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Rehabilitation Strategies for COVID-19 Survivors: A Guide to Restoring Functional Independence

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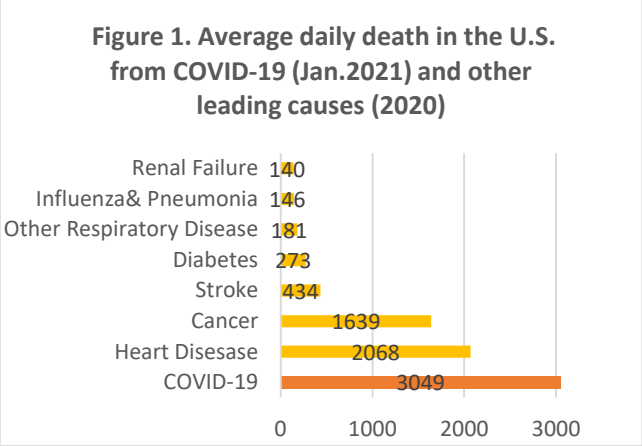
Abstract

The pandemic of coronavirus disease 2019 (COVID-19) and the response to it are creating a tsunami of rehabilitation needs. This white paper offers a comprehensive guide to designing effective rehabilitation strategies for individuals recovering from COVID-19. With a focus on treating respiratory and neuromuscular dysfunctions, the rehabilitation demands of COVID-19 survivors are becoming more widely acknowledged. Focused on restoring functional independence, the paper addresses key considerations in the rehabilitation process, including musculoskeletal, respiratory, cardiovascular, and psychosocial aspects. This white paper serves as a valuable resource for healthcare professionals and individuals seeking guidance on effective rehabilitation strategies post-COVID-19, emphasizing the restoration of functional independence.

Keywords*: Physical Therapy, COVID-19, Rehabilitation, Restoring Function*

I. INTRODUCTION

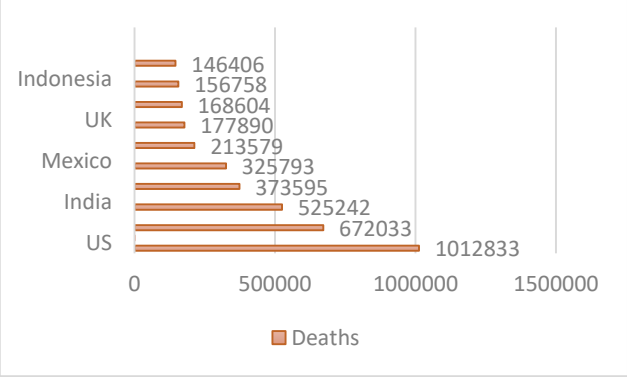
The novel coronavirus, known as severe acute respiratory syndrome coronavirus 2 [SARS-CoV-2], is the source of the illness known as coronavirus disease 2019 (COVID-19). The virus was first discovered during an outbreak in Wuhan, China, in December 2019 and quickly spread to several other countries. [1] Due to the illness's high infection and mortality rates and rapid worldwide spread, the World Health Organization (WHO) declared a pandemic on March 11 of that same year, after categorizing the disease as a public health emergency of international concern on January 30, 2020. [2] By May 1, 2020, the COVID-19 pandemic had claimed over 3.5 million cases globally and over 1 million cases and 62,406 deaths in the United States [[1], [2], [3]].



COVID-19 is the number one cause of death in the U.S. in early 2021 [104]

Clinical symptoms such as fever, cough, rhinorrhea, sore throat, anosmia, ageusia, asthenia, moderate dyspnea, hypoxia, nausea, diarrhea, and vomiting are linked to the mild or oligosymptomatic form of this virus infection in humans. [3] The respiratory system is not the only organ affected by the coronavirus that causes COVID-19; the cardiovascular, renal, gastrointestinal, endocrine, neurological, and musculoskeletal systems are also affected. [4]

Physical therapists are essential in the fight against the COVID-19 pandemic because they help prevent and treat the disease's side effects, help patients regain their functional independence, and help them reintegrate into society and the workforce. [5]

