



Are you prepared to be in
it for the long haul?
An overview of long-haul
COVID-19 and
rehabilitation implications.

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Course Overview

1. What is long COVID or post-acute COVID-19?
2. Clinical presentation, signs, and symptoms of long COVID Phenotypes
3. Long COVID-19 and rehabilitation

What is Long COVID or Post-Acute COVID-19?

Terms

- Long COVID
- Long-haul COVID
- Post-COVID Conditions
- Post-acute COVID-19
- Long term effects of COVID-19
- Chronic COVID
- Post-acute sequela of SARS CoV-2 infection (PASC)

What is Long COVID?

- Long-term effects of the COVID-19 virus
- Broadly defined as signs, symptoms, and conditions that continue or develop after acute COVID-19 infection
- Long COVID can include a wide range of ongoing health problems that can last weeks, months, or even years.
- First disease created by patients - stories were shared online and the term Long COVID was created
- *Was defined by the Department of Health and Human Services in collaboration with the CDC (Center for Disease Control and Prevention)*



Who can get Long Covid?

- Long COVID occurs more often in people who had severe COVID-19 illness, but anyone who had COVID-19 can experience it.
- People who are not vaccinated against COVID-19 and become infected may have a higher risk of developing Long COVID.
- Each time a person is infected or reinfected with SARS-CoV-2 (the virus that causes COVID-19), they have a risk of developing Long COVID.
- Some individuals with Long COVID may not have tested positive for the virus or even known they were infected.

Who can get Long-Covid?

Other factors to consider:

- Female sex
- Older age
- Immune response to initial infection
- SARS-CoV-2 variant that caused the initial infection
 - Delta variant > Omicron
- Health inequities
 - Increased risk of Long COVID in Hispanic and Latino heritage
 - Lower income has increased risk - could be due to less ability rest during initial infection

Children and Long COVID

- Children and teenagers can get Long COVID regardless of initial symptoms
- Multisystem inflammatory syndrome in children (MIS-C) is a serious delayed complication of the SARS-CoV-2 infection that can occur in children and young adults
- Inflammation occurs in heart, lungs, kidneys, brain, skin, eyes, and gastrointestinal organs
- Children ages 5-11 are most affected

Long COVID & Disability

- In July 2021, Long COVID was added as a recognized condition that could result in a disability under the Americans with Disabilities Act (ADA).
- Individuals with Long COVID are eligible for accommodations by their employers



But what is it really?

- Long COVID is hard to define
- It is a wide range of new, returning, or ongoing health problems
- It is experiences only after having been infected with COVID-19
- Most people with COVID-19 get better in a few days to weeks
- Four weeks after initial infection, is the earlier that Long COVID could be identified
- Some people who start to have Long COVID symptoms don't even know when they were originally infected

What causes Long COVID?



Scientists don't know for sure



SARS-CoV-2 particles may become active again which causes symptoms to reappear



Overactive immune cells may release high levels of inflammatory substances that can injure organs and tissues



The original infection may cause the immune system to start making autoantibodies that attack a person's own organs and tissues.



