ACRM
AMERICAN CONGRESS OF REHABILITATION MEDICINE

Archives of Physical Medicine and Rehabilitation

journal homepage: www.archives-pmr.org

Archives of Physical Medicine and Rehabilitation 2020;101:2243-9

SPECIAL COMMUNICATION

Managing the Rehabilitation Wave: Rehabilitation Services for COVID-19 Survivors

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Abstract

The coronavirus disease 2019 (COVID-19) pandemic is having a profound effect on the provision of medical care. As the curve progresses and patients are discharged, the rehabilitation wave brings a high number of postacute COVID-19 patients suffering from physical, mental, and cognitive impairments threatening their return to normal life. The complexity and severity of disease in patients recovering from severe COVID-19 infection require an approach that is implemented as early in the recovery phase as possible, in a concerted and systematic way. To address the rehabilitation wave, we describe a spectrum of interventions that start in the intensive care unit and continue through all the appropriate levels of care. This approach requires organized rehabilitation teams including physical therapists, occupational therapists, speech-language pathologists, rehabilitation psychologists or neuropsychologists, and physiatrists collaborating with acute medical teams. Here, we also discuss administrative factors that influence the provision of care during the COVID-19 pandemic. The services that can be provided are described in detail to allow the reader to understand what services may be appropriate locally. We have been learning and adapting real time during this crisis and hope that sharing our experience facilitates the work of others as the pandemic evolves. It is our goal to help reduce the potentially long-lasting challenges faced by COVID-19 survivors.

Archives of Physical Medicine and Rehabilitation 2020;101:2243-9

Reports of pneumonia of unknown etiology surfaced in Wuhan, Hubei Province, China in December 2019. Five cases of this new disease, documented between December 18 and 29, developed pneumonia with acute respiratory distress syndrome (ARDS). One of these patients did not survive. By January 22, 2020, there were 571 cases in 25 provinces in China. Only 8 days later, 7734 cases were reported in China and 90 other cases were reported throughout various other countries.[1] The World Health Organization declared the disease a pandemic on March 11, 2020.[2] Since then, the infection has spread to 187countries or regions in the world with 15,258,470 confirmed cases and 624,213 lost lives as of July 23, 2020.[3]

The World Health Organization named the novel disease *coronavirus disease 2019* (COVID-19) in February 2020. Typical disease manifestations include fever, cough, anorexia, diarrhea, loss of taste or smell, and malaise.[4,5] For most of the people, infection with COVID-19 is asymptomatic or mild. Conversely, some cases can be severe, causing respiratory distress, acute lung injury, and may progress to severe ARDS, multiorgan dysfunction, and death. A case series from Wuhan, China reported that 20% of hospitalized patients with confirmed COVID-19 required intensive care.[6] Similar numbers were reported in Lombardy, Italy where 16% of COVID-19 patients required intensive care unit (ICU) care.[7] Compared to typical ICU patients, COVID-19 patients need acute care and ventilator reliance for longer periods of time (reported to be as high as 20 days).[8] As a result, a myriad of

Disclosure: none.

0003-9993/20/$36 - see front matter © 2020 by the American Congress of Rehabilitation Medicine
https://doi.org/10.1016/j.apmr.2020.09.372

functional impairments are expected in this population. Consequently, patients recovering from COVID-19 will likely need rehabilitation interventions before they can return home.

The deficits associated with prolonged ICU care have been well described.[9,10] More than half of ICU patients suffer from postintensive care syndrome.[9] This syndrome includes markedly impaired strength or physical ability, critical illness myopathy, critical illness neuropathy, loss of muscle mass, nutritional deficiencies, and emotional and mental health diagnoses.[11] In addition, severe COVID-19 infection is associated with neurologic manifestations such as acute cerebrovascular disease, impaired consciousness, and skeletal muscle injury.[12] The complexity and severity of disease in patients recovering from severe COVID-19 infection require an approach that is implemented as early in the recovery phase as possible in a concerted and systematic way. We propose a spectrum of rehabilitation interventions that start in the ICU and continue through all the appropriate levels of care, including after the patient is discharged home. Here, we also discuss an administrative perspective and the effect of the COVID-19 pandemic on physiatry residency training.