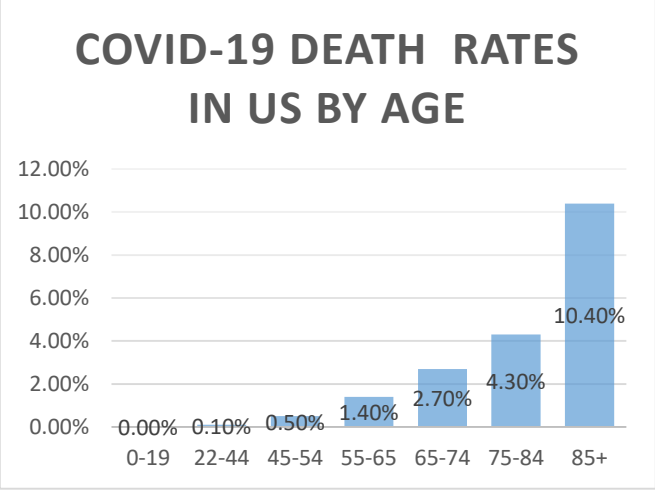


[108]

As of December 24, 2023, the worldwide COVID-19 recovery rate is 95.9%. [109] The COVID-19 pandemic has caused the worst global recession since the 1930s, affecting trade, tourism, investment, employment, poverty, inequality, inflation, fiscal balance, and external balance. The recovery is uneven and uncertain, depending on vaccination, policy support, and economic scarring. The crisis has also shown the need for more international cooperation and solidarity to build a more inclusive, resilient, and sustainable future. Fiscal positions deteriorated as governments boosted spending for health care, social protection, and economic stimulation, but tax receipts fell owing to decreasing economic activity. According to the IMF, the global public debt-to-GDP ratio will approach 99% by 2021, up from 84% in 2019. [110]

A fundamental rehabilitation blueprint must be followed at each stage in the following order: An accurate history and physical examination that emphasizes functional status, a list of issues based on the International Classification of Functioning, Disability and Health (ICF) data set (body functions and structure suggesting impairments, activity limitations, participation restriction, and related environmental and personal factors), addressing each issue with a management plan that includes short- and long-term realistic goals set after discussion with the patient, caregiver, partner, and family, and an effort to accomplish each goal. Support groups are also encouraged and formed to help with better program compliance, prevent dropout rates, and enhance mental health. [6]

The significance of comprehensive rehabilitation in the post-COVID era is a topic that has been gaining attention from various stakeholders, including health professionals, researchers, policymakers, and patients. To better understand the post-COVID-19 situation and to encourage the development of rehabilitation services and research, the World Health Organization (WHO) and its partners have been working. These efforts are crucial to address the needs and challenges of people with post-COVID-19 conditions and to ensure their optimal recovery and well-being in the post-COVID era.



[103]

The purpose of this study was to examine how COVID-19 affected occupational health, with a particular emphasis on the role that physical therapy plays in rehabilitation.

II. The Rehabilitation Landscape for COVID-19 Survivors

The virus can be transmitted from person to person by direct touch, or aerosol transmission by respiratory droplets. The most important factors determining a virus's ability to spread illness are its viral load and the intensity of symptoms like coughing and sputum production. [7]

Compared to earlier virus variations, the Delta and Omicron versions of SARS-CoV-2 cause more illnesses and propagate more quickly [8,9] The potential of these viral strains to induce long-term problems has to be thoroughly examined as new varieties appear. It is crucial to prepare for the possibility that some variations may have more detrimental long-term effects than others and that infected individuals may experience persistent symptoms that need extra care and aggressive, quick treatment methods to manage [10,11].

Tailored rehabilitation plans are very important for COVID-19 survivors, especially those who have experienced severe or critical illness that required intensive care unit (ICU) admission. According to the World Health Organization (WHO), many people recovering from COVID-19 may have long-term health problems that affect their physical, cognitive, and mental aspects of health. These problems may include fatigue, dyspnea, muscle weakness, cognitive impairment, anxiety, depression, and post-traumatic stress disorder. Therefore, rehabilitation is essential to restore function, improve quality of life, and reduce the risk of complications or disability in COVID-19 survivors. [12]

However, the rehabilitation needs of COVID-19 survivors may vary depending on the severity of their illness, the duration of their ICU stays, the presence of comorbidities, and the availability of resources. Therefore, a one-size-fits-all approach may not be suitable for this population. Instead, a tailored rehabilitation plan should be made for each patient, focusing on their specific impairments, goals, and preferences. [12]

Rehabilitation should start as early as possible, preferably during the acute phase of illness, and continue throughout the recovery process. Rehabilitation can be delivered in different settings, such as a hospital, community, or home, depending on the patient's condition and needs. Tele-rehabilitation, which uses information and communication technologies to provide remote rehabilitation services, maybe a feasible and effective option for some patients, especially in resource-limited settings or during pandemic restrictions [13]