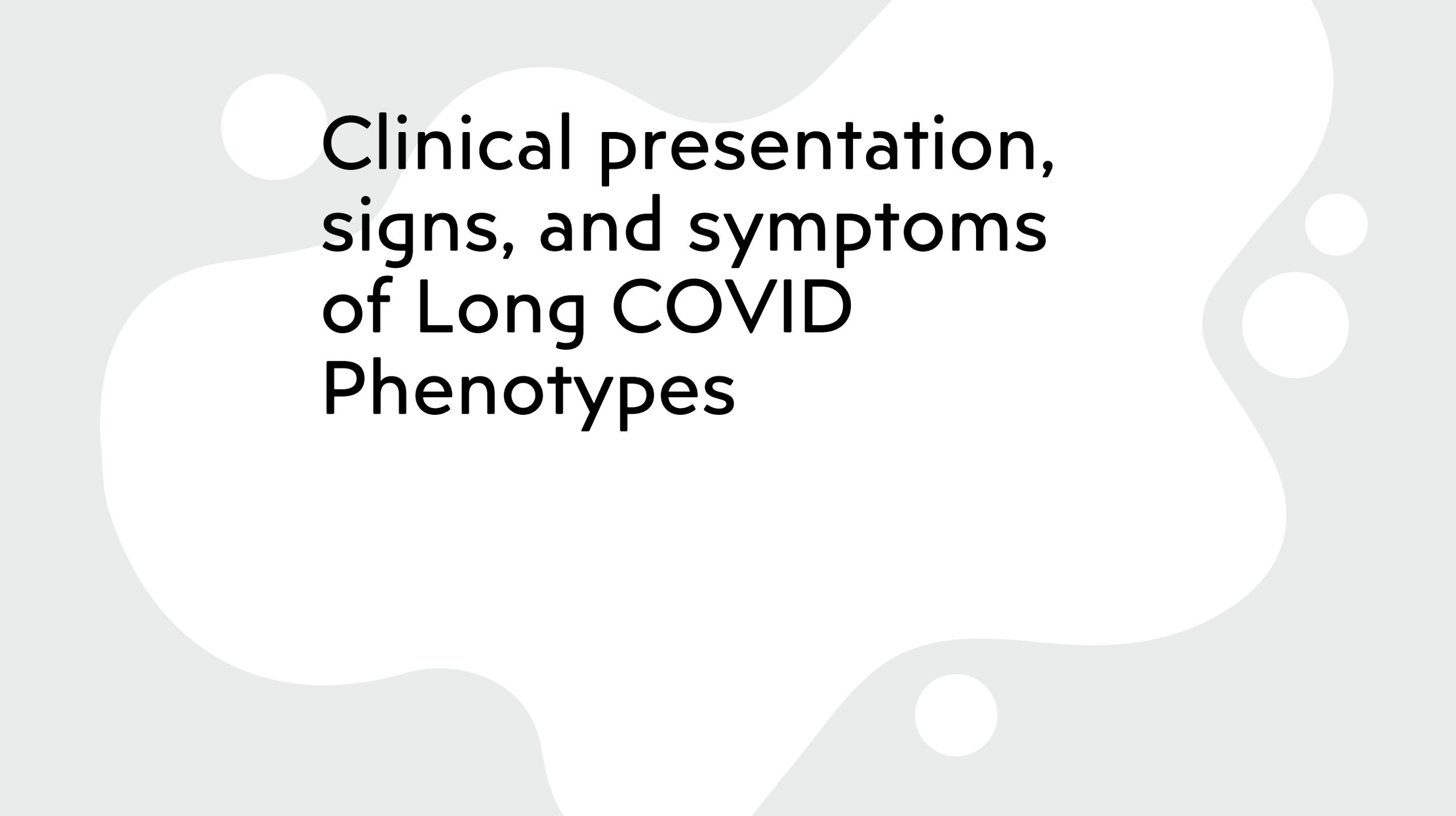
Diagnosis

- There is no test of Long COVID
- Long COVID is not one specific illness
- Presents in different phenotypes that vary in pathophysiological mechanisms, symptomatic manifestations, and interventional approaches
- Diagnosis of Long COVID is made by a healthcare provider after reviewing health history and health examination

Impact

Labor force study found that 44% of people with post COVID-19 were unable to work and 51% worked fewer hours, which directly causes lower incomes

