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Short Running Title: Rehab for COVID-19 Recovery: Scoping Review

Providing Rehabilitation to Patients Recovering from COVID-19: A Scoping Review

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Abstract

OBJECTIVE: To synthesize the nature and extent of research on rehabilitation care provision to COVID-19 (COVID) patients. Specifically, we aimed to: (1) Describe the impact of COVID on patients and associated rehabilitation needs; (2) Outline the adaptations and preparations required to enable the provision of COVID rehabilitation; (3) Describe the types of rehabilitation services and treatments provided to COVID patients; and (4) Identify barriers and facilitators to delivering COVID rehabilitation.

LITERATURE SURVEY: We searched Medline, PsychINFO, Embase, and CINAHL on June 26th, 2020 using key words such as “rehabilitation”, “physical medicine”, “allied health

professionals" and variations of "COVID". The search was updated on October 13th, 2020. We included articles published in English and that focused on some aspect of COVID rehabilitation for adults. We excluded articles focused on pediatric populations and those not focused (or minimally focused) on rehabilitation for COVID patients.

METHODOLOGY: Data were charted based on article type (i.e. primary data, secondary data, guidelines). Key information extracted included: (i) COVID sequelae; (ii) rehabilitation adaptations; (iii) structure, function and content of rehabilitation services/programs; (iv) facilitators and/or barriers to providing COVID rehabilitation; and (v) recommendations for COVID rehabilitation programming. Data were synthesized narratively.

SYNTHESIS: In total, 129 articles were included in the review that reported primary data (n=33), secondary data (n=82), and clinical practice/patient self-management guidelines (n=13). Evidence begins to suggest that rehabilitation is necessary and valuable for addressing COVID-related declines in health, function, and well-being. Most articles recommended that an individualized rehabilitation program be provided across the continuum of care by an interdisciplinary team of professionals and that the nature and extent of rehabilitation be informed by the care setting and COVID severity. Most issues that challenged COVID rehabilitation delivery were directly addressed by the facilitators and adaptations identified.

CONCLUSIONS: Future recommendations include a greater emphasis on the psychosocial aspects of COVID rehabilitation, inclusion of families in rehabilitation planning, and the use of qualitative approaches to complement clinical data.

KEY WORDS: Rehabilitation, COVID-19, Scoping Review

1. BACKGROUND

The COVID-19 (COVID) pandemic has required a rapid and drastic response by healthcare systems worldwide, including major changes in how organizations and staff function and deliver patient care.[1] Growing evidence indicates that many survivors are experiencing "long COVID" (i.e. lasting and debilitating symptoms that impede both physical and emotional recovery).[2] In turn, rehabilitation is being recognized as a pivotal aspect of the post-acute COVID[3,4] response. Critically ill COVID patients are typically ventilated for longer than other patients requiring care in the intensive care unit (ICU), which can lead to higher levels of physical deconditioning.[5] They also experience neurological and respiratory impairments, increasing the likelihood of a more complex and prolonged recovery.[5] Existing evidence on sepsis (which has an inpatient mortality rate similar to that of COVID) indicates that 30% of hospitalized patients require post-acute care.[6] In the United Kingdom (UK), it is estimated that 45% of COVID patients will need some form of rehabilitation and that 4% will require more specialized and long-term rehabilitation in an inpatient setting.[5]

Unfortunately, rehabilitation is often underemphasized in global disaster planning and responses, and the need for rehabilitation is often not recognized until many months after a disaster.[7] Yet rehabilitation is a key component of standard care delivery pathways and in other populations improves independence, facilitates community reintegration, and mitigates long-term disability.[8] For COVID patients, rehabilitation can improve functional capacity, address the effects of deconditioning after prolonged ICU stays, and alleviate stress by providing patients with needed support throughout recovery.[9] Collectively, this can potentially facilitate patients' return to home and vocational activities. Rehabilitation has been described as a necessity and right in the context of the COVID pandemic, and it is recommended that it be routinely incorporated into pandemic response plans early on prior to widespread disability.[5]

The COVID care pathway is complicated by several issues including: a) a lack of clarity around the patients' eligibility for rehabilitation[10]; b) the ability of rehabilitation facilities/units to adapt and prepare for COVID patients; and c) the impact of physical distancing on the provision of rehabilitation treatments and community discharge support. In light of the mounting recognition that rehabilitation will play a key role in COVID patients' recovery, many studies and practice guidelines have begun to address these issues. By synthesizing information across these data sources, our scoping review aims to provide rehabilitation practitioners with a comprehensive review of the evidence to support the ongoing rehabilitation response to the pandemic.

2. STUDY GOAL AND OBEJCTIVES: Our goal was to synthesize the nature and extent of research on rehabilitation care provision to COVID patients. Specifically, we aimed to:

1. Describe the impact of COVID on patients and associated rehabilitation needs;
2. Outline the adaptations and preparations required to enable the provision of COVID rehabilitation;
3. Describe the types of rehabilitation services and treatments provided to COVID patients; and
4. Identify barriers and facilitators to delivering COVID rehabilitation.

3. METHODS

We followed Arksey and O'Malley's methodological framework for conducting scoping reviews.[11] The framework entails five stages: (i) identifying the research questions; (ii) identifying relevant studies; (iii) study selection; (iv) charting the data; and (v) collating, summarizing and reporting the results. We searched Medline, PsychINFO, Embase, and CINAHL on June 26th, 2020. For stage 2, the search strategy was tailored to each database using key terms that included "rehabilitation", "physical medicine", "allied health professionals" and variations of "COVID-19" (See Appendix A for Medline search strategy). For stage 3, articles were included if they were in English and focused on some aspect of rehabilitation care specifically for COVID patients. Research articles reporting both primary and secondary data were included. Articles were excluded if they were: a) not focused on the COVID pandemic; b) not focused on the field of rehabilitation; c) not focused on rehabilitation for COVID patients (i.e. focused on some aspect of rehabilitation in the context of the pandemic but not on care for COVID patients themselves); and d) focused on a pediatric population.

The database searches produced 1399 studies for consideration. After duplicates were eliminated, 1167 articles remained. A two-phase screening process was undertaken. For Phase 1, MBW reviewed the title and abstracts to determine if they were eligible for full-text review. This resulted in the identification of 252 articles for full-text review. For Phase 2, MBW and SRC first screened 10% of the articles to establish inter-rater reliability (k=0.746, 88% agreement). Discrepancies were resolved by discussing the abstract(s) in question and coming to a consensus. MBW and SRC then proceeded to screen the remainder of the articles, where 57 met the inclusion/exclusion criteria and were included in the review. Our hand-search identified an additional 11 articles for inclusion in the review. In total, 68 studies were included (See Figure 1 for a PRISMA Flow Diagram of article selection). We conducted an updated search on October 13th, 2020. After screening and full-text review (conducted by SRC and KMK), we identified an additional 61 articles for inclusion. In total, we included 129 articles in our review. See Figure 1 for a PRISMA Flow Diagram of article selection

For stage 4, we used a data abstraction chart to extract relevant information from studies (e.g. sample details, rehabilitation program details). For stage 5, we employed a narrative synthesis of the included studies to answer the research questions.[12] Analysis was an iterative process of combining, categorizing, summarizing and comparing information across studies.

