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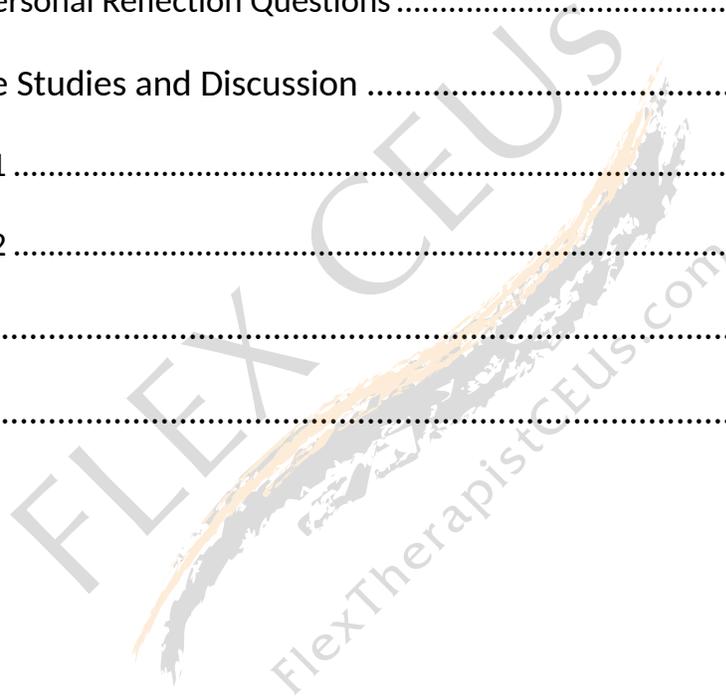


The Impact of COVID-19 on Physical Therapy Practice



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Introduction

The global outbreak of severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) created an unprecedented challenge to healthcare practitioners. As knowledge and understanding of the disease process evolves, experts are beginning to identify short and long-term needs for those recovering from the coronavirus disease 2019 (COVID-19). Physical therapists and physical therapy assistants can play a unique role in the recovery process as they are uniquely qualified to meet anticipated rehabilitation demands of this patient population. This course will review pertinent information and rehabilitation concepts involving COVID-19 across the spectrum of care in order to provide physical therapists and physical therapy assistants with the necessary insight to effectively manage patients who are recovering from COVID-19.

Section 1: Coronavirus disease 2019 (COVID-19)

In order to understand the impact of rehabilitation for individuals recovering from COVID-19, it is imperative to recognize the clinical manifestations of the virus itself. This section of the course will provide a brief overview and insight into the history of COVID-19, modes of transmission, risk factors for contraction, signs/symptoms of a possible infection, diagnosis, and available medical treatments.

What is coronavirus disease 2019 (COVID-19)?^{1,2}

- COVID-19 is caused by the coronavirus SARS-CoV-2, also known as severe acute respiratory syndrome coronavirus. It was first discovered in late 2019 in Wuhan, China, and may have originated from bats.
- The term “coronavirus” refers to a multitude of viruses in humans and animals that cause a myriad of symptoms. Unlike some common viruses that cause mild upper-respiratory tract illnesses, COVID-19 is a novel and highly contagious coronavirus that can cause a wide array of symptomatology with varying severity.
- While COVID-19 primarily affects the pulmonary system, new data suggests underlying involvement of the cardiovascular, integumentary, hepatic, renal, and neurological systems with equally devastating short and long-term consequences.

How is COVID-19 transmitted? ³

- Transmission primarily occurs through respiratory secretions and contact with an infected individual or contaminated surface. Transmission from person to animal is rare.
- In some cases, transmission of COVID-19 can become airborne.

What are the physical signs and symptoms associated with COVID-19? ^{4,5}

- There is a wide array of signs and symptoms reported in people with COVID-19. The severity of symptoms ranges from mild to severe illness requiring mechanical ventilation.
- Confirmed signs and symptoms include:
 - Fever or chills
 - Cough
 - Shortness of breath or difficulty breathing
 - Fatigue
 - Muscle or body aches
 - Headache
 - New loss of taste or smell
 - Sore throat
 - Upper respiratory infection
 - Nausea or vomiting
 - Diarrhea
- It is important for therapists and therapy assistants to recognize that neurological and gastrointestinal symptoms may develop before a fever and lower respiratory tract symptoms are identified.
- Clinicians should also acknowledge the possibility of rapid deterioration in presentation that can occur as quickly as one week following the onset of illness.

Emergency warning signs include dyspnea, chest pain, new onset of confusion or change in mental state, low arousal levels, or discoloration of lips or face.