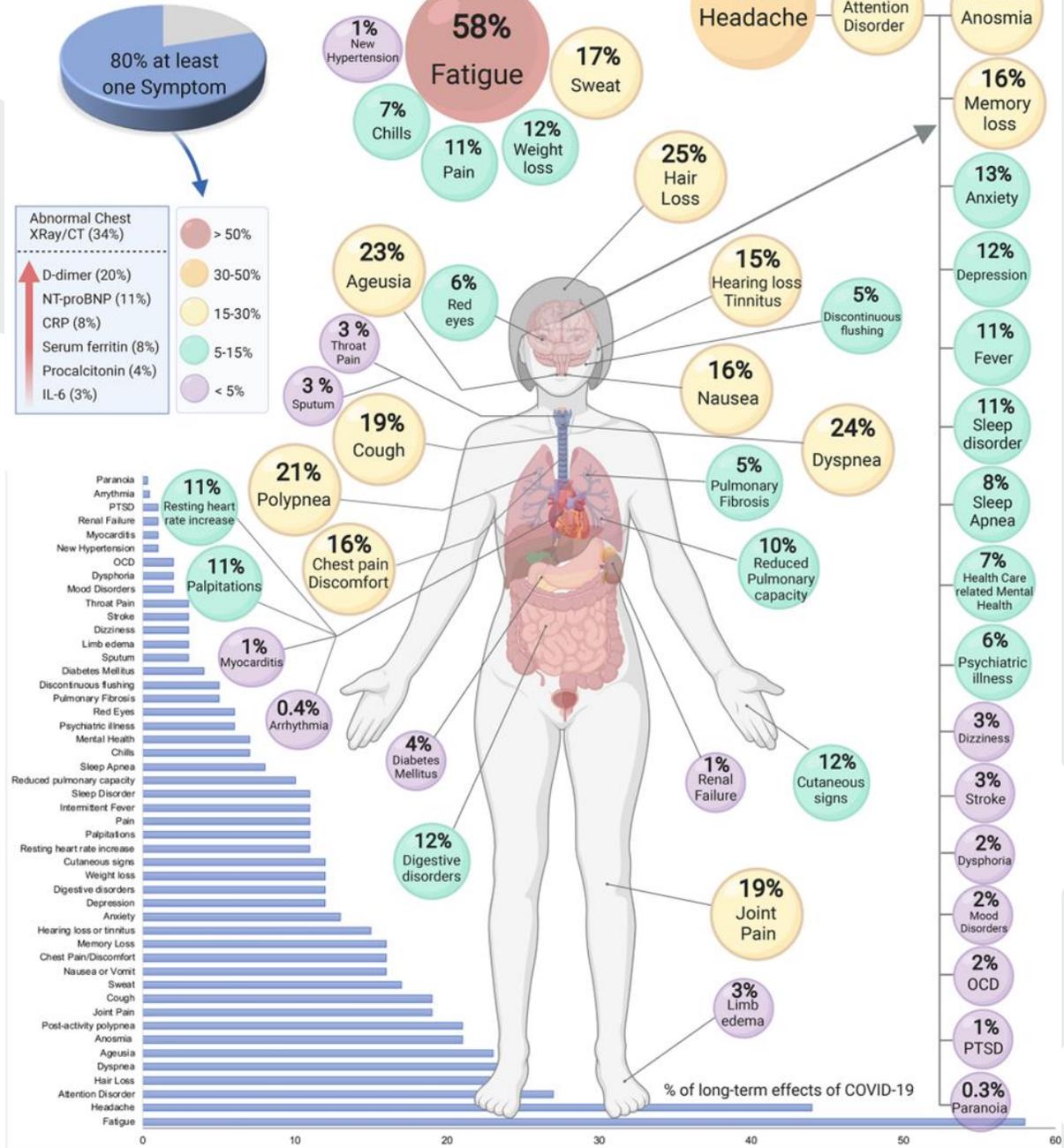
Long COVID causes a significant burden on health, healthcare systems, and the economy



Clinical presentation, signs, and symptoms of Long COVID Phenotypes

Lopez-Leon et al.,
2021

Long-term effects of COVID-19



Clinical Presentation

- More than 200 different symptoms in 10 different organ systems have been identified as potential post COVID-10 sequelae
- Originally COVID-19 was seen as a pulmonary condition, but it has become clear that this is not the case
- Many organ systems can be affected by Long COVID, some of the most common:
 - Cardiovascular
 - Nervous
 - Gastrointestinal
 - Musculoskeletal
 - Endocrinological