[insert figure 1]

4. RESULTS

4.1. Study Demographics

The initial search on June 26th, 2020 produced 1,167 articles after deduplication, of which 68 met the inclusion/exclusion criteria. Our updated search on October 13th, 2020 produced 2,501 articles after deduplication, of which 61 met the inclusion/exclusion criteria. In total, we included 128 articles in our review (see Figure 1 for PRISMA diagram).[3,4,13-138] With respect to article type, n=33 were primary data articles (i.e. observational studies, case reports),[22,24,33,41,51,55,57,63,69,78-89,115,117,119,127-129,131,132,134,136-138] n=82 were secondary articles (i.e.

reviews, letters to the editor that did not report results of an original research project, commentaries)[3,4,14,17-21,25,27-31,34-40,42-49,53,54,56,58-60,62,64-68,70,71,73-75,90,92-114,116,118,120-126,130,133,135] and n=13 were articles reporting guidelines for rehabilitation in COVID patients.[13,15,16,23,26,32,50,52,61,72,76,77,91] Details pertaining to the geographic distribution of research can be found in Table 1.

[insert table 1]

4.2. Primary Study Details

Of the 33 articles that reported primary data, most were cross-sectional in nature and aimed to describe the development and delivery of a rehabilitation program for COVID patients (n=13).[22,24,33,41,51,63,69,78,81,88,127,129,136] Additionally, one article described a physician's experience with being treated for COVID,[57] a second outlined the organizational changes made to accommodate COVID patients,[63] and a third estimated the post-acute rehabilitation needs of COVID patients.[55] Three studies aimed to describe the demographics, clinical characteristics and level of rehabilitation of patients with COVID at their institutions.[79,80,85] One additional study investigated the rehabilitation needs of COVID patients at their institution.[134] Only one study implemented a randomized control trial design to investigate the outcomes of a pulmonary rehabilitation program for COVID patients.[41]

4.2.1 Study Sample Characteristics

In total, 30 studies reported sample sizes. Seventeen case report studies reported on n=1 to n=9 patients, [33,51,78,79,81,83-86,88,115,117,119,128,131,132,137,138,] and the remaining 16 studies reported sample sizes ranging from n=9 to n=312, with a mean of n=101. The mean age of patients in the case reports was 53 years old (Range: 41-69). Five of the cross-sectional studies[22,24,63,127,129] reported the mean age of patients in the sample (50-73 years old; Mean=63) and one study[55] reported the median (66 years old; IQR: 45; 85). A third cross-sectional study reported age groups for their participants (i.e. ≤35, 36-50, 51-65, ≥76).[134] The RCT reported a mean of 69.4 years old for the intervention group and 68.9 for the control group. Twenty-seven studies reported participants' gender. All but five of the case reports[83,115,128,131,132] reported on male patients[33,51,78,79,81,84-86,88,117,119,137,138] and the RCT study only included males in both the intervention (n=24) and control groups (n=25). The remaining six cross sectional studies[22,24,55,127,129,134] reported a mean of n=61 females and n=101 males. Ten studies reported information pertaining to patients' ICU length of stay (LOS). The manner of reporting varied, with two studies reporting a mean of 5[22] and 16.4 days[24] and one reporting a median of 15 days (IQR:2;30),[55] whereas two studies were similar at 14 days.[83,136] Another study mean reported a 19 days(± 10 days).[80] The mean ICU LOS across the case report studies was 18.83 days.[33,51,78,115,119,131] Only one study reported a 25 day post-acute rehabilitation LOS.[51] Other studies reported an overall rehabilitation LOS of 10 days-14 weeks.[81,84,87,88,119,127,136]

4.2.2 COVID Sequelae

In total, 19 of the 33 articles reporting primary data discussed COVID sequelae that would warrant the need for rehabilitation for this population.[22,33,51,55,57,63,69,79-81,87,115,117,119,127-129,131,136,137] Table 2 outlines the specific sequelae reported.

[insert table 2]

4.2.3 Co-Morbidities

Eleven articles mentioned common co-morbidities that COVID patients presented with, including cardiovascular co-morbidities (e.g. hypertension, arrhythmias, heart disease),[24,41,69,80,83,85,86,115,117,131,134] overweight/obesity,[83,86,119,128,131] mental health diagnosis (e.g., depression),[86,115,119] pre-existing respiratory disease (e.g. chronic obstructive pulmonary disease (COPD)),[117,132,134] type 2 diabetes,[24,41,80,83,85,117,131,134] and other chronic diseases (e.g. liver disease, hyperthyroidism, polyneuropathy).[117,129,134]

4.2.4 Rehabilitation Admission Criteria

Six articles discussed potential criteria and associated assessments that could be used to identify COVID patients for post-acute rehab. The most commonly discussed criteria were as follows:

(i) Age (>65 years)[41]
(ii) Respiratory Presentation[138]:
  - Forced expiratory volume: (FEV1) ≥70%[41]
  - Oxygen needs: i) patients wearing non-rebreather mask, Venturi mask or oxygen mask (FiO2 ≥40 and <60%); ii) patients without oxygen support devices or wearing nasal cannula (FiO2 ≥21 and <40%)[24]

(iii) Mechanical ventilation and tracheostomy status (i.e. those who were ventilated are expected to need rehab)[80]
(iv) Functional status[51,55,138] (e.g. high level of dependency as determined by an activities of daily life (ADL) score < 4)
(v) Dyspnea[51,138] (e.g. using Medical Research Council (mMRC) Dyspnoea Scale[24])

Other considerations for identifying eligible COVID patients included body composition, muscle function, and quality of life.[51,138] Two articles suggested that patients might potentially be excluded from rehab due to other co-morbidities (e.g. stroke, neurodegenerative diseases, additional respiratory complications).[24,41]

4.2.5 Adaptations to Rehabilitation

Six studies discussed the adaptations made to provide rehabilitation to COVID patients.[63,80,82,84,137,138] These adaptations included: (i) modifying tasks, roles, and scheduling of the rehabilitation teams; (ii) creating multidisciplinary COVID teams including the physicians, nurses, respiratory physiotherapists (RPTs), and physiotherapists (PTs); (iii) scheduling changes, including scaling back staff numbers to address personal protective equipment (PPE) shortages; (iv) delegating tasks based on expertise (e.g. RPTs trained in management of chronic respiratory failure and non-invasive ventilation); (v) organizing an online communication system to facilitate email and printing of documents (so as to minimize contact between care team

members) and (iv) mandating PPE for patients undergoing rehabilitation. Some studies described moving from in-person rehabilitation to telerehab.[84,88,136]

4.2.6 Nature of Rehabilitation Programs

All of the articles provided information on what a rehabilitation program for COVID patients could entail (Table 3).