- A comment on COVID-19 in children: children who contract COVID-19 may have fewer symptoms than adults. Albeit rare, there have been a few cases of multisystem inflammatory syndrome reported in children diagnosed with COVID-19.
- Clinicians should also acknowledge a percentage of individuals with COVID-19 who are asymptomatic but remain carriers of the virus. An abundance of caution should be taken at all times to avoid close physical contact around these individuals. Some sources report that the number of asymptomatic children who test positive for COVID-19 may be more than the estimated amount of asymptomatic adults with COVID-19, thus indicating the possibility that children may be asymptomatic carriers and vectors of the virus.

Who is at risk for contracting COVID-19? ^{6,7}

- Individuals of all ages are at risk for infection and severe complications from COVID-19. However, some individuals are more likely than others to fall severely ill. In adults, the risk for severe illness from COVID-19 increases with age. Those who are 85 years and older have the greatest risk for developing severe complications following COVID-19.
- Individuals who live in long term care facilities and nursing homes are also at heightened risk for developing serious complications from COVID-19.
- People with certain medical conditions are also at increased risk for complications during recovery from COVID-19. Such medical conditions may include:
 - Cancer
 - Chronic kidney disease
 - Chronic obstructive pulmonary disease (COPD)
 - Immunocompromised state from an organ transplant
 - Body mass index of 30 or higher
 - Serious heart conditions, such as heart failure, coronary artery disease, or cardiomyopathies
 - Sickle cell disease

- Type 2 diabetes mellitus

How is COVID-19 diagnosed? ^{8,9,11,18}

- Diagnosis is made following a clinical evaluation and laboratory testing. Testing requirements are made by local and state health departments and vary from state to state.
- The U.S. Food and Drug Administration (FDA) has approved viral testing, collected through nasal swabs or saliva samples, to confirm a positive infection.
- Antibody tests are used to confirm previous infections of COVID-19.
- New evidence reveals the efficacy of a bedside lung ultrasound in its ability to diagnose and monitor the recovery trajectory. Clinically, its implications for use is to quantify structural changes during the disease progression and to make decisions with respect to mechanical ventilator settings.
- CT scans are not recommended for use in screening for COVID-19 and/or confirming a diagnosis of COVID-19. It is recommended that CT scans should be used sparingly and only when indicated in symptomatic patients with additional medical needs.
- Chest radiographs have diagnostic limitations and should not be used as a sole determining factor when diagnosing COVID-19. They have been used in research and clinical practice to quantify structural changes to airways and lungs.

What treatments are available for COVID-19? ^{9,10}

- Currently, no treatments are available to prevent or treat COVID-19 or its sequelae.
- The National Institutes of Health has created treatment guidelines that offer recommendations for infection prevention and control measures for the wide range of clinical manifestations in individuals with COVID-19. These treatment guidelines are based upon the medical management of COVID-19 and vary based upon the clinical presentation of each individual during his/her respective state of recovery.

Section 1: Key Concepts

- A novel coronavirus, SARS-CoV-2, outbreak in 2019 led to the worldwide pandemic of coronavirus disease 2019, also known as COVID-19.

- Several common signs and symptoms have been identified in individuals following COVID-19, ranging in severity from mild to respiratory failure. However, experts agree that the virus can rapidly evolve with multiple system involvement and at varying degrees of severity.
- Successful management of these patients is incumbent upon a timely diagnosis which is confirmed through the clinical evaluation and laboratory testing. Some evident points to the use of imaging to support diagnosis and monitor the progression of the disease throughout the patient's recovery.
- Due to an evolving clinical presentation, medical treatment is based upon the individual's unique sequelae of symptoms. Unfortunately, no treatments are approved to prevent or treat COVID-19 at this time.

Section 1: Key Terms

COVID-19 - Short for coronavirus 2019, a highly contagious virus that can cause flu-like symptoms and respiratory infections with varying degrees of severity

SARS-CoV-2 - Severe acute respiratory syndrome coronavirus 2 that began in Wuhan, Hubei Province, China

Mechanical ventilation - A machine that assists a patient in multiple stages of breathing when he/she is unable to breathe independently due to trauma, respiratory failure, infection, or cardiovascular distress

Section 2: Physical Therapy Management of COVID-19 in Acute/Inpatient Settings

While much about the coronavirus continues to evolve, rehabilitation needs of individuals diagnosed with COVID-19 have begun to emerge. This supports the role and efficacy of physical therapy interventions across the settings. Considering the acutely debilitating effect of COVID-19 on multiple body systems, rehabilitation professionals should have a thorough understanding of the evaluative and treatment components for individuals in the acute care and inpatient settings.

This section will offer insight on the timing and appropriateness of physical therapy referrals, recommendations for evaluations and treatment interventions, and review

precautions/contraindications for treatment in individuals recovering from COVID-19 in the acute care and inpatient settings.