The pandemic: local effect

The first COVID-19 positive patient was admitted to Johns Hopkins Hospital in March 12, 2020. Admissions peaked late March and ICU utilization peaked early May. As of July 22, 895 patients with COVID-19 patients had been admitted. Of all COVID-19 admitted patients, the rehabilitation team followed approximately 60% to 70% of the patients given their rehabilitation needs. Since this represented an unprecedented surge in the volume of patients with functional needs, the Department of Physical Medicine and Rehabilitation instituted a series of changes to adapt and provide rehabilitation services for the COVID-19 patients. Here we present our overall experience organizing the different levels of care.

Rehabilitation in the ICU

The benefits of early rehabilitation intervention in the ICU for patients with ARDS have been described in detail.[13] Commonly applied therapy interventions include positioning, range of motion exercises, respiratory and peripheral muscle training, and electrical stimulation.[14]

There are specific factors in the treatment of COVID-19-related ARDS that need to be considered because they are likely to affect the course of recovery. The average duration of mechanical ventilation appears to be longer for COVID-19-related ARDS.[15]

List of abbreviations:

ACIR	**acute comprehensive inpatient rehabilitation**
AM-PAC	**Activity Measure for Post-Acute Care**
ARDS	**acute respiratory distress syndrome**
ARISE	**Acute Hospital Rehabilitation Intensive SErvice**
COVID-19	**coronavirus disease 2019**
e-ACIR	**extended acute comprehensive inpatient rehabilitation**
ERAC	**Enhanced Recovery After COVID-19**
ICU	**intensive care unit**
PPE	**personal protective equipment**
RISC	**rehabilitation intervention severity categories**
SLP	**speech-language pathologist**

In addition, patients with ARDS due to COVID-19 frequently require high positive end-expiratory pressure, which may lead to further alveolar injury due to barotrauma.[16] Anecdotally, deeper sedation has been used for COVID-19 patients during ventilation due to fear of accidental disconnection of the ventilator, which can result in airborne dissemination.[17] Increased duration of mechanical ventilation and sedation in ARDS is associated with worse cognitive outcomes, weakness, and decreased physical function.[18] Thus, postintensive care syndrome is expected to be a problem faced by a larger proportion of patients.

Evaluation of the ICU patient

Patients with COVID-19 admitted to the ICU are screened by trained intensive care staff, including ICU physicians and nurses, or by a physiatrist and rehabilitation therapists to determine appropriateness for participation in early rehabilitation. Using the Johns Hopkins early mobility protocol[19] deployed in the medical ICU prior to the COVID-19 pandemic, specific categories were developed to appropriately identify and treat the rehabilitation needs of patients receiving ICU care.

The rehabilitation intervention severity categories (RISC) are based on the preexisting medical ICU protocol and modified for patients with COVID-19. A RISC score is determined based on chart review of multiple factors including the length of stay, days on a ventilator, level of sedation (eg, Glasgow Coma Scale or wakefulness), level of agitation (eg, Richmond Agitation Sedation Scale score), positioning, medical comorbidities, medical stability, and prognosis. The chart reviewer assigns a score based on their assessment of clinical factors and clinical experience. Table 1 details the factors used in the RISC categorization and the recommended rehabilitation according to the level. Of note, all rehabilitation interventions are performed in negative pressure rooms while maintaining airborne precautions and using appropriate personal protective equipment (PPE).

Acute care rehabilitation models

A large portion of hospitalized COVID-19 patients do not require ICU care and could also benefit from early rehabilitation.[20] Regular therapy interventions enhance functional recovery and safe discharge either to home or other levels of care. If the patient has the potential to return home, therapy goals should focus on providing interventions to address this goal. Delivery of therapy during acute hospitalization may vary across institutions based on patient needs and availability of resources. An individualized plan of care should be developed to address each impairment: aerobic capacity and endurance, pulmonary hygiene, strength, nutrition and dysphagia evaluation, and neuropsychological dysfunction. A patient's baseline functional status, performance on standardized outcomes measures, and prognosis allow clinicians to formulate levels of care and choose appropriate rehabilitation interventions. It is also important to consider the availability of PPE and human resources that may limit the provision of services. Redeployment of the outpatient therapy workforce was required to provide the services needed. At our institution, we developed a standardized therapy care model for COVID-19 patients to maximize efficacy while conserving resources.

