duration: 16–24 sessions • Twice weekly	• COVID-19 patients confirmed by PCR who had been hospitalized for the infection. • Discharged home. • ≥14 days after the confirmed diagnosis of COVID-19. • ≥4 days without COVID-related symptoms (fever, sore throat, cough) or common cold. • Met ≥1 of the following criteria at baseline evaluation post-discharge: ○ Six-minute walk test (6MWT) distance: below the age- and gender-specific norms or below the lower limit of normal. ○ Post–COVID-19 Functional Status Scale (PCFS) > 1. ○ EQ-5D-5L visual analogue scale < 80%.	• Results: At follow up: ○ Tolerability of interval-based training was: ▪ 83% for exercise duration of aerobic cycle endurance (ACE); ▪ 100% exercise duration of resistance training (RT); ○ 92% for training intensity; ○ 83% progressive increase of intensity; and ○ 83% mode in ACE. • Outcome Measures: ○ Adherence (% of recommended training sessions attended). ○ Tolerability (% of patients requiring a reduction in training frequency, intensity, or duration or a change in aerobic cycle endurance mode). ○ Adverse events. ○ Physical performance (6MWT). ○ Disability due to breathlessness (4-point ordinal mMRC). ○ Quality of life (EQ-5D-5L and EQ-5D-5L VAS). ○ Perception of COVID-19–specific limitations in daily life.[7]

Jurisdiction, Sample, & Year	Study Purpose & Design	Type of Rehabilitation/ Control Group	Timing & Duration	Eligibility Criteria	Results & Outcome Measures
• China (Pre-print study) • N=119 • 2021	• Study Purpose: Examine a telerehabilitation program for COVID-19. • Study Design: Randomized controlled trial, unblinded. ○ *Setting*: Multicentre, three major hospitals from Jiangsu and Hubei provinces. ○ *Follow-up Time*: 24 weeks. ○ *Study Period*: April to December 2020.	• Intervention: ○ *Telerehabilitation*: ▪ Remotely monitored home exercise program delivered via a smartphone application (RehabApp). ▪ Breathing control and thoracic expansion. ▪ Aerobic exercise. ▪ Lower-limb muscle strength. ▪ Patients wore a heart rate telemetry device connected to the application during exercise; data was reviewed regularly by physiotherapists. ▪ Teleconsultations every week. ▪ Exercise types and intensity determined by physiotherapists based on baseline assessments and in accordance with the American College of Sports Medicine's guidelines. ▪ Exercise progression according to patient's condition and lack of adverse events. • Control: ○ *Education:* ▪ Ten-minute standardized educational instruction from physiotherapist plus information sheet containing these instructions in written form. ▪ Advised to maintain normal	• Duration 40 to 60 mins. per session. • Three to four sessions per week for six weeks.	• Adults (18 to 75 yrs.). • Clinically diagnosed COVID-19 infection confirmed by laboratory. • Treated in hospital. • Owning a smart phone. • Dyspnea score of two to three on the modified British Medical Research Council Dyspnea Scale (mMRC); i.e., moderate dyspnea.	• Results: ○ *6-minute walking distance (6MWD):* Increased from 65.45 metres at post-treatment to 68.62 metres at follow-up; ○ *Lower limb muscle strength (LMS)*: Increased from 20.12 seconds at post-treatment to 22.23 seconds at follow-up. • Outcome Measures: ○ Functional exercise capacity (6MWT). ○ LMS. ○ Pulmonary function (FEV1, FVC). ○ Quality of life. ○ Perceived dyspnea. ○ Adverse events.[4]

Jurisdiction, Sample, & Year	Study Purpose & Design	Type of Rehabilitation/ Control Group	Timing & Duration	Eligibility Criteria	Results & Outcome Measures
		daily activities, avoid excessive bed rest and immobilization, take part in moderate physical activities such as housework, adhere to a healthy diet, and get six to eight hours of sleep per day.			

Figure 1: A Proposed Care Pathway for Long COVID[g]



[g] Components were included in the proposed pathway based on the frequency of their occurrence in the literature. Efficacy data was not available at the time of the review.[2]

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