Timing and Appropriateness of Physical Therapy Referrals in the Acute Care/Inpatient Setting ¹¹

- Referrals to physical therapy in an acute care setting are utilized as a means of improving health outcomes once the patient is medically stable and appropriate for physical activity. Following the enormous influx of patients requiring mechanical ventilators due to respiratory failure from COVID-19, rehabilitation is necessary to negate the substantial impact of a stay in a critical care unit.
- A consult to physical therapy should be considered when:
 - Patients exhibit significant physical weakness and functional decline
 - Patients are at a heightened risk for ICU-acquired weakness or when their length of stay exceeds seven days in a critical care unit
 - Nursing staff is unable to progress patient's mobility following extubation
- Conversely, deferring a consultation to physical therapy may be indicated when:
 - Patients are early in their recovery process, deeply sedated, or have limited arousal as measured on the Richmond Agitation and Sedation Scale (RASS)
 - Patients exhibit severely impaired respiratory function on mechanical ventilation with the high ventilator settings and decompensation with routine care and coughing
 - Patients have an unstable cardiovascular system with abnormal mean arterial pressures (MAP), or patients are hemodynamically inappropriate for awakening and ordered for deep sedation (RASS -4 to -5)
 - Patients present with severely impaired cognitive statuses and consistently score -3 to -4 on the RASS
 - Elderly patients present with a poor prognosis and a high likelihood of poor health outcomes
- Other considerations for the clinicians to withhold treatment may include adequate physical strength, acuity of stay in critical care, or the ability of nursing staff to

adequately progress patients' mobility and ambulatory status. In the latter example, the independence of patients to ambulate without assistance and achieve baseline functional status does not indicate the need for skilled therapeutic interventions and may be viewed as an overutilization of care.

Evaluation Recommendations in the Acute Stage ¹²

- Tests and measures should address common impairments seen at the acute stages of recovery in individuals with COVID-19. Outcomes should objectively measure changes to the patient's pulmonary function, endurance, strength, and functional performance with activities of daily living.
- The following outcomes should be prioritized:
 - State of consciousness/level of arousal
 - Respiratory rate and degree of dyspnea
 - Vital signs
 - Pulse oximetry
 - Joint range of motion (passive and active)
 - Muscle strength
 - Balance
 - Endurance
 - Presence of anxiety/depression
 - Functional ability

Acute Treatment Recommendations ^{11,12,17,19}

- Through treatment, practitioners can help to decrease symptoms of dyspnea, improve lung capacity, counteract complications arising from respiratory failure and immobility, and decrease anxiety in individuals recovering from COVID-19. When appropriate, patient and family education during this state of recovery is paramount to compliance and ensuring continued recovery following discharge. Discharge planning should begin upon initial evaluation, and family members should always be

included in the decision-making process. Family education on diagnosis, interventions, and prognosis should be communicated accordingly.

- Effort should be made by all members of the healthcare team to mitigate exposure risk and optimize alternative means of communication with patients who are actively recovering from COVID-19. The use of video conferencing to deliver virtual services, screening patients through other medical staff, or using the telephone to perform subjective assessments should be encouraged when appropriate.
- Positioning is a vital component of management and family education for individuals recovering from COVID-19. Consistent repositioning, at least every two hours, is recommended in order to avoid pressure ulcers, hospital-acquired infections, atelectasis, and to optimize oxygenation. Current literature supports the use of prone positioning in adults on mechanical ventilators for a minimum of 16 hours per day in order to improve hypoxemia associated with COVID-19.
- Physical therapy interventions can mitigate the effects of prolonged immobility and mechanical ventilation in patients requiring critical care stays. Once medically stable, the patient may be appropriate for an individualized rehabilitation program that addresses his or her cognitive state, physical strength, psychological status. Suggestions for interventions that may be appropriate in this patient population include:
 - Abdominal breathing and diaphragmatic breathing exercises
 - Passive, active assistive, active, or resisted joint range of motion exercises
 - Bed mobility and transfers
 - Tilt table
 - Walking
 - Upper and lower extremity ergometry less than 5 METs
 - Progressive resisted exercises 1-2x per day for 30 minutes per day at a recommended intensity level of 3-4 on Rate of Perceived Exertion scale or 5-6 on the Visual Analog Scale
- According to research on the disease progression and pathology, COVID-19 does not cause overproduction of secretions requiring airway clearance techniques (ACT). In patients without clinical indicators for airway clearance techniques, other treatment

interventions should be prioritized as the performance of ACT may further damage the structural integrity of the alveoli within the lungs.