Clinical Presentation

- The most common overall symptoms:
 - Fatigue
 - Headache
 - Attention disorder
 - Hair loss
 - Dyspnea
 - Loss of taste and smell
 - Painful muscles



Clinical Presentation – Other Common Symptoms

- Joint pain
- Cough
- Sweating
- Depression/anxiety
- Digestive disorders
- Weight loss
- Increased resting HR
- Palpitations
- Intermittent fever
- Sleep disorder
- Sleep apnea
- Pulmonary fibrosis
- Red eyes
- Psychiatric illness
- Diabetes mellitus
- Limb edema
- Throat pain
- Dizziness
- New HTN
- Myocarditis
- Renal failure
- Arrhythmias

Long COVID-19 Phenotypes

- Long COVID presentation varies between individuals
 - Four main phenotypes have been identified which vary based on pathophysiological mechanisms, symptomatic manifestations, and potential interventional approaches
1. Mild COVID-19 but with multi-organ sequelae (most common)
 2. Manifest ME/CFS (rare)
 3. PICS/Pulmonary Fibrosis (hospitalized patients)
 4. Unmasking and/or exacerbation of underlying comorbidities (unclear prevalence)

Phenotype #1: Mild COVID-19 with Multi-Organ Sequelae (most common)

Common presentation includes muscle weakness and exercise intolerance

Contributing factors:

- Mix of systemic inflammation, viral infection, and persistent physical inactivity/muscle disuse may contribute to decreased neuronal activation, muscle fiber atrophy, and alterations in blood flow and metabolic muscle function

Exertional dyspnea is most likely due to impaired lung function (resulting in dysfunctional breathing) and diaphragmatic weakness

Phenotype #1: Mild COVID-19 with Multi-Organ Sequelae (most common)

- Need to evaluate to differentiate underlying pathophysiological mechanisms and to identify treatable conditions for rehab
- Potential therapeutic interventions include treatment of fatigue, dyspnea, and cognitive impairments

Phenotype #1: Mild COVID-19 with Multi-Organ Sequelae (most common)

- **Fatigue**

- Need to differentiate general fatigue symptoms from Myalgic Encephalomyelitis or chronic fatigue syndrome - comprehensive lab testing, screening questions, and physical exam necessary
- When general fatigue syndrome is present treatment should include education on energy conservation techniques and individualized exercise training.
- Anxiety and depressive symptoms can develop - screening should occur with treatment as warranted

Phenotype #1: Mild COVID-19 with Multi-Organ Sequelae (most common)

Respiratory Symptoms

- Components of pulmonary rehab programs will be beneficial to patients with this phenotype of Long COVID
- Goals: improve gas exchange, improve thoracic mobility, and reduce dyspnea at rest and with activity
- Treatment should include education and training in breathing strategies:
 - PLB
 - Diaphragmatic breathing
 - Huffing
- Respiratory muscle weakness can be addressed with inspiratory muscle training

Phenotype #1: Mild COVID-19 with Multi-Organ Sequelae (most common)

Cognitive Symptoms

- Goal: develop strategies to overcome daily life challenges and improve attention, memory, and executive function
- Treatment approaches: computerized training, cognitive/behavioral feedback, and task specific training with a focus on basic tasks and activities to restore cognitive impairments
 - Memory exercises
 - Strategic games
- Individuals with Long COVID loss of smell may benefit from training with repetitive deliberate sniffing of various odors



Phenotype #2: Myalgic Encephalomyelitis or Chronic Fatigue Syndrome

- Complex and debilitating disease that is triggered by viral infections
- Has existed for a long time but increased incidence is noted due to SARS-CoV-2
- Exact mechanism of why this occurs post-virus infection is unknown