The patient-centered and participatory approach of rehabilitation: Rehabilitation should be based on the patient's needs, goals, preferences, and values. The patient should be actively involved in the decision-making process and the implementation of the rehabilitation plan. The patient should also be empowered to self-manage their condition and participate in their daily activities. The patient's family and caregivers should also be engaged and supported by the rehabilitation team. [14]

A tailored rehabilitation plan for COVID-19 survivors can help them recover from the impact of the disease, regain their function and independence, and improve their quality of life. It can also reduce the burden on the health system and society by preventing complications, disability, and

hospital readmission. Therefore, rehabilitation is a vital component of the COVID-19 response and recovery.

III. MUSCULOSKELETAL REHABILITATION STRATEGIES

Myalgias, arthralgias, and neuropathies/myopathies are prevalent musculoskeletal (MSK) symptoms that are clinically manifested by COVID-19. According to one study, 15.5% of the 12,046 patients had myalgia and/or arthralgia. As a result, medical professionals must learn more about and look into the musculoskeletal symptoms and presentation of COVID-19 patients. For patients infected with COVID-19 or with a history of the virus, the treatment of myalgia and/or arthralgia comprises NSAIDs and/or physical therapy rehabilitation. When identifying the source of arthralgia and/or myalgia, care should be taken, and other explanations like reactive arthritis or inflammatory disease processes should be thoroughly investigated. [20]

Numerous proposed mechanisms have been found to negatively impact the musculoskeletal system as a result of COVID-19-induced inflammation. SARS-CoV-2 enters cells and replicates via means of the ACE2 receptor, which is found in a variety of tissue types such as cartilage, synovial tissue, and smooth muscle. ACE2 is a multifunctional protein that inhibits bone resorption and has anti-inflammatory qualities. [20]

Indeed, weakness, fatigue, and decreased mobility have been noted by over 60% of patients with prolonged COVID-19. [15,16] Interestingly, in COVID-19 survivors without a history of musculoskeletal issues, reduced physical performance and a high prevalence of skeletal muscle weakness have been found. [17] Due to the potential interaction between ongoing age-related decreases in muscle mass and function and the prolonged COVID-19 virus, older persons are more likely to experience musculoskeletal complaints.

Muscle mass and function are also significantly impacted by physical inactivity, which may be made severe by hospitalization and quarantine. [18] Malnutrition was noted by Bedock and colleagues [19] to be present in around 42% of hospitalized COVID-19 patients, and it increased to approximately 67% of patients admitted to the intensive care unit. Malnutrition is thought to be mostly caused by decreased food intake brought on by COVID-19 symptoms (such as anorexia, diarrhea, vomiting, nausea, abdominal pain, anosmia, and dysgeusia) and increased nutritional requirements.

Between 40 and 88 years old, hospitalized COVID-19 patients were among the 75–85% of participants in the cohort study who had decreased strength in activities like arm flexion and knee extension. A lengthier hospital stay was associated with muscle limitations, and recovery took five years to complete because of the correlation between COVID-19 disease and acute respiratory distress syndrome (ARDS) [21,22].

The elevated echogenicity of the femoris muscle in patients with severe forms of COVID-19 revealed tissue abnormalities, which may have resulted from the previously described alterations in muscle tissue. The activation of the ubiquitin-proteasome enzyme results in muscle atrophy and

autophagy, which in turn leads to muscle loss in COVID-19 and other consumptive diseases such as cancer, sepsis, cachexia, and chronic obstructive pulmonary disease (COPD) [23].

In a cohort study by Huang et al., which involved 1733 patients admitted to Jin Yin-tan Hospital between January 7, 2020, and May 29, 2020, it was found that 63% of patients reported fatigue or muscle weakness as their primary post-illness symptomatology, 26% had sleep disorders, and 23% had residual conditions like anxiety or depression [24].

IV. Cardiorespiratory Rehabilitation Approaches

Exercise-based CR programs are just as cost-effective as medical treatment and are safe [25]. Myocardial oxygen demand, endothelial function, self-reliance tone, coagulation and coagulation factors, inflammatory indicators, and the formation of collateral coronary arteries are just a few of the immediate positive effects of exercise for the heart and coronary vasculature that have been demonstrated to occur [26, 27, 28].