While there are limited reports of a productive cough caused by COVID-19, patients with a pre-existing comorbidity, such as COPD or cystic fibrosis, can present with impaired airway secretions which indicate a need for appropriate treatment interventions. Those who develop muscular weakness or neuromuscular disease, secondary to ICU-acquired weakness, that impedes a productive cough may also require ACT. Each case should be evaluated with an interdisciplinary team approach based on clinical indicators.

In the presence of airway secretions, airway clearance techniques (ACT) may be initiated with extreme caution and upon consulting with the healthcare team once the patient is medically stable. The safety of providing these treatment interventions is unknown as many of them are considered to be aerosol-generating procedures that warrant specific precautions and personal protection equipment in order to preserve the health of the rehabilitation specialist. When indicated, ACT may be useful in promoting expulsion of effusions and those with inadequate airway clearance. Some examples of ACT include:

1. Active cycle breathing techniques (ACBT) in a semi-recumbent or seated position with an emphasis on relaxation of inspiratory muscles. Encourage the patient to prolong the breath prior to exhalation in order to encourage alveolar inflation in the lungs.
2. Percussion and vibration manual techniques
3. Positive expiratory pressure therapy (PEP)
4. Body positioning to promote sputum excretion and reduce dyspnea

Common Precautions and Contraindications for Physical Therapy Treatment in the Acute Stage ¹²

- Precautions
 - Pulse oximetry 95-100% with the exception of patients at risk for hypercapnia
 - Use of respiratory training with medically unstable patients in the acute stages of recovery as this may further compromise patients' ability to breathe
- Contraindications

- Severe dyspnea
- Resting heart rate greater than 120BPM
- Pulse oximetry less than 95% and or more than 4% change from baseline oxygen saturation with activity
- Resting blood pressure less than 90/60 mmHg or greater than 140/90
- Arrhythmia or myocardial ischemia
- Respiratory rate greater than 30 breaths/min during exercise

Long Term Implications as a Result of Prolonged Critical Care Stays ^{13,14}

- Those who require intensive care or mechanical ventilation are at high risk for developing Post-Intensive Care Syndrome (PICS), which is a commonly observed phenomenon in ICU survivors of all ages. It is characterized by prolonged disability due to muscle weakness, dysfunction, pain, fatigue, and dyspnea. Impairments can last up to one year following critical illness.
- The risk of developing PICS is higher in patients requiring ventilation due to increased risk for ventilator-induced lung injury and lung fibrosis that leads to restricted lung function.
- Prolonged stays in critical care units can also result in a wide range of complications and hospital-acquired infections including ventilator-associated pneumonia, secondary infections, contractures, and pressure ulcers.

Section 2: Key Concepts

- Physical therapy evaluation and treatment of COVID-19 survivors in the acute/ inpatient care setting is essential in order to prevent lingering disability and impaired participation in activities of daily living, which is associated with higher risk of institutionalization, greater healthcare expenditures, hospitalization, and higher mortality.
- Referrals to physical therapy are appropriate when patients are exhibiting difficulty clearing secretions, functional decline, or at risk for ICU-acquired weakness. Conversely, referrals to physical therapy may be deferred in the presence of an unstable clinical presentation or in situations where the patient exhibits exceptional functional progress with the assistance of nursing staff.

- Physical therapy may be initiated in individuals with COVID-19 who have achieved medical stabilization and can tolerate interventions aimed at improving respiration, strength, and mobility. Evaluative measures should examine the patient's pulmonary function, endurance, strength, and functional performance with activities of daily living.
- When selecting and administering appropriate treatment interventions, clinicians should be aware of the danger of prescribing aerosol-generating procedures that may exponentially increase the transmission of COVID-19. Decisions to engage in such interventions should be carefully weighed and thoroughly discussed among the interdisciplinary healthcare team.
- Clinicians should be aware of precautions and contraindications for physical therapy treatment in order to avoid medical complications and harm to the patient during physical activity.
- The implications of a lengthy hospitalization requiring critical care has long-term sequelae that have been widely documented. Those who are discharged from intensive care units following ventilation are at an increased risk for developing Post-Intensive Care Syndrome and other secondary infections and should be followed across the continuum of care.

Section 2: Key Terms

Richmond Agitation Sedation Scale (RASS) - A 10-point scale, with four levels of anxiety or agitation (+1 to +4 [combative]), one level to denote a calm and alert state (0), and 5 levels of sedation (-1 to -5) culminating in unarousable (-5)

Hemodynamics - Refers to basic measures of the cardiovascular system and circulatory system

Mean Arterial Pressure (MAP) - Defined as the average arterial pressure throughout one cardiac cycle, systole, and diastole. It is influenced by cardiac output and systemic vascular resistance, and measured as the product of heart rate and stroke volume. Minimal MAP at rest is at least 60 mmHg in order to achieve perfusion to all the tissues in the body. When the MAP is inadequate, then the body's vital organs do not receive enough blood and can create hypotensive shock and organ failure.