[insert table 3]

4.3 Secondary Data Article Details

Of the 82 secondary articles, 57 articles specified the place of rehabilitation (i.e. acute care/ICU (n=39),[3,4,17,19-21,27-30,36,39,40,43,44,46,49,53,59,60,62,64,66,68,73,75,96,99,105,107,110,114,118,120,122-124,126,130] post-acute/ICU discharge (n=10),[3,28,29,44,64,68,95,110,118,122] inpatient rehabilitation (n=15),[18,19,21,29,38,39,48,62,74,110,112,124,130,133] and community-based setting (n=20).[17,25,27,30,39,40,47,53,54,56,65,67,73,74,105,107,109,111,120,130]) The most common rehabilitation profession to be involved in care for COVID patients was physiotherapy (n=29),[4,19,20,27,47,49,58-60,64-66,68,73,96,102-107,109,111,113,114,122,125,126,130] with three studies highlighting the inclusion of RPTs.[30,36,53] Other rehabilitation professionals included physiatrists/physical medicine and rehabilitation (PMR) specialists (n=11),[4,21,58,60,64,65,67,92,99,113,130] occupational therapists (OTs) (n=11),[4,27,62,64,65,73,95,102,104,113,122,130] speech language pathologists (SLPs) (n=7),[4,19,46,62,65,95,104,130] psychologists (n=2),[112,113] dieticians (n=1),[95] respiratory therapists (n=1),[113] and social workers (n=1).[62]

4.3.1 COVID Sequelae

In total, 61 articles discussed COVID sequelae (see Table 4).

[insert table 4]

4.3.2 Co-Morbidities

Only 11 secondary articles identified comorbidities observed in individuals with COVID.[34,38,40,53,62,65,74,120] The most commonly discussed comorbidities were cardiovascular diseases[40,53,97,120,123] including coronary artery disease,[62] hypertension,[38,53,62,120] and stroke.[62,65] Other conditions included diabetes,[40,53,90,97,120] pressure injuries,[40] bladder dysfunction,[40] chronic pulmonary diseases,[74,120,123,126] cancer,[123] autoimmune diseases,[123] and neurological conditions.[65,126]

4.3.3 Rehabilitation Admission Criteria

Only 12 of the secondary articles explicitly outlined criteria that could be used to determine COVID patients' eligibility for rehab: a) negative COVID status of the patient (e.g. two consecutive negative nasal swabs within 24 hours or 7+ since diagnosis);[4,21,29,42,48,111,124,130] b) stable cardiovascular function, respiratory function (e.g. stable oxygen saturation with no need

for respiratory assistance), nervous system function and general parameters (e.g. no fever);[4,21,29,38,44,105,130] and c) functional status of the patient should reflect some independence (as determined by the Functional Independence Measure), however, patients should receive rehabilitation to address any functional deficits they may be experiencing (e.g. unable to complete some activities/instrumental activities of daily living, residual functional deficits due to hospital-acquired weakness).[29,70,73] Only two studies spoke to ventilation status, with one suggesting that ventilator-dependent patients to be tracheotomised at least 24 hours prior to admission[38] and the other recommending that rehabilitation not begin unless there is absence of ventilator resistance.[105]

4.3.4 Adaptations to Rehabilitation

Eighteen articles described adaptations to rehabilitation services that facilitated the provision of rehabilitation to COVID patients. These adaptations included: (i) modifying the physical space of the rehabilitation unit/centre (e.g. to enable isolation of infectious COVID patients or to create additional space for ICU patients—many who could receive early rehabilitation as a result) or modifying tasks, roles, and schedules of the rehabilitation teams[4,19,29,38,39,43,49,62,65,66,107,123]; (ii) creating multidisciplinary COVID teams including physicians, nurses, RPTs, and PTs[29,35,38,49,107]; (iii) scheduling changes to address PPE shortages[4]; (iv) delegating tasks based on expertise (e.g. matching approaches to the right profession, using best mix of skills)[25,68,107]; and (v) using technology to facilitate communication between providers, and to deliver rehabilitation at a distance.[25,62,73,123]

4.3.5 Nature of Rehabilitation Programs across the Continuum

All the included articles discussed the nature of rehabilitation. Fourteen of the articles touched on what rehabilitation may look like in a broader context, rather than within a specific area (i.e. acute care).[3,14,31,37,42,45,58,70,71,96,99,113,121,125] The articles highlighted how rehabilitation is a vital component of care and recovery for persons with COVID.[14,31] Articles suggested that the COVID rehabilitation programme include pulmonary,[31,58,125] cardiac,[31] respiratory,[45,113] physical,[45,58,70,113,121] psychosocial,[70,113] and swallowing[113] aspects. Postural positioning was discussed to be an important technique to help mitigate the impacts of prolonged bedrest.[40,58,70] Only two studies described specific techniques that could be used in this population (e.g. Zheng's recumbent exercises, air way clearance, bed mobility, sit to stand, walking, etc) but did not describe specific prescription information.[58,113] Articles also suggested that severity of the illness be considered when developing a therapy regimen.[45,58,71] Lopez and colleagues suggested that a registry be created to document symptoms and recovery trajectories over time of COVID patients, to help inform rehabilitation practices going forward.[42] Finally, one study recommend the use of telehealth but did not describe a protocol.[37] An additional 12 articles provided specific suggestions for frequency, duration, and modality of COVID rehabilitation (See Table 5). Most of the suggestions were adapted from respiratory rehabilitation guidelines for COVID patients specifically[56,62,73,106] or for similar populations (e.g. COPD, ARDS).[58,59,73,109] One article made recommendations based on front-line expert consensus and references[74] and another adapted general exercise principles from the American College of Sports Medicine.[120] Three articles did not specify what they based their recommendations on.[47,60,122]

[insert table 5]

4.3.5.1 Acute Care

Thirty one articles provided information on what rehabilitation in the acute phase may look like.[4,17,19-21,27,29,30,36,40,43,44,46,49,59,60,62,64,66,68,73,105,107,110,118,120,122-124,126,130] Four studies identified that rehabilitation in the acute phase would be helpful to mitigate sequelae of COVID but did not provide any additional information regarding the rehabilitation program itself.[3,39,53,75] Nearly all the articles recommended in-person rehabilitation at the bedside, with one specifying techniques that minimize handling of patients (e.g. mechanical assisted limb exercisers, remote controlled mechanical tilting beds).[124]
Respiratory rehabilitation was most commonly discussed (n=18).[19,20,28-30,36,40,43,44,46,59,60,62,66,68,73,114,122] In the acute stage, early mobilization (i.e. postural management) was suggested by articles to improve respiratory function and maintain oxygen saturation levels.[4,19,20,28,30,36,40,43,44,46,60,66,68,73,105,107,110,118,126] Articles proposed that for unconscious or sedated patients, passive range of motion mobilization exercises[19,20,27,30,110,114,120,126] and electrical muscle stimulation (EMS)[30,49,59,68,110,114,118] could be used in an attempt to counteract deconditioning and immobilization deficits. Airway clearance techniques such as stimulated cough manoeuvres and airway suctioning were also discussed in nine studies for those who were on invasive mechanical ventilation.[30,36,66,68,73,105,107,114,120] These techniques were not recommended for patients with significant bronchial obstruction.[30] One study described exercise training, breathing exercises and chest care and airway secretion for those who were ventilated but had “clear cognitive status” (not defined in article).[120] Further details about articles’ recommendations for COVID rehabilitation in the acute care setting can be found in Table 6.