One kind of exercise that can assist in improving muscle strength and endurance is resistance training. As soon as two days after an acute myocardial infarction or 24 hours after bypass surgery, stretching or flexibility exercises can be started. According to current guidelines, dynamic resistance exercise should be introduced cautiously in II Phase CR, starting with low-intensity training (<30%) and working up to 60% and, in certain cases, 80% in specific patients [29]. It is now widely known that ET has beneficial effects on patients with heart conditions and normal systolic left ventricular function [30].

Several national and international organizations have created and approved cardiac risk stratification guidelines about exercise program participation in the past few years. These could include multivariate analyses, which have given researchers and physicians access to a wealth of data. As a result, there are now fewer chances of acute cardiovascular events due to more adequate and secure CR intervention or exercise regimen setups [31].

Centre-Based Cardiac Rehabilitation (CBCR) and Home-Based Cardiac Rehabilitation (HBCR) are the two types of cardiac rehabilitation programs that are performed. Because they are supervised by specialists, individuals with heart conditions can feel better participating in CBCR exercises, which are conducted in hospitals or other specialized facilities. However, because these long-term programs need transportation and parking near facilities may incur additional costs, CBCR programs are highly expensive and may not be appropriate for patients living in remote areas [32]. It is therefore recommended that patients with CBCR barriers use HBCR. For patients who dislike group exercise, HBCR is especially suitable [33].

A. Home-based cardiac rehabilitation

Present telemonitoring methods seem sufficient to enable heart rate monitoring and physical exercise, including the use of wearable sensors (e.g., accelerometers, sports watches, and heart rate chest zones) and web platforms for instantaneous uploading of training data [34]. A physician medical director's specialist supervision of cardiac rehabilitation (CR) programs is vital, according

to the American Association of Cardiovascular and Pulmonary Rehabilitation (AACVPR). Furthermore, it is suggested that every patient have a baseline assessment and be given a customized rehabilitation plan that includes mental health assessment, weight counseling, nutritional education, risk factor control, fitness training, and quitting smoking [35].

B. Cardiac telerehabilitation during the COVID-19 era

The COVID-19 pandemic has recently placed significant obstacles in the way of CBCR program execution. Conversely, COVID-19 has only served to highlight the vital role that CR plays in enabling patients to make healthy lifestyle decisions that reduce the risk of COVID-19-related morbidity and mortality as well as atherosclerotic CVD [36]. It is now possible to connect the Health Insurance Portability and Accountability Act (HIPAA) with comprehensive patient counseling, making it possible to submit video sessions to the electronic media record. Furthermore, compared to the same period in 2019, telemedicine visits increased by 50% in the first quarter of 2020 [37].

An additional 7.3 million workers—including their families—have lost their jobs as a result of the current pandemic [38]. Before the COVID-19 pandemic, hospitalized patients who met the requirements for continuous rehabilitation (CR) were able to participate in outpatient exercise sessions no later than two weeks after their hospital release, according to data from a related study carried out in Singapore. These days, and in the era of the COVID-19 epidemic, CR programs are being delayed for up to six months. Regrettably, poor patient outcomes are probably going to result from the delays in early CR deployment [39].

Thus, patients with atherosclerotic CVD who have more cardiometabolic risk factors continue to be at a higher risk since cardiac populations will not have access to CR. In addition to making, it more difficult for patients to receive CR, COVID-19 has caused other issues for hospital clinics. For many sites, CR during COVID-19 is not financially feasible. Furthermore, during the COVID-19 restrictions, more than half of all CR programs were discontinued. Promisingly, there is a growing integration of cutting-edge technology into mainstream clinical practice, which could enhance access to and engagement in exercise-based community rehabilitation after the COVID-19 pandemic [40].

C. Advantages and disadvantages of cardiac telerehabilitation

Virtual and home-based cardiac rehabilitation (CR) programs are emerging as viable alternatives to traditional center-based CR programs, especially in the context of the COVID-19 pandemic. These programs use digital tools such as remote monitoring sensors, telecounseling, and mobile apps to deliver comprehensive CR services to cardiac patients who are low-risk and clinically stable. The benefits of these programs include improved access, uptake, adherence, outcomes, and cost-effectiveness. However, some challenges still need to be addressed, such as ensuring data security, engaging older patients, and providing real-time feedback during exercise. More research is needed to evaluate the long-term effects and optimal delivery models of virtual and home-based CR programs. [41,42]

V. Neuromuscular Considerations in Post-COVID Rehabilitation

Although pre-existing neurologic disorders have been associated with more severe COVID-19 infections, the prevalence of neurologic symptoms in COVID-19 patients has become more apparent.