Health outcomes - Characteristics that describe the consequence of a disease. Can reference symptoms, impairments, functioning, participation in activities and social roles, and health-related quality of life.

Extubation - The removal of an endotracheal tube, which is the last step to be taken when liberating a patient from the mechanical ventilator

ICU-acquired weakness (ICUW) - Associated with longer durations of mechanical ventilation and hospitalization, ICUW can cause muscle weakness, critical illness neuropathy and/or myopathy, and muscle atrophy in patients who suffer from critical illness and require ICU care.

Respiratory muscles - Diaphragm, rib cage muscles, and abdominal muscles

Dyspnea - an uncomfortable awareness of breathing and considered to be a subjective report by patients. Should not be confused with rapid breathing (tachypnea), excessive breathing (hyperpnea), or hyperventilation. It is often described as shortness of breath, inability to take a breath, or chest tightness.

Respiratory failure - A condition in which the respiratory system fails in one or both of its gas exchange functions. It is either a result of lung failure resulting in hypoxemia, or pump failure causing alveolar hypoventilation and hypercapnia.

Aerosol Generating Procedures (AGP) - Respiratory interventions and procedures that generate an airborne transmission of the virus and increase risk for contraction. Examples of AGPs specific to physical therapy include cough techniques, percussion, use of positive pressure breathing devices, PEP devices, and inspiratory muscle retraining.

Semi-recumbent positioning - Supine positioning in which the head of the bed is elevated greater than 30 degrees.

Prone Positioning - Utilized as a form of treatment in the presence of acute respiratory distress syndrome in patients on mechanical ventilators. Patients who are appropriate for prone positioning techniques must meet specific guidelines and require assistance from multiple personnel to successfully perform the transfers.

Rate of Perceived Exertion (RPE) - Subjective method to measuring exercise intensity. The scale correlates with exercise heart rate and is scored from 6-20 (original Borg scale) or 0-10 (revised category-ratio scale).

Visual Analog Scale (VAS) - Measurement of pain intensity where a higher score indicates greater pain intensity

Progressive resistance exercise (PRE) - A method of increasing the ability of muscles to generate force. Using these principles, exercise begins with a small number of repetitions until fatigue with appropriate rest breaks between exercises for recovery. Resistance is increased as the ability to generate force increases.

Post-ICU Syndrome (PICS) - New or worsening new or worsening impairments in physical, cognitive, or mental health status arising after critical illness and persisting beyond acute care hospitalization

Ventilator-associated pneumonia - Pneumonia that can occur 48-72 hours or thereafter following endotracheal intubation

Pressure ulcers - Localized areas of tissue damage or necrosis that develop secondary to pressure over a bony prominence.

Section 2: Personal Reflection Questions

- When would you advocate for the use of aerosol-generating procedures in patients recovering from COVID-19?
- What would be some alternative interventions to airway clearance techniques?
- When are we adding value to the healthcare team and mitigating harm during recovery versus becoming additional disease vectors consuming personal protection equipment?

Section 3: Physical Therapy Management of COVID-19 for In-home/Community-based Settings

It is important for physical therapists and physical therapy assistants to possess knowledge of higher-level impairments and functional deficits that may arise from COVID-19 and/or critical care procedures. While long term implications of the virus have yet to be studied, rehabilitation specialists should expect to see a continuation of mild to high physical and cognitive deficits following discharge from the hospital system. COVID-19 survivors who are at risk for poor health outcomes will also require the continuation of therapeutic services in order to increase functional capacity and to avoid succumbing to an acquired COVID-19 infection. The main goals for patients with needs in

the home and community-based settings are to promote safe return to activity, encourage healthy lifestyles, and to provide support as patients reacclimate to family and society.

Section 3 will delve into recommendations for outcome measures, treatment interventions, and indications for cessation of physical activity in individuals receiving physical therapy services in the home and community-based settings during recovery from COVID-19.