Phenotype #2: Myalgic Encephalomyelitis or Chronic Fatigue Syndrome

- Symptoms:
 - Extreme fatigue
 - Post-exertional malaise
 - Pain disorders
 - Sleep disturbance
 - Cognitive impairments (brain fog)
 - Neuroendocrine/immune alterations
 - Orthostatic intolerance and autonomic dysfunction (due to injury of the autonomic nervous system by SARS-CoV-2)
 - Postural orthostatic tachycardia syndrome (POTS)

Phenotype #2: Myalgic Encephalomyelitis or Chronic Fatigue Syndrome

- Symptoms typically begin after individual engages in a minimally cognitive, physical, emotional, or social activity and then worsen for 12 - 72 hours after the activity
- Diagnosis is difficult - symptoms are broad and overlap with other chronic conditions
 - Diagnosis can only be confirmed if symptoms are present for >3 mos.
 - Diagnosis of exclusion - must rule out other reasons for fatigue
 - No specific pharmacological or non-pharmacological treatments that will result in a cure

Phenotype #2: Myalgic Encephalomyelitis or Chronic Fatigue Syndrome

Rehab Interventions

- Pacing and energy conservation techniques
 - Teach the patient to control their symptoms by being aware of what activities cause exacerbations as well as what activities are possible without resulting in exacerbations
 - Learn when to take preventative breaks when engaged in activities that may cause exacerbation
- Symptomatic medications
- Avoidance of exhaustion and mental stress

Phenotype #2: Myalgic Encephalomyelitis or Chronic Fatigue Syndrome

Rehab Interventions

- General guideline: keep activity level at 2/3 of the duration and intensity that has previously exacerbated symptoms
- Recommendation: low intensity activities such as stretching and balance exercises
- Cognitive behavioral therapy may be beneficial in improving mental and physical fatigue
- In order to address pain syndromes, physical therapy, relaxation, and meditation can be used
- Sleep hygiene and nutrition are essential
- POTS management: avoid warm environments, large food portions, and sudden changes in posture into an upright or standing position, compression stockings, drink at least 2L water/day

Phenotype #3: Severe to Critical COVID-19 with Post-Intensive Care Syndrome (PICS)

- Patients who were admitted to the ICU due to COVID-19 and experienced respiratory failure or acute respiratory distress syndrome (ARDS) and needed mechanical ventilation
- Survivors of such critical illnesses often develop physical, mental, and emotional symptoms that can persist for months to years after discharge and affect QOL - this is called Post-Intensive Care Syndrome (PICS)
- In the acute phase, these patients experience microvascular ischemia, immobility, and metabolic changes - all of which can contribute to the development of PICS

Phenotype #3: Severe to Critical COVID-19 with Post-Intensive Care Syndrome (PICS)

- Pulmonary fibrosis that ARDS survivors often develop (whether ARDS was due to COVID-19 or not)
- The greater the severity of the COVID-19 infection the increased risk for developing pulmonary fibrosis
- Symptoms of pulmonary fibrosis:
 - Severe exertional dyspnea
 - Dry cough
 - Chest pain
 - Impaired exercise tolerance
- Recent study revealed that 75% of ICU-treated COVID-19 patients, met PICS criteria 3 months after hospital discharge

Phenotype #3: Severe to Critical COVID-19 with Post-Intensive Care Syndrome (PICS)

Rehab Interventions

- Early mobilization and mobility training in the ICU, respiratory therapy, and nutritional support in the acute setting are impactful
- Pulmonary rehab
 - Post-COVID-19 patients vs. non-COVID-19 patients who engaged in early pulmonary rehab, had a longer stay in the ICU but had a greater increase in the 6 Minute Walk Test
 - This increase indicates the value in early pulmonary rehab interventions in those post-COVID-19

Phenotype #4: The “black box” or the unmasking and/or exacerbation of underlying comorbidities

- Another explanation for post-COVID-19 sequelae is the unmasking of underlying comorbidities
- Individuals who are at high risk for developing chronic diseases can have these diseases manifest or “unmasked” after an infection with COVID-19
- Another explanation for this is that regular healthcare interventions declined during the pandemic which may have led to an overall deterioration in health for some
- The risks of developing new diagnoses and symptoms of the respiratory, cardiovascular, liver, kidney, and metabolic systems were higher in post-COVID-19 patients compared to the non-COVID population