Although neurologic problems that already exist predict worse outcomes, there is also a significant prevalence of neurologic sequelae resulting from SARS-CoV-2 infection. Neurologic problems occur in 6% to 36% of hospitalized COVID-19 patients [43,44].

1) Neurologic complications associated with COVID-19 infection

A) Acute cerebrovascular disease

Among COVID-19 populations, acute cerebrovascular disease continues to be one of the more prevalent and dangerous neurologic effects. The cause of this last typical presentation is complicated, though. Disseminated intravascular coagulation, elevated D-dimers, and prolonged prothrombin time are indicators of a hypercoagulable state brought on by SARS-CoV-2 [45,46].

Furthermore, severe hypoxia associated with decreased brain oxygenation and infarcts can occur in COVID-19 patients, especially in those who already have cerebrovascular illness [47,48]. The risk of ischemic stroke can be significantly elevated in elderly patients due to infection, inflammation, and hypercoagulable conditions [49,50,51]. Guidelines for a protected code stroke have been developed by the American Heart Association, which emphasizes screening protocols, personal protection equipment, and crisis resource management [52]. However, patients should continue to receive the standard of care prescribed by their institution after being diagnosed with an ischemic stroke, taking into account intravenous thrombolytic agents and endovascular thrombectomy in the relevant clinical situations, without changing the intervention criteria [53,54].

B) Encephalitis and encephalopathy

Acute fever, vomiting, convulsions, and altered or diminished awareness are the hallmarks of encephalitis [55]. Although the exact pathophysiology is unknown, it may have been associated with edema driven on by inflammatory damage rather than a direct viral infection [56]. As with other encephalitis instances, the most important things to do are to reduce elevated intracranial pressure and provide intensive supportive care.

Acute necrotizing encephalopathy (ANE) is an uncommon neurologic consequence resulting from disruption of the blood-brain barrier and cytokine storm [57]. Although the exact cause of ANE is unknown, therapeutic options include intravenous immunoglobulin (IVIG) and medications for the hyper-inflammatory state [58,59].

C) Guillain-Barré Syndrome (GBS)

SARS-CoV-2 infection has recently been connected to this progressive neuropathy; 5 cases have been reported from Italy, and 2 additional cases are from Wuhan, China. An upper respiratory infection can occur anywhere from 5 to 14 days before symmetric weakness develops, and 3

patients experience respiratory failure. The nasopharyngeal polymerase chain reaction (PCR) test and chest imaging characteristic of SARS-CoV-2 were positive in all patients; however, the SARS-CoV-2 PCR on all cerebrospinal fluid (CSF) samples was negative. The need for consultation and additional testing, such as nerve conduction investigations, when there is a high clinical suspicion even in the absence of radiographic results is highlighted by the interesting fact that brain and spine MRIs did not reveal abnormalities in half of the patients. [60,61,62]

2) Integrating Neuro-Rehabilitation Techniques for Improved Function in covid 19

Neuro-rehabilitation is a process that aims to restore or improve the functioning of the nervous system, especially the brain, after an injury or illness. COVID-19 can cause various neurological complications, such as cognitive impairment, stroke, or nerve damage, that may require neuro-rehabilitation to enhance recovery and quality of life.

Different types of neuro-rehabilitation techniques can be used for COVID-19 patients, depending on their specific needs and goals. Some of the most common ones are: [63,64,65]

Physical therapy: This involves exercises and activities that help improve mobility, strength, balance, and coordination. Physical therapy can also help reduce pain, fatigue, and muscle weakness that may result from COVID-19 or prolonged hospitalization.

Pulmonary rehabilitation: This focuses on improving lung function and breathing capacity, as well as managing symptoms such as breathlessness, cough, or chest pain. Pulmonary rehabilitation can also include education, nutrition, and psychological support.

Cognitive rehabilitation: This aims to enhance cognitive abilities such as memory, attention, concentration, and problem-solving. Cognitive rehabilitation can involve various strategies, such as mental exercises, memory aids, or computer-based training. Cognitive rehabilitation can also help with emotional and behavioral issues that may arise from COVID-19, such as anxiety, depression, or trauma.