[insert table 6]

4.3.5.2 Post-Acute Care (Exact Setting Unspecified)

It was recommended by all articles that COVID patients receive rehabilitation after discharge from the acute care setting—though a subset did not specify the exact setting.[3,28,29,44,64,68,105,110,118,122] With respect to what a post-acute program might look like, details were scarce. Articles suggested that post-ICU discharge exercise therapy,[28] multimodal physiotherapy treatment[44] and respiratory therapy[3] be prescribed, but do not provide further details. For individuals who have functional deficits and physical barriers to discharge (e.g. inability to navigate steps to enter home, needing assistance with transfers), continued physical and occupational therapy as well as access to a physiatrist can help with discharge planning and symptom management.[64] Few described a post-acute care rehabilitation program in more detail.[29,68,105,118,122] These articles focused on respiratory therapy, mobilization and postural management,[29,68] strength training, endurance training, balance training, EMS & chest physiotherapy.[68,105,118,122] Articles recommended that prescribed exercise be of low-intensity (<3.0 metabolic equivalents).[68,118] Psychological support, nutritional support and ADL guidance was also suggested for this phase of recovery.[68,105,118,122] Finally, it was recommended that the rehabilitation program be tailored based on disease severity.[110]

4.3.5.3 Inpatient Rehabilitation

Three of the nine studies that suggested that persons with COVID undergo inpatient rehabilitation did not provide additional details.[38,39,67] Overall, it was recommended that care be provided by a multi-disciplinary team included OTs and PTs.[130] Some articles proposed that rehabilitation programmes in the inpatient setting include mobilization,[19] strength training,[19,21,29,48,124] endurance training,[21,29,48,74,124] and balance exercises[48,62,74] to help with recovery from deconditioning and generalized weakness. The main goal of rehabilitation discussed for inpatient settings was for the patient to regain enough physical functioning to be independent.[17,133] Three of the articles suggested that assessments be done to identify deficits in activities of daily living.[29,48,62] With respect to respiratory training, only three articles described the use of this type of therapy at this stage.[21,62,74] One article proposed that oxygen therapy be provided to support COVID patients with chronic pulmonary diseases during exercises.[74] Another suggested that respiratory functioning be assessed and if the muscles are found to be weak, respiratory training could be included.[62] Carda et al.,[21] recommended breathing training in line with published guidelines for primary lung fibrosis. Other areas of consideration for an inpatient rehabilitation programme for COVID included cognitive rehabilitation,[112] smoking cessation,[48,74] dietary and nutritional counselling,[18,21,48,74,124] psychological support,[21,29,48,62,98,112,124,130] and supports to improve quality of life.[48,74] One article described the need to address voice or communication impairments.[62] Telerehab was recommended for consultations once approved by a consultant on the unit.[130]

4.3.5.4 Community Based Rehabilitation

A majority of the articles (n=13) indicated the use of a telehealth-based programme for those requiring rehabilitation upon return to the community.[25,27,30,39,40,47,65,67,73,74,104,107,130] It was recommended that the focus of the telehealth program be on physical functioning, quality of life and support with returning to community participation.[107] One article argues that telerehab is a better choice for patients at higher risk of COVID mortality, such as immunocompromised individuals and diabetes patients.[96] Another study recommended the use of apps which provided guidance on completing exercise regimens.[74] With respect to in-person setting, one article recommended the use of spa facilities to provide community rehabilitation.[111]
With respect to what these programmes might entail, main areas included exercise training (i.e. strength and endurance training),[30,40,54,56,74,130] diet guidance,[40,56,74] pulmonary or respiratory rehabilitation,[39,54,74,111,130] cognitive rehabilitation,[39,54,130] and psychological support.[56,74,130] Few studies (n=6) discussed the assessment and rehabilitation of psychosocial issues such as quality of life, adjustment to family and social life, return to work and activities of daily living.[30,39,40,53,54,56] However, none of these studies described what may be included in this type of programme.

4.4 Guideline Details

A total of 13 guideline documents were included in the review. Each of these outlined an actionable set of recommendations that targeted COVID patients,[26,61] rehabilitation practitioners,[13,15,16,32,50,72,76,77,139] or policy makers.[52] The guidelines were published by organizations and researchers from the UK,[16,52,61,72,139] Australia,[13] Turkey,[15] Denmark,[26] Canada,[32,91] China,[77] and New Zealand.[76]

4.4.1 Nature of Rehabilitation Program across the Continuum

Nearly all of the guidelines (n=10) suggested that COVID rehabilitation programs be provided by an interdisciplinary team of practitioners including physiatrists, PTs, OTs, SLPs, and dieticians.[13,15,16,32,50,52,61,72,76,77] Guidelines recommended that COVID rehabilitation begin early (i.e. as soon as the patient has stable system(s) functioning) and be sustained throughout the patient's recovery and across the continuum of care.[13,15,16,50,76,77,139]

4.4.1.1 Acute Care

Guidelines suggested that rehabilitation in the acute care setting focus primarily on respiratory management, mobility, and nutrition. Respiratory management is likely provided by respiratory therapists and SLPs who can help COVID patients resume normal breathing patterns through oxygenation, airway secretion clearance, and ventilation weaning.[32,50,52,76,77] PTs and OTs can support early mobility by mitigating the effects of deconditioning using both passive and active range of motion exercises, positioning, and strength training.[32,61,76,77] SLPs are well-positioned to support patients' nutrition by screening for malnutrition, addressing swallowing difficulties, and providing appropriate diet and fluid modifications.[50,72,76]

4.4.1.2 Inpatient Rehabilitation

Guidelines suggested that post-acute care focus on addressing on-going impairments in mobility, respiratory function, nutrition and communication with the goal of promoting independence with activities of daily living.[50] Both mobility and respiratory function can be managed using aerobic exercises that are tailored to patients' abilities (e.g. slow jogging, swimming, brisk walking), strength training, and breathing exercises.[76,77] Nutritional needs can be monitored in terms of oral intake and muscle function. Specifically, SLPs can help manage swallowing issues and promote communication ability.[72,76]

4.4.1.3 Community Based Rehabilitation

Most guidelines recognized that COVID recovery is a complex and on-going process that will likely extend into the community.[26,32,50,52,72,76] The suggested goal of community-based rehabilitation is to optimize COVID patients' functional recovery and quality of life. This entails continuing to provide rehabilitation support to manage respiratory function, mobility, nutrition, and communication (e.g. through tailored exercise programs, energy/fatigue management plans, SLP support for diet plans).[32,50,72,76] Importantly, it is recommended that patients be supported and empowered to manage their own health and reintegrate into the community.[72] This can be facilitated by rehabilitation practitioners providing patient education,[50] virtual rehabilitation,[50] home safety assessments.[32,50,76]

4.5 Key Recommendations (across Article Types)

Five primary articles, 12 guidelines and 40 secondary data articles provided recommendations to inform the ongoing rehabilitation response to the COVID pandemic (Table 7).

[insert table 7]

4.6 Barriers and Facilitators of COVID Rehabilitation Provision (across Article Types)

Factors that act as barriers (Table 8) or facilitators (Table 9) of COVID rehabilitation provision were discussed across primary data articles (n=7), secondary data articles (n=42), and guidelines (n=6)

[insert table 8]

[insert table 9]

5. DISCUSSION

The goal of this scoping review was to provide a comprehensive and up-to-date synthesis of evidence pertaining to rehabilitation for COVID patients. We included 129 articles, with 26% reporting primary data (n=33), 64% reporting secondary data (n=82), and 10% outlining practice/self-management guidelines (n=13). A quarter of the included articles came from Italy and China, which were amongst the first countries to experience and begin responding to the impact of the COVID pandemic.

5.1 Rehabilitation Programs to Meet the Needs of COVID Patients

The emerging body of literature on COVID rehabilitation has begun to elucidate the important role that rehabilitation can play in addressing COVID-related declines in health, function, and well-being. Most articles agreed that an individualized rehabilitation program be provided across the continuum of care by an interdisciplinary team of professionals and that the nature and extent of rehabilitation be informed by the care setting and COVID severity.