Evaluation Recommendations in the Home/Community-based Setting

12,15,20

- While a majority of patients will have recovered from respiratory distress and acute effects from COVID-19, many will still require rehabilitation services to address function, disability, and participation in lifestyle activities. Tests and measures should focus on identifying and quantifying impairments such as muscle weakness, neuromuscular impairment, low exercise endurance, fatigue, and screening for lasting psychological effects during recovery from COVID-19. Selecting and administering reliable and valid outcome measures supports the creation of an individualized plan of care that is important in managing all aspects of the patient's needs.
- Consideration of setting should be carefully contemplated. If patients can be managed at home and receive telehealth services, then this option may be preferable to reduce additional exposure as the risk for reinfection has yet to be studied.
- Due to compromised cardiorespiratory complications following COVID-19, clinicians should always screen for cardiovascular risk factors and monitor vital signs before, during, and after physical therapy is administered. In addition, screening for additional cognitive and psychosocial impairments such as delirium, depression, and anxiety is also strongly recommended to identify possible referrals to a mental health specialist.
- The Cross-Academy/Section COVID-19 Core Outcome Measure Task Force was created by the American Physical Therapy Association in mid-2020 to recommend outcome measures that are most appropriate for patients recovering from COVID-19. Their recommendations include the Short Physical Performance Battery (SPPB), Medical Research Council Slum Score (MRC-SS), 2-Minute Step Test, Saint Louis University Mental Status examination (SLUMs), and the EQ-5D-5l (health-related quality of life measure). It is important to note that these recommendations by the Task Force were designed to measure the overall trajectory of recovery and facilitate research

initiatives. However, caution should be taken when administering these tests in individuals during the acute stage of recovery. The Task Force recommends utilizing these core measures across the continuum of care and denoting an “O” if the patient is unable to complete testing. Results of testing should be shared across settings to serve as an indicator of progress and to measure change in function.

- Other recommendations that may be indicated are the Six-Minute Walk Test (6MWT), Timed Up and Go Test (TUG), the Berg Balance Scale, gait speed, and other functional balance measures.

Numerous studies have reported a significant reduction in exercise capacity in the first year following critical illness. The 6MWT has been validated in survivors of critical illness and has predictive validity for future mortality, hospitalization, and health-related quality of life. While the 2-minute walk test (2MWT) requires less time to administer, clinicians should be wary of substituting the 2MWT for the 6MWT as the 2MWT has been shown to be of less value in this patient population.

Gait speed has been referred to as the sixth vital sign as it is a reliable and valid measure across various populations, including those recovering from critical illness. Slowed gait speed has implications for morbidity, safety, and balance. The NIH Toolbox for the Assessment of Neurological and Behavioral Function recommends the utilization of gait speed measurements in individuals following critical illness as they can provide insight into risk for future hospitalization and quality of life measures.

Lastly, the importance of balance measures should not be overlooked in individuals recovering from critical illness. New evidence suggests that the risk for injurious falls rises following discharge from an intensive-care unit. Clinicians should be aware of the heightened proclivity to falls and include various outcomes to measure static, dynamic, and walking balance in this patient population. Two frequently utilized balance assessments are the TUG and the Berg Balance Scale.

- With the increasing number of survivors of COVID-19, physical therapists are likely to encounter patients who have been referred for musculoskeletal and neurological impairments that may not be identified as being related to a critical illness. An important screening question to include after the standard follow up question to “Have you ever been hospitalized?” should be “Did you require care in an ICU? If yes, how many days were you in the ICU, and were you on a breathing machine (mechanical ventilator)?” This simple screen can alert the clinician to recognize the

possibility of additional physical limitations, cognitive impairments, and/or psychosocial symptoms that may derive from critical illness.

In-Home and Community-based Physical Therapy Treatment Recommendations ^{12,16,20}

- Exercise prescription parameters for patients recovering COVID-19 have yet to be studied. Early indicators suggest that these patients may suffer from deconditioning, lasting neurological effects, and mental health problems that will require interventions to separately address each impairment and functional deficit. An interdisciplinary approach that coordinates the efforts of multiple rehabilitation specialists is strongly encouraged.
- Rehabilitation efforts should optimize recovery and health outcomes while taking into account the patient's cardiorespiratory health. Interventions may include:
 - Aerobic activity, like walking, swimming, dancing, stair climbing for 5x per week, 30-60 min per day
 - Progressive resisted exercise for 2-3x per week
 - Balance and respiratory retraining
 - Abdominal and pursed-lip breathing
 - Thoracic expansion exercises
 - Functional retraining

While not commonly utilized in the acute phase of recovery, respiratory training in the home and community-based settings may be more applicable to patients recovering from COVID-19 in the presence of airway clearance dysfunction, excess secretions secondary to exacerbation of comorbidities, and weakened respiratory muscles. Respiratory retraining techniques can include inspiratory muscle strengthening with an emphasis on deep breaths and thoracic expansion. Positive expiratory pressure devices may be added on a case-by-case basis, however, care must be taken to avoid overexerting the respiratory system and causing distress. Cough assist exercises should also be exercised with caution and recommended on an individual basis.