Phenotype #4: The “black box” or the unmasking and/or exacerbation of underlying comorbidities

Rehab Implications

- Hard to differentiate if COVID-19 is the direct reason someone develops a new medical condition
- Any new symptoms or conditions should be addressed with established therapies



Long COVID Rehabilitation

Long COVID Rehabilitation

- The importance of rehabilitation for patients with persistent COVID-19 symptoms has been highlighted in a *Call for Action by the World Health Organization*.
- Exercise can result in the following improvements:
 - Improved immune system function
 - Improved psychological and mental health neural plasticity (healing of the nerves in the brain)
 - Reduced pulmonary complications
 - Enhanced cardiovascular outcomes

Long COVID Rehabilitation

Challenge: Difficult to determine what kind of rehab services would be most useful when patients have symptoms across a variety of organs and body systems

Telehealth has been shown to be effective in Long COVID-19 patients



Rehabilitation Safety

- Safety:
 - Significant cardiac impairments should be ruled out - myocarditis, pulmonary embolism - before starting an exercise training program
 - Pacing and energy conservation techniques are highly recommended
 - Intensive training should not be applied

Rehab Expectations

- The goals for Long COVID-19 rehab patients need to be realistic
- Patients with Long COVID-19, especially if they have fatigue, are usually not cured after a rehab program
- Return to pre-COVID health status is unclear takes time and is not always a realistic prognosis
- Complete recovery should not be the primary goal of rehab, rather, also need to address the situation and teach the patient to live in their current situation including any disabilities

Rehab Expectations



Rehab treatment plans with Long COVID-19 should be very individualized



There is significant heterogeneity of symptoms and impairments



Comprehensive assessment is needed to identify the most appropriate treatment plan



Optimal care pathways do not yet exist for Long COVID-19, however, proposals have been made

Long COVID-19 Rehab Progression

Which patients should be referred to post-COVID 19 rehabilitation?

- Those with persistent COVID-19 sequelae that lead to significantly reduced quality of life, physical function, and/or impaired working ability

Timing of rehab

- Severe to critical COVID-19: directly after hospital discharge
- Mild to moderate COVID-19: depending on symptom severity – wait and see approach for at least 6 weeks to observe and let natural healing occur. Then referral to rehab if needed.

Long COVID-19 Rehab Progression

Graded delivery modes of rehabilitative interventions

1. Advice for self-management
2. Single intervention (examples: physical therapy, occupational therapy, etc.)
3. Multidisciplinary outpatient or telehealth rehab
4. Comprehensive and multidisciplinary inpatient rehab

Long COVID-19 Rehab Progression

Core Components of Rehab

1. General exercise training
2. Education
3. Pacing strategies
4. Cognitive training
5. Relaxation techniques
6. Breathing therapy
7. Psychological support
8. Supervised group therapy to exchange experiences with others

Long COVID-19 Rehab Progression

- Most patients with Long COVID can begin with supervised breathing and light exercise programs
- Use the Borg perceived exertion scale - recommendation is to begin exercise as low as 6-8 which is from "no exertion" to "extremely light"
- Progress by 2-3 points on the Borg every week as tolerated

Long COVID- 19 Rehab Progression

Multi-professional team

- Rehabilitation physician
- Physical therapist
- Occupational therapist
- Psychologist
- Social worker
- Other specialists as needed:
pulmonary, cardiology,
neurology, psychiatry,
orthopedics, sleep medicine,
speech therapy

A hand holding a smartphone with a blank white screen. The background is a whiteboard with various diagrams, charts, and sticky notes, suggesting a clinical or research setting. The image is overlaid with several light green circular shapes.

Long COVID-19 Rehab Progression

Maintenance/follow-up

- Outpatient setting
- Telehealth
- Smartphone app-based

References

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