Only a small number of articles (29%) made mention of the psychosocial impacts of COVID (e.g. anxiety, depression, PTSD, reduced QoL) and very few (5%) presented evidence pertaining to rehabilitation's role in addressing them.[29,48,62,68,74,107] A number of psychosocial factors (e.g. distress, mental health) have been found to be significantly associated with an elevated risk of COVID hospitalization.[140] It is likely that these psychosocial vulnerabilities that predispose individuals to COVID hospitalization are the same vulnerabilities exacerbated post-hospitalization. In turn, psychosocial rehabilitation programming warrants further attention. Our review begins to elucidate what psychosocial rehabilitation might entail, including psychological counselling/interventions to address issues such as depression, anxiety and sleep-deprivation[48,62,68,78]; collaboration between physical medicine and rehabilitation specialists and psychiatrists/psychologists,[21] and education to promote patients' participation in valued activities.[62,74]

None of the articles discussed what community-based psychosocial rehabilitation should entail or how it should be delivered. Telehealth was widely discussed and endorsed by studies in our review but its potential for providing psychosocial rehabilitation was not considered. Telehealth and computer-mediated consultations with other chronic illness populations have been shown to

be beneficial and to foster closeness and communication amongst care providers, patients, and families.[141] While telerehab interventions have been demonstrated to be comparable in effectiveness to in person therapy with other disease populations such as stroke,[142,143] they disproportionately focus on physical recovery and have been underutilized to provide social support to patients and their family caregivers in the community setting.[142] To this end, we suggest that telehealth and other virtual care modalities have high potential for facilitating outpatient counselling and education to community-residing COVID patients. Rehabilitation professionals can also leverage virtual modalities to facilitate peer-led support and education for COVID patients. Despite peer support being recognized as an important aspect of psychosocial rehabilitation,[144] it was not discussed by studies in our review. Peer support has been demonstrated to promote community reintegration in other patient populations[145] and may be particularly beneficial for COVID patients who are already reporting that online groups are a valuable source of experiential knowledge and support—especially in the absence of other community/home care services.[146]

5.2 Adaptations to Enable the Provision of COVID Rehabilitation

Several of the adaptations and facilitators we identified directly resolved issues that challenged the provision of COVID rehabilitation. For example, modifying physical spaces, schedules, and teams was done to limit the spread of COVID and to address PPE shortages. Providing professional development opportunities was considered one way of addressing staff wellness and burnout. These solution-oriented adaptations should continue to be optimized so as to break down barriers to rehabilitation provision.

Notably, three aspects identified as challenging the provision of COVID care were not explicitly addressed by any of the adaptations or facilitators: 1) the paucity of evidence and guidelines for COVID rehabilitation; 2) patients' health status; and 3) health system issues. The first two issues are interconnected as the variability in COVID severity and impact has made it difficult to establish eligibility criteria and to generate a broad rehabilitation prescription. At minimum, articles in our review recommend that eligibility criteria entail: a) negative COVID status (as determined by two negative nasal swabs or patient being 7+ days from diagnosis); b) stability in respiratory and cardiovascular function as well as general health parameters (e.g. stable oxygen saturation, no fever); and c) functional need (one article suggested rehabilitation need be determined by a functional independence measure (FIM) score of <100).[29] As mentioned earlier, the rehabilitation prescription itself is best tailored to each patient to ensure that it holistically meets individual needs.

The health system issues we identified centered on poor system coordination which limited the continuity of COVID rehabilitation across the care continuum. Challenges with rehabilitation continuity—especially as patients transition back to the community—are not new.[147] However, several aspects of the COVID pandemic exacerbate these challenges (e.g. physical distancing restrictions, closing outpatient services, and early discharge from inpatient rehabilitation), suggesting that a multi-prong approach is needed. Many actionable strategies to promote COVID rehabilitation continuity can be leveraged from articles in our review and adapted from research that has focused on maintaining rehabilitation for non-COVID patients in the wake of the pandemic. These include: a) capitalizing on telemedicine to provide remote

rehabilitation[130,148,149]—particularly using accessible tools such as Skype, FaceTime, and Zoom without penalty to healthcare providers for non-compliance with privacy regulations[149]; b) creating strong partnerships with home care[130] and ensuring that rehabilitation services are viewed as 'essential'– particularly for those returning to congregate care settings where lockdowns may restrict non-essential care[148]; and c) ensuring that healthcare providers can bill and/or be reimbursed for telehealth visits using appropriate billing codes and in a streamlined way that does not detract from their time with patients.[4,65,149] It is important to note that these suggestions will not universally apply to health systems and organizations across geographic boundaries. In turn, they should be adapted to countries' national and regional contexts and health system capacities.

5.3 Future Directions

Many aspects of COVID rehabilitation were difficult to summarize across articles given the vast variability in reporting. Thus, there is a need for more consistent reporting to ensure that future studies can meaningfully aggregated to inform COVID rehabilitation programming and evaluation. Based on our review, we suggest standardized reporting parameters for the following data elements: a) patient populations, b) rehabilitation admission; c) service adaptations, and d) rehabilitation programming. For patient populations, capturing demographic information such as age, gender, hospital/ICU/rehabilitation LOS, co-morbidities, and COVID sequelae would provide important contextual information and enable detailed program evaluations. There was not a great deal of consistency in rehabilitation admission criteria reported but, at minimum, our review elucidates that COVID status at admission, respiratory function (e.g. oxygen saturation), and functional ability (e.g. using the FIM) should be outlined. Some degree of consistency was observed in the reporting of adaptations to enable COVID rehabilitation according to the broad categories of: a) modifications to physical space, b) staffing, c) scheduling, and d) communication modalities/procedures. Although information pertaining to rehabilitation programming was inconsistently reported across articles, we were able to extract data from at least one article for each of the following categories and thus suggest them as a good starting point for more streamlined reporting: a) timing (i.e. when program was initiated), b) duration (i.e. duration from start to end of program), c) frequency, d) modality (e.g. bedside, virtual), e) setting (i.e. acute care, ICU, in-patient/out-patient/community rehabilitation), and f) content (i.e. rehabilitation disciplines involved, number of rehabilitation professionals involved, specific therapies provided).