- There is strong evidence to suggest the use of compensatory interventions in patients recovering from COVID-19 based upon research on survivors of critical illness, like PICS. Compensatory strategies and interventions aimed at improving patients'

participation and performance with daily activities may lower risk for hospital readmission. Task-specific exercises to foster improvements with motor learning is also strongly recommended in this patient population. Following restoration of function, emphasis on physical therapy interventions may progress to restorative techniques. Examples of restorative exercises may be: strength and endurance training, circuit and high-intensity interval training, balance reintegration, and patient/family education on the recovery process.

Contraindications for Physical Therapy Treatment in In-Home/Community-based Clinics ¹²

- Clinicians should be aware of adverse responses to exercise that increases risk for overexertion, cardiopulmonary complications, and injury in patients recovering from COVID-19. Contraindications for exercise include:
 - Resting heart rate greater than 120 BPM
 - Resting blood pressure greater than 140/90 or less than 90/60mmHg
 - Oxygen saturation less than 95%
 - Dyspnea with no relief after resting
 - Chest pain, chest tightness, aggravated cough, dizziness, headache, blurred vision, palpitation, night sweats with exercise

Section 3: Key Concepts

- Evaluation and treatment of COVID-19 survivors in the home/community-based setting is vital to address lingering physical, functional, and psychosocial deficits that will impact their return to society. While many of the long-term effects of COVID-19 have yet to be confirmed, the literature supports the possibility of lingering musculoskeletal, neurological, and cardiopulmonary complications following discharge from the hospital setting.
- Caution should be taken when determining the appropriate setting for physical therapy services in individuals recently discharged from critical care. When indicated, telehealth may be a suitable mode of delivery to minimize the transmission of communicable diseases and limit exposure.

- The American Physical Therapy Association recommends the use of six core outcome measures to quantify and observe changes in function, strength, endurance, cognition, and quality of life in individuals diagnosed with COVID-19. Recommendations borrowed from literature on critical illness survivors also may also be considered due to the similarities in the recovery trajectory and include gait speed, the 6-Minute Walk Test, and the Berg Balance Test.
- Exercise prescription parameters for patients recovering from COVID-19 in the home/community-based settings have not been studied, however, interventions should be aimed at improving the patient's physical, emotional, and cognitive limitations. Other recommendations based upon research in individuals recovering from critical illness emphasize the importance of compensatory strategies to maximize functional improvements.
- Patients who are appropriate to receive therapy services in this setting may exhibit signs of medical instability during exercise. It is important to recognize signs of activity intolerance in the presence of exercise contraindications.

Section 3: Key Terms

Telehealth - A method of delivering healthcare services through the telephone or video conferencing platforms

Cross-Academy/Section COVID-19 Core Outcome Measures Task Force - Comprised of members from the American Physical Therapy Association's academies and sections who worked together to create a core set of outcome measures for patients diagnosed with COVID-19 across the continuum of care

Six Minute Walk Test (6MWT) - Submaximal measurement of functional capacity targeted at people with at least moderately severe impairment. The test has been widely used for preoperative and postoperative evaluation and for measuring the response to therapeutic interventions for pulmonary and cardiac disease.

Timed Up and Go (TUG) - Objective test and measure to evaluate overall functional mobility with normative data established for multiple age groups and diseases

Delirium - A common neurological disorder characterized by an acute change in cognition, attention, and consciousness that results in what experts describe as brain failure

Respiratory training - Specific training to improve the endurance and strength of the respiratory muscles

Activities of daily living (ADLs) - Refer to basic actions that involve caring for one's self and body, including personal care, mobility, and eating

Task-specific exercises - Exercises that are closely related to a functional task, like walking or climbing stairs. These exercises may directly or indirectly mimic the functional task or they may consist of components of a functional task, like being able to raise the leg in preparation for negotiating a curb.

Section 3: Personal Reflection Questions

What therapeutic interventions are appropriate to improve aerobic endurance in individuals presenting with deficits related to critical illness hospitalizations in the outpatient setting?

What clinical indicators may signify the appropriateness of a telemedicine in-home therapy visit as opposed to in-clinic visits at an outpatient facility?

Section 4: Case Studies and Discussion

Case Study 1

A 77-year-old woman with a history of uncontrolled hypertension presented to the emergency room with worsening fever and cough for the past two days. Chest x-ray, clinical examination, and symptom reports warranted testing for COVID-19, and she was admitted for possible pneumonia with isolation precautions for suspected COVID-19. She was found to be positive for COVID-19, and her presentation rapidly deteriorated within 48 hours following admission. She was transferred to the ICU where she was immediately intubated, placed on a mechanical ventilator, and diagnosed with severe acute respiratory distress syndrome (ARDS).