Non-invasive brain stimulation (NIBS): This involves applying electrical or magnetic currents to specific areas of the brain to modulate its activity and plasticity. NIBS can be used to stimulate or inhibit brain regions that are affected by COVID-19, such as those involved in motor, sensory, or cognitive functions. NIBS can also be combined with other neuro-rehabilitation techniques, such as physical therapy or cognitive training, to enhance their effects.

Technological approaches: These include the use of novel devices or platforms that can assist or augment neuro-rehabilitation, such as robotic, virtual reality, or wearable systems. These technologies can provide feedback, guidance, motivation, or challenge to the patients, as well as monitor their progress and outcomes.

Neuro-rehabilitation for COVID-19 is a relatively new and emerging field, and more research is needed to determine the best practices and protocols for different patient groups and settings. However, some studies have shown promising results and suggest that neuro-rehabilitation can significantly improve the physical and mental health of COVID-19 survivors.

VI. PSYCHOSOCIAL SUPPORT IN THE REHABILITATION JOURNEY

Immediately following the quarantine period, people experience anxiety, irritability, sleeplessness, depressive disorders, and symptoms of post-traumatic stress disorder. The long-term effects are extensive and include alcohol addiction, post-traumatic stress disorder symptoms, stress, rage, and sadness, and behavioral changes including avoiding crowded areas and washing your hands carefully. Following the quarantine period, these psychological symptoms may persist for several months or up to three years. [66]

One year after discharge, survivors of critical illness are shown to have persistent psychological impairment with considerable levels of anxiety, depression, and post-traumatic stress disorder. The majority of patients with severe acute respiratory distress syndrome had neurocognitive impairment at one year, which included problems with attention, concentration, memory, and mental processing speed. When patients with severe acute respiratory syndrome and prolonged mechanical ventilation were discharged from the critical care unit, their quality of life was significantly lower than when they were admitted for other reasons. [67]

Many years after the pandemic, the COVID-19 pandemic's effects on mental health might persist and increase. In the post-pandemic period, it is expected that the prevalence of common psychiatric diseases and suicide will rise. To address the issue, it is critical to improve access to mental health services, such as telepsychiatry, early assessment, treatment, and psycho-social support; screen for and provide support for particular groups, such as frontline HCP; implement long-term measures to mitigate the impact of economic recession on mental health; and address stigma during the pandemic. [68]

The 2019 coronavirus disease pandemic is probably going to cause a spike in mental health issues. These health problems are the result of ordinary individuals being put in unusual circumstances. The symptoms can show up as serious mental illness or as bodily repercussions like disturbed sleep or hunger, or as emotional problems like anxiety or depression. The global mental health care system is under more strain as a result of the rise in the prevalence of these disorders. [69]

The lockdown's unpredictable and uncertain environment, together with its many limitations, unemployment, and shifting standards of living, have made it harder for those who already have tenuous access to mental health treatments. Furthermore, the populace is now carrying a heavy psychological burden as a result of these concerns. As a result, it was noted that the prevalence of mental problems had increased among previously healthy persons and that pre-existing mental diseases had gotten worse. [70]

An approach to effectively treat the post-pandemic mental health requirements is through telepsychiatry. Using remote video or phone conferences for telepsychiatry services has proven successful in providing sufficient mental health care during the epidemic. Applications for digital health are also being developed that enable patient monitoring and remote screening. [71]

Telepsychiatry offers patients several benefits, such as easier access to care, shorter wait times and travel distances, and lower costs. The main benefits of telepsychiatry for physicians include greater

safety, improved diversity of practices, and scheduling flexibility. There have been reports of worries about the reduced capacity to recognize nonverbal signs and interact with patients, though. [72]

Frontline workers and healthcare professionals should be given information about various techniques to manage stress. Using psychological intervention services that offer apps for mental health support, routine screenings for mental health conditions, and early support can help achieve this. Group talks are also essential to support employees in discussing honestly how the pandemic is affecting their jobs, identifying stressors, and cooperating to find solutions. All institutions should also provide their staff members with access to an anonymous online self-check tool that offers personalized feedback and encourages sincere and thoughtful answers. [73]

Hence, early diagnosis and appropriate treatment to increase the viability of access to support frontline work groups, education about self-care techniques, addressing the stigma associated with mental health, and the development of additional services like telepsychiatry are some crucial steps that must be taken to address this impending crisis. [69]

VII. Technology and Innovation in Post-COVID Rehabilitation

However, the industry stated that the pandemic had a detrimental effect on creative technology in rehabilitation because of the widespread global spread of COVID-19. The market for rehabilitation robots has grown as a result of the prevalence of neurological illnesses, strokes, and injuries to the brain and spinal cord. [74]

However, given the massive impact of lockdowns, supply chain disruptions, demand destruction, and customer behavior changes, along with the global restructuring of healthcare systems, a market crash seemed unavoidable.