The Johns Hopkins' rehabilitation care services for COVID-19 patients are based on the patient's functional level at baseline and at the time of initial evaluation. All patients are evaluated for

Table 1 Rehabilitation intervention severity categories

Score	Factors	Rehabilitation Intervention
0	Severe sedation or agitation (RASS −3 to −5 or RASS +2 to 4), significant vasopressor use or hypertension, prone position, unstable hemodynamics, poor prognosis	No practical rehab team interventions recommended at this time
0.5	>72 h on ventilator, severe sedation or agitation (RASS −3 to −5 or RASS +2 to 4), supine position	Possible occupational therapist intervention for positioning and splinting
1	Mild agitation and/or mild to moderate sedation with intermittent *lucid* periods (RASS −2/−1, or +1), stable ventilator settings, weaning sedatives and vasopressor use, consistently supine	Passive ROM limbs, voluntarily move limbs when feasible medically, splinting as needed, initiation of low-tech communication devices
2	Mild agitation and/or mild sedation (RASS −1 to +1) with command following, weaning ventilator settings, off sedatives and vasopressors	Volitional limb ROM exercises for strengthening, brief sitting edge of bed, simple bed mobility, consider use of bicycle ergometry passive/active, simple cognitive stimulation exercises
3	Mild agitation and/or mild sedation (RASS −1 to +1) with more frequent alert periods (RASS 0), progressing SBT or extubated, stable hemodynamics	Active limb strengthening and ROM exercises with mild resistance, prolonged sitting EOB, increased bed mobility, standing and walking trials, continued cognitive stimulation exercises
4	Medically stable, weaned off mechanical ventilation, possibly on HFNC weaning or NC/RA	Rehabilitation progression of interventions to next level of care, possible physiatry consult to help manage rehabilitation needs and oversee handoff to colleagues on regular medical floor for continued rehabilitation care

Abbreviations: EOB, edge of the bed; HFNC, high flow nasal cannula; NC/RA, nasal cannula/room air; RASS, Richmond Agitation Sedation Scale; ROM, range of motion.

functional deficits by our rehabilitation team including physical therapists, occupational therapists, speech-language pathologists (SLPs), rehabilitation psychologists or neuropsychologists, and physiatrists. Prior to the COVID-19 pandemic, the Activity and Mobility Promotion initiative established a common language of function among the rehabilitation and medical teams (physicians, nurses, case managers) to describe and quantify patient function in the hospital.[21] The hospital adopted the Activity Measure for Post-Acute Care (AM-PAC) Inpatient *6-Clicks* Basic Mobility and Daily Activity Short Forms to document a patient's capacity to perform basic mobility and daily activity tasks (tables 2 and 3).[22] AM-PAC 6-Clicks is a standardized functional assessment measure that provides a picture of the patients' activity limitations during acute hospitalization based on the International Classification of Functioning, Disability and Health framework.[23] A raw score of 24 in each of the short forms represents no basic mobility and daily activity deficits to be addressed in the hospital, and abilities consistent with functioning within a home and performing limited outdoor activities. The minimum raw score for both scales is 6. AM-PAC Inpatient 6-Clicks Basic Mobility Short Form was used by physical therapists, whereas AM-PAC Inpatient 6-Clicks Daily Activity Short Form was used by the occupational therapists. AM-PAC Inpatient 6-Clicks Short Form raw scores were used instead of T scores for ease of categorization into the different groups mentioned below by bedside clinicians (physical therapists or occupational therapist) after initial evaluation. SLPs assess a patient's cognition and swallowing function and address their ability to tolerate different diets.

The patients are divided into 3 groups based on their preadmission functional status and AM-PAC raw scores at initial evaluation: Enhanced Recovery After COVID (ERAC), Acute Hospital Rehabilitation Intensive SErvice (ARISE), and Standard of Care.