The role of families in supporting COVID patients' rehabilitation and recovery was not a focus of any articles included in our review. This is potentially due to ongoing public health restrictions that limit the physical presence of families for hospitalized patients.[150] However, it has been pointed out that physical restrictions on family presence should not undermine family-centered care efforts.[150] Distressing times like those experienced during the pandemic intensify patients' need to feel safe and connected to their loved ones,[151] making family-centered rehabilitation more important now than ever. Like other complex illnesses, COVID leads to a large and diverse set of needs requiring active participation and support from families.[152] Family-centered COVID rehabilitation ensures the involvement of both patients and families in treatment planning and can thus facilitate the individualized type of rehabilitation that COVID patients need.[153] Several strategies for engaging families in the overall care of COVID patients

can be adapted and implemented in the rehabilitation setting. These include: a) facilitating synchronous patient-family communication (e.g. using videoconferencing) as well as asynchronous engagement (e.g. pre-recorded videos, pictures, patient journaling); b) ensuring environmental familiarity for patients (e.g. arranging for family to bring in objects from home) and describing this environment to families; and c) prioritizing family-care provider communication (e.g. establishing a family communication plan, daily videoconferencing).[151] Engaging families early on when COVID patients are in hospital can enable smoother transitions to home and greater continuity in care.[153]

Sociocultural factors were only considered by one article in our review,[116] highlighting the need for further investigation into their impact on COVID rehabilitation provision and outcomes. For example, those with lower socioeconomic status (SES) may have reduced access to telerehab, which may differentially impact their recovery and other outcomes). Future research should capture variations in age, race, gender, and SES as it is becoming increasingly apparent that COVID disproportionately affects older adults, people of color, women, and those with lower SES.[154-156]

Our review only identified one qualitative study pertaining to COVID rehabilitation. Qualitative approaches are an important complement to epidemiological and clinical research and can provide insight into behaviors and perceptions.[157] In the context of COVID rehabilitation research, qualitative approaches can elucidate stakeholders' (e.g. patients, families, care providers) lived experiences with rehabilitation care and recovery, thereby moving us beyond the 'what' of COVID rehabilitation (e.g. what aspects of rehabilitation to provide? what outcomes to measure?) to the 'why' and 'how' (e.g. why are certain aspects of a rehabilitation program beneficial? How do the unique circumstances of COVID patients and families influence care needs and experiences?).[157]

6. Strengths & Limitations

To the best of our knowledge, this is the first scoping review to systematically identify and synthesize a diverse set of evidence sources (i.e. primary data, secondary data, guidelines) pertaining to rehabilitation for COVID patients. Our comprehensive synthesis of 129 articles has the potential to provide rehabilitation practitioners with a range of evidence to support their ongoing response to the COVID pandemic. Although the authors have expertise in scoping review conduct, the present review may have been strengthened by an academic librarian designing and deploying the search strategy. The search strategy did not include any terms explicitly related to psychological rehabilitation, which may account to some extent for the lack of data on psychosocial rehabilitation programming for COVID patients. Given that this review was conducted during the early stages of the COVID pandemic, the large majority (74%) of articles we included reported only secondary data (e.g. reviews, opinion papers). As such, we were limited in our ability to synthesize primary evidence and make recommendations based on real-world data that captures COVID rehabilitation "in action".

7. Conclusion

It is clear that rehabilitation will need to play an important role in the recovery of COVID patients, many of whom have long-lasting symptoms that do not permit return to full community participation. Research to date has begun to elucidate the criteria that can be used to identify patients for rehabilitation as well as the nature, extent, timing, and mode of this rehabilitation. However, a large majority of articles reported secondary data, underscoring that we know little about actual COVID patients receiving rehabilitation, the rehabilitation program itself, and the effectiveness of COVID rehabilitation across the continuum of care. Organization- and system-level adaptations have the potential to facilitate COVID rehabilitation delivery by mitigating barriers to rehabilitation provision. Additionally, engaging families in COVID rehabilitation may serve to optimize the continuity of care for patients. Future research should prioritize the reporting of primary data and subsequently the synthesis of studies reporting on the effectiveness of rehabilitation interventions as they are developed and delivered over time.

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Table 1- Geographic Distribution of COVID Rehabilitation Research

Continent	Country	Articles (N)	Citations
Europe (n=54)	Italy	24	3,14,18,19,**24**,29,36,43,44,48,**51**,54,60,**63**,68,**69**,94,110,111,114,**117**,**119**, 121,122
	United Kingdom	17	16,23,25,30,34,52,**57**,61,70-72,80,95,97,104,108,109
	Turkey	4	15,20,67,118
	Spain	2	90,100
	France	2	38,**55**
	Denmark	1	26
	Greece	1	**33**
	Switzerland	1	**84**
	Netherlands	1	17
	Multi-country	1	21
Asia (n=33)	China	14	**22**,40,**41**,56,74,75,77,**78**,**89**,96,98,**128**,**134**,135
	Japan	6	47,49,**85**,103,**136**,**137**
	India	4	31,99,126,**127**
	Singapore	3	**87**,**132**,**138**
	Korea	1	**115**
	Taiwan	1	120
	Iran	1	58
	Nepal	1	107
	Philippines	1	37
	Israel	1	133
The Americas (n=31)	United States	21	27,28,39,42,45,46,64,65,73,**79**,**81**-**83**,**86**,92,102,112,123,**129**-**131**
	Canada	4	4,32,62,93
	Brazil	4	53,59,101,125
	Multi-country	2	50,91
Australia (n=5)	Australia	4	13,35,66,**88**
	New Zealand	1	76
Africa (n=3)	Nigeria	2	105,106
	Morocco	1	113
Multi-content (n=2)	--	2	116,124

Note: Citations bolded and underlined correspond to articles reporting primary data. The remaining references correspond to secondary data articles and guidelines.

Table 2—COVID Sequelae Details from Primary Data Articles (n=22)

COVID Sequelae	**Manifestation**
Respiratory (n=15)	Obstructive respiratory dysfunction, pneumonia, deterioration and/or failure of respiratory function, dyspnea, cough, and ICU-acquired weakness.[22,33,51,55,57,82,87,119,127-129,131,136-138]
Physical (n=11)	Muscle weakness, and fever.[22,51,57,63,83,87,129,137] COVID-related fatigue and pain were discussed and included overall fatigue, nausea, vomiting, and myalgia.[57,82,119] One case study described lower-limb amputation as the result of COVID related coagulopathy.[117]
Psychosocial (n=7)	Anxiety, depression, sense of abandonment, isolation, fear, post-traumatic stress syndrome.[69,83,87,115,119,128,138]
Cognitive (n=3)	Delirium.[80,84,86]
Cardiovascular (n=2)	Coagulopathy, stroke and myocarditis.[117,127]
Organ System(s) Failure (n=2)	Renal failure was mentioned by one article,[55] while another mentioned multi-organ failure.[127]
Communication/Swallowing (n=1)	One study reported dysphagia.[84]

Table 3—Nature of Rehabilitation Program (Primary Data Articles)

Program Element	Details
Timing	• No consensus on timing of rehabilitation initiation. • Individual studies indicated that: o Pulmonary rehabilitation was initiated on day 16 of 25 for patient in ICU.[78] o General rehabilitation initiated on day 30 post-COVID diagnosis.[115] o Physiotherapy began within 24 hours of admission to ICU.[80] o Rehabilitation therapy was started immediately, based on the patient's general condition.[136]
Duration and frequency of rehabilitation activities	• Most studies reported on exercise-based rehabilitation performed by a PT, with individual exercise sessions lasting 10-45 minutes.[22,24,41,51,63] • Exercise sessions took place 1-2 times a day.[22,24,51,63,115] • There was less consistency in the overall duration of activities needed to help patients resume a relatively normal level of daily function: o One study suggested 2-3 weeks.[24,80] o One study suggested at least 6-8 weeks.[22,55,81,82]
Modality	• ICU-based rehabilitation predominantly taking place at the bedside.[24,33,57,80,127,131,137] • Modality of post-acute rehabilitation not clear in many articles but seems most took place in the patient's room,[22,41,51,83,115,119] later shifting to telerehab after discharge.[22,86,136]
Disciplines involved	• Physiotherapists and respiratory therapists most common.[22,41,51,57,63,80,81,86-88,127,129,131] • Other disciplines involved included: o Occupational therapy.[81-83,87,131,136-138] o Psychiatry and/or psychology.[86,131] o Speech-language pathology.[84,138] o Physiatry.[115,131]
Rehabilitation treatments/services provided	***Respiratory Therapy Interventions****:* • Mostly respiratory muscle training through various exercises including cough exercise, diaphragmatic training and stretching.[22,51,119,127,128,131] • Exercises included sit-to-stand training, walking, balance and aerobic training.[51] • Interval training for those who could not tolerate sustained aerobic exercise.[131] • Equipment used included commercial hand-held resistance devices,[51] neuromuscular electrical stimulation via squared electrodes,[51] cycle ergometer,