Case Study 1 Discussion

1. *What indicators may or may not support a referral to physical therapy services?*

A positive COVID-19 test should trigger a decision-making process to weigh the risk and benefits of treatment. Secondly, the acuity of the patient's presentation should factor heavily in the decision of when to initiate physical therapy services. While rapid

deterioration and a diagnosis of severe ARDS increases the possibility of a poor prognosis, patients can still benefit from skilled therapeutic services depending upon medical stability. Early intervention for patients in critical care is strongly encouraged and has been shown to improve long term health outcomes as opposed to interventions initiated following discharge from acute care services. The clinician should carefully weigh the above factors and consult other members of the healthcare team in order to make an informed decision.

- 2. Once the patient is medically stabilized, what would be some appropriate outcomes to measure her current functional status?*

The following test and measures may be indicated for this patient based upon her level of acuity: state of consciousness/arousal level, respiratory rate, vital signs, oxygen saturation/ventilator settings, passive joint range of motion. While observing the patient's ability to participate in transfers and upright mobility is most applicable to functional tasks, those may not be medically appropriate to assess at this time.

- 3. How does an understanding of the potential long-term effects of mechanical ventilation affect the physical therapy plan of care for this patient?*

Understanding the pathology, presentation, and prognosis of PICS and ICU-acquired weakness is helpful in creating a comprehensive plan of care for this patient. Armed with the knowledge that deficits related to these conditions can span across the spectrum of settings, the clinician should identify an appropriate time to initiate therapeutic services in order to optimize the patient's health outcomes and prognosis for functional recovery. Lastly, knowledge of the long-term effects of mechanical ventilation can prepare the clinician to screen for potential cardiorespiratory complications during exercise, and/or identify a need for respiratory training in future settings.

Case Study 2

A 41 year-old-male with a 20-year history of smoking two packs per day presented to an outpatient physical therapy clinic with a new onset of lower extremity muscle weakness and difficulty completing his daily morning runs. Imaging was negative for structural deformity in the spine and extremities. Past medical history was positive for COVID-19 which required a 14-day hospitalization prior to being released home.

Case Study 2 Discussion

1. *How does the patient's history of smoking affect his prognosis and health outcomes?*

People with COPD are at increased risk for complications during recovery from COVID-19. Smoking increases one's risk of COPD and, given the patient's age and packs smoked per day, may strongly affect his prognosis and increase the risk of poor health outcomes. COPD also increases the patient's risk for airway clearance dysfunction requiring aerosol-generating procedures following recovery.

2. *What additional questions, relative to the diagnosis and hospitalization, should be included in the patient's initial interview?*

Emphasis should be placed on the length of hospitalization and time spent in critical care, whether the patient required mechanical ventilation, early mobilization efforts, and screening questions for potential PICS, ICU-acquired weakness, and other complications secondary to prolonged critical care stays.

3. *Name 2-4 outcome measures that would be appropriate to administer for this patient.*

Based upon the information provided, any outcome measures that address the patient's current function, level of disability, and participation in daily activities would be appropriate. Specific to this case, physical examination may focus on strength testing, pulmonary reserve, and exercise capacity.

4. *Which contraindications for exercise might be most applicable to this patient scenario?*

The patient's personal history of smoking and subjective reports could reasonably lead to the assumption that this patient would exhibit low exercise capacity and endurance upon physical examination. Given the patient's recent hospitalization and positive COVID-19 diagnosis, he may also suffer from mild ICU-acquired weakness and/or PICS. These factors warrant close observation of the patient's activity tolerance by monitoring for:

- Resting heart rate greater than 120 BPM
- Resting blood pressure greater than 140/90 or less than 90/60mmHg
- Oxygen saturation less than 95%
- Dyspnea with no relief after resting

- Chest pain, chest tightness, aggravated cough, dizziness, headache, blurred vision, palpitation, night sweats with exercise

Conclusion

The pandemic affected millions and caused enormous disruptions to the delivery of healthcare across every setting. Confirmed understanding of the virus's presentation and its acute effects on multiple body systems can provide insight and guidance for the timing of physical therapy interventions and appropriate outcome measures to quantify changes. Uncertainty regarding the long-term sequelae of COVID-19 still exists, leaving many healthcare professionals in post-acute care settings without specific guidance for treatment and recovery expectations. However, reasonable conclusions can be drawn from similar recovery trajectories like Post-ICU Syndrome and ICU-acquired weakness. Interventions aimed at improving health outcomes and avoiding hospital readmission should be prioritized across the spectrum of settings. Physical therapists and physical therapy assistants play a critical part in prescribing exercise and effective rehabilitation techniques to restore function in survivors of COVID-19 and enable their return to society.

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