Enhanced Recovery After COVID

ERAC is conceptually drawn from our Enhanced Recovery After Surgery experiences providing early rehabilitation over a short duration to support optimal recovery and discharge home.[24] This group is defined as those patients with AM-PAC raw scores >21 on Basic Mobility and Daily Activity Short Forms at initial evaluation for physical therapist or occupational therapist. AM-PAC cutoff scores of 22 or higher were used based on the previous report that higher AM-PAC scores are good predictors for discharge home.[25,26] For SLPs, patients who fall into the ERAC category include patients on a minced and moist or soft and bite-sized diet (when not a baseline diet) and/or with new cognitive deficits on screening or formal cognitive evaluation. Typically, this group receives daily in-person therapy for the first 3 visits and then is placed on a maintenance plan for at least once a week for in-person visits to ensure no regression in their function until their medical condition improves to allow safe discharge home. If appropriate, these patients receive daily telehealth education on energy conservation techniques and/or therapeutic exercises focusing on strengthening and endurance training. Therapists also provide in-room mobility, activity, and swallowing exercise programs to the patient and nurses to be performed outside therapy sessions.

Acute Hospital Rehabilitation Intensive SErvice

This group is defined as those patients having more complex rehabilitation needs with AM-PAC raw scores between 13 and 21 for Basic Mobility or Daily Activity[27] and with daily intensive therapy has the potential to return home or to a rehabilitation facility after the hospital stay. For SLP services, patients who are nothing by mouth, on a pureed diet, or thickened liquids receive

Table 2 AM-PAC inpatient 6-Clicks Basic Mobility short form

How much help from another person does the patient need:	Total	A Lot	A Little	None
Turning from your back to your side while in a flat bed without using bedrails?	1	2	3	4
Moving from lying on your back to sitting on the side of a flat bed without using bedrails?	1	2	3	4
Moving to and from a bed to a chair (including a wheelchair)?	1	2	3	4
Standing up from a chair using your arms (eg, wheelchair, or bedside chair)?	1	2	3	4
To walk in a hospital room?	1	2	3	4
Climbing 3-5 steps with a railing?	1	2	3	4

ARISE until they progress to minced or moist diet and thin liquids (not baseline diet). Patients with new-onset cognitive deficits are also categorized in the ARISE group for SLPs.

The patients in the ARISE group are seen at least once a day by all the relevant rehabilitation disciplines as tolerated until their AM-PAC raw scores reach >21 for either physical therapist or occupational therapist and they tolerate diet progression for SLP. A physiatrist evaluates the patient periodically for coordination of medical and rehabilitative care and to plan for postacute care needs as appropriate. In addition, therapists provide in-room mobility, activity, and swallowing exercise programs to the patient to be performed outside therapy sessions facilitated by nursing.

Postacute disposition to rehabilitation facilities can be challenging for COVID-19 patients because many facilities require negative COVID-19 tests before admission prolonging the length of stay. Therefore, the main focus of this group is to prevent any further functional deterioration due to their illness and hasten the functional recovery with the goal of returning home with home care services or improving their function to the point that they can transition to inpatient rehabilitation settings when admission criteria are met.

Standard of care

If a patient's AM-PAC Inpatient 6-Clicks Basic Mobility and Daily Activity raw scores range between 6 and 12 at the time of initial evaluation, the patient receives standard of care as recommended by physical therapist or occupational therapist. Patients with AM-PAC raw scores less than 12 require total or significant help to perform basic mobility and activity tasks and are more likely to be discharged to postacute rehabilitation facilities.[25]

Some patients with low AM-PAC scores are admitted from skilled nursing facilities or long-term care facilities due to the community outbreak and may already be at a low baseline functional level prior to COVID-19 infection. The goal of the therapy team is to ensure that these patients do not experience further deterioration during the hospitalization and are able to return to their prior facilities. Team members use clinical judgment to formulate a follow-up plan of care with nursing to include positioning to prevent hospital acquired complications (eg, contractures, pressure injury). Patients on a regular or thin diet who need diet checks and/or with cognitive or language deficits at baseline will also fall in this group and receive follow-up SLP interventions as needed.