	with elastic bands or free weights,[51] and an inspiratory volumetric exerciser.[78]
	***Pulmonary Therapy Interventions**:* • Mostly posturing and prone positioning strategies.[24,33,69,78,87,127,131,137] • Pulmonary therapy strategies to be provided according to patients' oxygen support needs: o Those requiring oxygen support: breathing control and chest clearance techniques.[24] o Those not requiring oxygen support: thoracic expansion training and forced inspiration/expiration.[24]
	***Musculoskeletal Therapy Interventions**:* • Mostly passive and active-assisted range of motion, stretching and pumping exercises for limbs.[22] • These included exercises like balance training, walking, and limb strengthening exercises.[63,78,115,128,131]
	***Psychosocial Therapy Interventions**:* • Psychological counselling and sleep-promotion activities such as providing patients with earplugs, eyeshades, and sleep medications.[78,117,128,131]
	Speech-Language Therapy Interventions: • Swallowing rehabilitation and nutritional support.[117,119,131]

Table 4- COVID Sequelae Details from Secondary Data Articles (n=56)

COVID Sequelae	Manifestation
Respiratory (n=41)	Breathing difficulties, acute respiratory distress syndrome (ARDS), lung damage, pneumonia, and hypoxia.[4,14,17,21,28,29,31,34,35,38-40,44,45,49,53,54,56,59,60,62,66,67,70,74,90,93-96,98-100,102-105,107,113,114,121-123,125,126]
Psychosocial (n=30)	Depression, anxiety, PTSD, and quality of life.[4,14,17,21,31,34,39,40,48,53,56,60,62,67,68,71,74,93,95,98,102-105,110,112,113,122,123,130]
Neurological (n=35)	Dizziness, impaired consciousness and polyneuropathy.[3,14,21,34,35,39,42,60,62,67,68,70,75,90,93,94,97,102,107,110,112,122,130] Impacts on cognition (e.g. impaired memory, attention and higher order executive function; delirium).[4,17,21,28,29,39,48,93,112,113,123,130]
Motor (n=23)	Deconditioning and muscle weakness.[17,20,21,29,30,34,35,39,42,53,56,59,60,67,68,74,97,105,107,110,113,122,130]
Cardiovascular (n=13)	Myopericarditis, thrombosis and myocardial injury.[42,56,59,62,70,74,90,93,95,96,99,102,126]
Physical/Movement (n=10)	Problems with fatigue or pain[34,59,95,96,98,107,110,122] and fever.[101,102]
Organ System(s) Failure (n=9)	Renal and multi-organ failure.[56,62,70,74,95,96,102,104,126]
Communication/Swallowing (n=5)	Communication and swallowing issues.[21,46,114,122,123]
Other (n=4)	Gastrointestinal issues[95] and malnutrition.[18,102,130]

Table 5— Suggested modality, frequency, intensity and timing of rehabilitation protocols from secondary articles.

Article	Modality	Program Components	Frequency	Intensity	Duration	Timing
Mukaino et al., 2020	Telehealth	Exercise program	Once	NR	20 minutes	Community rehabilitation
Qu et al., 2020	Telehealth	Exercise program	Daily	1.0 MET - <3.0METS	15-45 minutes	Community rehabilitation
Rayegani et al., 2020	NR	Physical activity	2x per day, 1 hour after eating	NR	15-45 minutes	NR
Righetti et al., 2020	In-person	Prone ventilation	Once per day	NR	12-16 hours	Acute care
Ronconi et al., 2020	In-person	Prone positioning Head and arm mobilization	Once per day	NR NR	12 hours Every 4-6 hours	Acute care
Sheehy, 2020	In-person	Strength Training Aerobic Exercise	3x per week, for 6 weeks Increased to 3-5x per week over time	8-12 RM, 1-3 sets Start with <3 METs and increase over time	NR Increased to 20-30 minutes over time	Across continuum
Wang et al., 2020	In-person	Prone positioning Stretching	NR 3x per day	NR NR	2 minutes NR	Acute care
Yang & Yang, 2020	Telehealth	Aerobic exercises Strength training Traditional Chinese Medicine	Increase to 3-5x per week 2-3x per week Once per day	Progressive increase from low intensity 8-12 RM, 1-3 groups each time; increase load 5-10% every week NR	Increase up to 20-30 minutes 2 minutes per group	Community rehabilitation

					30-50 minutes	
Abdullahi, 2020	In-person	Postural Management	Once per day	NR	12-16 hours	Within 72 hours of endotracheal intubation
Ahmed & Haji, 2020	Telehealth	Aerobic exercises Resistance training Flexibility	3-5x per week 2+ days per week 2 days per week	Build toward 12-14/20 RPE 40-50% 1RM, 1-4 sets, 10-15 reps 2-4 reps per muscle group	Baseline tolerance build to 60 minutes NR 10-30s per stretch	At home
Cheng et al., 2020*	Telehealth	Aerobic exercises Resistance training	5x+/week 2-3 days/week, 48 hour intervals	40-59% HRR Strength – 60% 1RM, 2-4 sets, 8-12 reps Endurance – 50% 1RM, ≤2 sets, 15-25 reps	30-60 minutes	At home
Demeco et al., 2020	Telehealth	Aerobic exercises Strength training	3-5x per week 2-3x per week for 6 weeks	Low intensity with steady increase Weekly intensity increases by 5-10%	20-30 minutes NR	At home

**Recommended for mild COVID no pre-existing risk factors. NR = not reported; METS = metabolic equivalents; RM = Repetition maximum; RPE = Rate of perceived exertion; HRR = Heart rate reserve*

Table 6—Nature and Modality of Acute-Based COVID Rehabilitation

Nature of Rehabilitation	Rehabilitation Modality	Rehabilitation to Avoid
For patients with mild COVID: • Respiratory training,[40,44,59,68,73,118] exercise training,[4,27,30,40,43,44,59,66,73,123,130] and progressive recovery of standing and walking activation[43,66,68,73,118] to be adopted as early as possible to combat deconditioning. • Exercise training (e.g. resistance, balance and endurance).[29,30,44,68] **For patients with moderate COVID:** ➢ Chest physiotherapy (e.g. airway clearance, positioning, chest percussion and controlled coughing).[120] **For all patients regardless of COVID severity:** • Cognitive rehabilitation (e.g. neuropsychological training, counselling sessions, and psychological support).[29] • Address psychosocial issues (e.g. anxiety management, family support, quality of life, nutritional support).[4,44,75,98,118,123,124,130] • Introduce speech-language therapy in the acute care setting.[123,130]	**For patients with mild or moderate COVID:** • Increased use of telerehab in ICU setting to provide care to stable patients to facilitate mobility.[27,107,124,130] • For ambulatory patients, walking and standing exercises can be prescribed via audio or videoconferences.[107]	**For patients with severe COVID:** • Breathing exercises, mobilization, and respiratory muscle training are not recommended during the acute phase when the patient is sedated or in a more critical condition.[36,62,105,118] • Rehabilitation to begin after the patient is extubated and non-acute.[21]