Although most patients received the same level of rehabilitation from physical therapist and occupational therapist, the program was sensitive to account for cases when patients required different intensities of rehabilitation based on their impairments with mobility versus activity.

Acute comprehensive inpatient rehabilitation models

At Johns Hopkins, we developed 2 options for the care of COVID-19 patients with ongoing rehabilitation needs who require comprehensive rehabilitation.

Traditional acute comprehensive inpatient rehabilitation

For admission to the Johns Hopkins' acute comprehensive inpatient rehabilitation (ACIR) unit, airborne precautions must be removed because we do not have negative pressure environments in our ACIR, and PPE conservation measures are in place. Per the Centers for Disease Control[28] and hospital epidemiology and infection control guidance, patients need to meet the following 3 criteria for discontinuation of transmission-based precautions: (1) negative COVID-19 testing from at least 2 consecutive nasopharyngeal swab specimens collected at least 24 hours apart; (2) afebrile for >24 hours without the use of antipyretics; and (3) improvement in respiratory symptoms (shortness of breath or cough). Once the patient is transferred to ACIR, precautions do not differ from those taken with every patient treated in the

Table 3 AM-PAC Inpatient 6-Clicks Daily Activity short form

How much help from another person does the patient need:	Total	A Lot	A Little	None
Putting on and taking off regular lower body clothing?	1	2	3	4
Bathing (including washing, rinsing, drying)?	1	2	3	4
Toileting, which includes using toilet, bedpan, or urinal?	1	2	3	4
Putting on and taking off regular upper body clothing?	1	2	3	4
Taking care of personal grooming such as brushing teeth?	1	2	3	4
Eating meals?	1	2	3	4

unit during the pandemic. These precautions include surgical mask use for all patients and providers, face shields for all providers in close proximity to patients, social distancing, and no visitors.

Extended acute comprehensive inpatient rehabilitation

To provide ACIR care for the patients who meet ACIR admission criteria but continue to have COVID-19 positive tests, we created the extended ACIR (e-ACIR) service. Once the patients are medically stable to be transferred to e-ACIR, the patient's care is transitioned to a physiatrist as the attending of record, while they continue to stay in negative pressure units housed in the department of medicine. The patients receive usual ACIR rehabilitation services including physical therapy, occupational therapy, speech-language pathology, rehabilitation psychology or neuropsychology, and social work evaluation. The medical team evaluates the patient in-person 3 times per week unless more frequent evaluation is needed due to medical status or complexity. Only necessary services are provided in-person and the rest of the services are provided through video conference to preserve PPE. For in-person services, PPE guidelines for airborne precautions are followed. The patients can also reach their providers as needed through a video-conference application using bedside tablets. Patients in the e-ACIR are discussed daily in rehabilitation huddles performed through video conference. Team meetings are held as is standard for ACIR. The e-ACIR length of stay is estimated to be 5-7 days.

Because many COVID-19 patients have varying respiratory diseases from mild to severe pneumonia, which can then result in ARDS and multiorgan dysfunction, much of their therapy needs are related to pulmonary function and counteracting debility. When the patients are unable to tolerate the 3 hours of therapy a day traditionally required in ACIR, goals are revised to perform 2 hours of therapy per day broken down into 30- to 60-minute sessions with progression to 3 hours as tolerated. This approach was made possible by the flexibility provided by law during the pandemic.

Prior to discharge, a home exercise plan is created by the therapists and provided to the patient. A copy of the home exercise plan is added by the medical team to the discharge summary for easy access. Physiatry and other telemedicine appointments are scheduled prior to discharge to evaluate adherence to home exercise programs and continued progress at home.

General ACIR considerations

To limit patient and provider COVID-19 exposures and to preserve PPE, all consultants are offered the option to perform telemedicine encounters in the traditional ACIR and e-ACIR. Once the consultant confirms that a telemedicine consultation is appropriate, the unit's secretary coordinates the visit time so as to not interfere with the patient's therapy schedule. Bedside tablets with teleconferencing applications are used. An unforeseen advantage of the use of telemedicine consults is that patients became familiar and comfortable with the use of these tools facilitating the transition to outpatient telemedicine visits.

Before discharge, the ACIR team facilitates activation or access to the electronic medical record application (Epic MyChart). This application facilitates communication with providers and allows for follow-up telemedicine encounters to continue rehabilitation after hospital discharge.

Transition from inpatient to follow-up at home

A significant number of COVID-19 patients have residual impairments and decline in function at discharge requiring ongoing rehabilitative care. To address this need, a multidisciplinary team was developed to provide care for patients recovering from acute COVID-19 illness, especially those who had required ICU-level care to address impairments in physical function, mental health, cognition, and ongoing respiratory needs. This clinic leverages telemedicine and home care services to take care of the postdischarge needs of this population.

Administrative considerations

The Center for Medicare & Medicaid Services has provided flexibility to perform rehabilitation during the crisis in multiple ways. The document COVID-19 *Emergency Declaration Blanket Waivers for Health Care Providers*[29] allowed for the relocation of inpatients from distinct rehabilitation units to an acute care bed. The document also provides flexibility on the diagnosis mix of patient by waiving the *60% rule*. A separate document published by the Center for Medicare & Medicaid Services provides guidance specific to inpatient rehabilitation facilities.[30] This document specifically allows the use of telehealth to fulfill the requirement for physicians to conduct face-to-face visits at least 3 days a week, eliminates the need for postadmission evaluations for Medicare patients admitted to an inpatient rehabilitation facility, and clarifies other details that were not present in the previous document. The Coronavirus Aid, Relief, and Economic Security Act, H.R. 748, section 3711, signed into law March 27, 2020, waives the inpatient rehabilitation facility *3-Hour Rule*.[31]

The coordination of the myriad of services needed to comprehensively treat patients recovering from COVID-19 infection is not trivial. A strong leadership team was needed to foster the development of a transdisciplinary approach. Developing such an approach required the expertise, flexibility, and ingenuity of a large team of rehabilitation and medical professionals.

Conclusion

The COVID-19 pandemic has affected the health care system in the United States dramatically. Because of the rapid surge in COVID-19 cases and the need for acute hospital care exceeding hospital capacity, health care systems have struggled to meet demands. A significant proportion of patients have progressed to acute respiratory failure requiring mechanical ventilation and prolonged ICU stay. Although pulmonary symptoms are the most prevalent and well reported, COVID-19 also affects the cardiovascular, cerebrovascular, and neuromuscular systems, which in turn result in sequelae after recovery from the acute phase. As the curve progresses and more patients are discharged, the rehabilitation wave brings a high number of postacute COVID-19 patients suffering from physical, mental, and cognitive impairments that threaten their return to normal life.

Unlike other areas of the country, where the steep surge in COVID-19 cases required the conversion of most of inpatient rehabilitation beds to medical beds, our ability to maintain ACIR services to help throughput for the hospital through rehabilitation services remained. We identified the need for early rehabilitation for this population and developed a comprehensive rehabilitation program serving all phases of care: ICU, acute care units, and ACIR. The program was designed to provide an appropriate level of rehabilitation care to prevent further deterioration during the acute hospital stay, facilitate functional recovery, and manage impairments secondary to COVID-19 infection. Importantly, one of the additional program's goals was to conserve PPE and maintain social distancing by leveraging telemedicine technology.

The COVID-19 pandemic is having a profound effect on the provision of medical care. Many questions remain unanswered. The local evolution of the pandemic and our rehabilitation efforts prior to the pandemic allowed for the rapid deployment of the levels of care presented. Detailed outcomes data are beyond the scope of this communication. As the acute crisis resolves, we will analyze and report data on the functional outcomes of COVID-19 patients who received different levels of rehabilitation care. We have been learning and adapting real time during this crisis and hope that sharing our experience facilitates the work of others as the pandemic evolves. It is our goal to reduce the long-lasting challenges faced by COVID-19 survivors by working at every level to minimize the effect this disease has on patients' function and disability.

Keyword

COVID-19; Physical and rehabilitation medicine; Rehabilitation; SARS virus; Telerehabilitation

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Acknowledgments

We thank all the frontline providers during the COVID-19 pandemic, including those rehabilitation providers whose selfless efforts have saved multiple lives and helped COVID-19 survivors get back to living.

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