Table 7— Key Recommendations from Articles for COVID Rehabilitation

Recommendation Area	Details
Timing of Rehabilitation	• Early and sustained provision of rehabilitation by multi-disciplinary team.[13,16,19,23,28,52,65,70,74,76,77,**117**,**129**] • Specific suggestions for inclusion of SLP interventions early on in ICU[72] and overall management by PTs.[106]
Rehabilitation Assessment	• Patient triage recommended (e.g. discharge, referral and tracking systems via telehealth).[35,104,122] • Use of triage tool and a functional capacity tool to identify patients' rehabilitation needs recommended.[64,121] • Collect patient demographics and intervention outcomes data.[123]
Rehabilitation Provision	• Provide adequate PPE to clinicians.[114] • Use negative pressure rooms when possible and limit number of healthcare workers in the room at a time.[114]
Prescribing Rehabilitation	• Rehabilitation prescription should be personalized to each individual patient according to their comorbidities, stage of recovery, severity of symptoms, and place of care.[13,15,23,27,40,48,66,68,72,75-77,118,120,122,**132**,133] • Monitor patients throughout the rehabilitation process and assess for additional sequalae.[42,68,**132**] • Use telerehab for those recovering in the hospital with mild cases[107,122,124] and for pre-habilitation protocols.[109] • Provide rehabilitation interventions such as: o Postural management,[27,40,**127**] o Nutrition,[18,**117**] o Strength training,[19,40,58,68,124,**127,132,134**] o Aerobic exercise,[120,124] o Respiratory rehabilitation,[19,30,40,58,111,124,**127**,**134**] o Psychological support,[19,68,111,**117**,**134**] o SLP,[40,46,104] o EMS,[49] o Assessment of ADLs,[19,58] and o Physical activity.[111] • Should not provide early respiratory therapy (e.g. diaphragmatic breathing, manual mobilization and active exercises).[60,73,122,**127**] • Passive movement early on might be the best approach.[**127**] • Engage in key psychological activities such as assessment of PTSD, cognitive impairment, psychosocial impacts and secondary adversities.[48,107]
Discharge and Community Reintegration	• Patients should receive educational and multi-disciplinary support during discharge and ongoing rehabilitation to facilitate community reintegration.[4,13,16,19,23,27,52,61,64,67,68,72,76,**127**] • Establish a link between community-based rehabilitation programmes and specialized rehabilitation centres.[110]

	• Telerehab should be used for home-based rehabilitation follow-up.[120,124,**132**] • Rehabilitation pathways should consider those who are not admitted to the hospital.[108]

Note: Citations bolded and underlined correspond to articles reporting primary data. The remaining references correspond to secondary data articles and guidelines.

Table 8—Barriers to Providing COVID Rehabilitation

Barriers	Details
COVID infectivity	• Limited patients' access to rehabilitation due to isolation procedures[4,14,47,62,72] and rehabilitation facility closures.[27,64,122] • Physical distancing difficult to implement.[13] • Constrained therapists' ability to provide rehabilitation in common areas as they typically would.[24] • Restricted use of usual therapies due to potential aerosol transmission.[58,59,65,74] • Prevented the involvement of families in the care of COVID patients.[127]
Patients' health status	• Variability in severity of COVID infection made prescribing and initiating rehabilitation challenging.[70,4,49,56,60] • Severe disability heightens risk of fatigue and respiratory decompensation, which limits the range of therapies that can be provided.[24,34,40] • Lack of clarity about which patients are stable enough to receive rehabilitation using a virtual modality, thereby limiting the use of telerehab.[69]
Lack of evidence/guidelines	• Makes reorganizing care difficult since it is not clear which patients require rehabilitation and the type(s) of rehabilitation to be provided.[21,30,34,53,63,78,110,123] • Absence of evidence pertaining to virtual care especially challenging for provision of telerehab.[69,74]
PPE	• Insufficient PPE causes rationing of supplies and thereby challenges team assembly, shift schedules, and the overall ability to provide rehabilitation in an infectious environment.[4,13,27,35,49,63-65,73,76,106,107,127] • Use of PPE also impacts communication between clinicians and patients.[127]
Staff-related issues	• Declines in staff wellness, increased burnout, and staff shortages limit the extent and quality of rehabilitation provision to COVID patients.[20,34,35,104,107,127] • Increased workloads.[80] • Healthcare provider fear of infection and transmission to own families was challenging.[138]
Health system issues	• Lack of coordination across all levels of the healthcare system limits effective delivery of rehabilitation to patients across care settings (e.g. in hospital, at home).[27,56,70,71]

	• Existing billing procedures are stringent and burdensome for physicians and take away from patient care time and quality.[4,65] • Key challenge for developing nations is that they may not have an existing comprehensive rehabilitation system or disaster-response systems that include rehabilitation.[13,106] • Lack of funding to support telerehab and other infrastructure.[**86**,107]

Note: Citations bolded and underlined correspond to articles reporting primary data. The remaining references correspond to secondary data articles and guidelines.

Table 9—Facilitators of Providing COVID Rehabilitation

Facilitators	Details
Use of virtual care	• Use of audio-visual and telehealth options helped overcome challenges of COVID infectivity to enable delivery of a range of rehabilitation services (e.g. OT, physiotherapy (PT), SLP, physiatry).[21,25,27,37,39,40,62,64,65,67-**69**,74,88,105,123] • Telerehab viewed favorably by patients.[**22**]
Multidisciplinary teams	• Collaboration between rehabilitation disciplines enabled optimal patient recovery.[57,71,74,**85**,**87**,**138**] • Key strategies included the coordination of professional skills and improvement of cross-team communication.[4,38,53,63,70,72,76,**78**,104]
Self-management	• Empowering patients to take an active role in their recovery (e.g. teaching them to perform exercises on their own) can help to ensure rehabilitation continuity.[16,61,**63**,76,77,105]
Professional Development	• Professional recognition and proper delegation of responsibilities can motivate staff to endure stress.[**63**] • Capitalizing on professional networks can facilitate collaborative skill development across disciplines and care teams.[**63**,72] • Rehabilitation staff should receive pandemic preparedness training that includes training on infection control and the proper donning/doffing of PPE.[4,35,53,59,66-68] • Important to support rehabilitation staff wellness.[4,65]
Reorganization of unit and staffing	• Units to be reorganized: o In a way that promotes infection control.[21,35,65,66] o Enables greater collaboration between HCPs and coordination of skills.[**63**,76] o Facilitates the provision of care to large volumes of patients under stressful circumstances.[**63**] • Capitalizing on HCPs' transferable skills can ensure broader delivery of care to COVID patients (e.g. utilizing respiratory PTs' skills with non-invasive ventilation and oxygen management during exercise).[38,**63**,64]

Note: Citations bolded and underlined correspond to articles reporting primary data. The remaining references correspond to secondary data articles and guidelines.

Figure 1- PRISMA Flow Diagram

Figure 1-PRISMA Diagram