Patients who have spent a significant amount of time in intensive care units (ICUs) and have symptoms of post-intensive care syndrome (dyspnea, anxiety, depression, prolonged pain, impaired physical and cognitive function, and poor quality of life) have been treated with practical guidelines by physiatrists and neurologists. To address the neurological, psychological, and cardiac consequences, a comprehensive approach should be taken into account. [75]

However, the circumstances for neurological patients in need of rehabilitation who were unaffected by COVID-19 have been considerably more severe. Global healthcare systems have altered their organizational structures in response to the pandemic. Acute wards have replaced several chronic diseases and/or rehabilitation wards to handle COVID-19-related medical and neurological consequences.

Specifically, patients who tested negative for COVID-19 were discharged from rehabilitation centers early, with their rehabilitation plans shortened where appropriate assistance and medical conditions allowed. When a patient tested positive for COVID-19, the majority of them were moved to COVID-19 hospitals where they were placed in isolation or long-term care units as they waited for their infection to clear.

The number of new admissions to neurorehabilitation units was either stopped or temporarily reduced. Careful pre-admission tests for COVID-19 were subsequently instituted, and patients who tested negative for the virus were given other treatment options. [76]

As a result, neurological patients experienced social isolation, a lack of cognitive stimulation, and physical inactivity. This may be the situation facing us in the years to come. In addition to a worsening of their motor-cognitive issues, patients with chronic diseases, such as those with dementia and Parkinson's disease, are particularly vulnerable and may experience other medical complications, such as pneumonia. [77,78]

One of the best solutions to this time has been telerehabilitation, and the excellent experience of the past few months has given us some excellent advice on improving its delivery. [79] A key component of therapy is guidance; the patient's relationship with the therapist aids in more accurate and cautious training. The therapeutic team can communicate with the patient and caregivers through the use of new telerehabilitation systems, which view this as a hot point.

Integrating assistive technologies for enhanced independence in COVID-19 patients is a topic that has been explored by various researchers and practitioners in the fields of health, social care, and engineering. Assistive technologies are devices or systems that enable people with disabilities, chronic conditions, or aging-related issues to perform tasks that they would otherwise find difficult or impossible to do. Some examples of assistive technologies are hearing aids, prosthetics, wheelchairs, smart speakers, and wearable sensors. [81]

During the COVID-19 pandemic, many people who rely on assistive technologies faced challenges in accessing the services and support they needed, such as maintenance, repair, or adjustment of their devices. Moreover, the pandemic also increased the demand for assistive technologies that could help people cope with the physical, mental, and social impacts of the disease, such as long-haul symptoms, isolation, and anxiety. [80,81]

Therefore, integrating assistive technologies for enhanced independence in COVID-19 patients requires a holistic and collaborative approach that considers the needs, preferences, and capabilities of the users, as well as the availability, affordability, and accessibility of the devices. Some of the possible benefits of such integration are: [80,82,83]

- Improved health outcomes and quality of life for COVID-19 patients, especially those with long-term or complex conditions, by enabling them to monitor, manage, and improve their health and well-being.
- Increased independence and productivity for COVID-19 patients, by allowing them to perform daily activities, access information, and communicate with others more easily and effectively.
- Reduced burden and stress for caregivers and health professionals, by providing them with tools and data to support and coordinate the care of COVID-19 patients.

- Enhanced resilience and preparedness for future pandemics or emergencies, by strengthening the assistive technology ecosystem and ensuring its continuity and sustainability.

VIII. Long-Term Rehabilitation Considerations

Just 1% of COVID-19 patients are hospitalized; however, the majority of COVID-19 research focuses on in-patients with severe illness. [84] There is limited information available regarding the medium- and long-term effects of COVID-19 in patients who are not hospitalized. According to the most recent data, [85-87] 10–30% of non-hospitalized patients with mild to moderate COVID-19 instances will not recover rapidly, within the anticipated period for symptom resolution.

A group of individuals that the US National Institutes of Health recently dubbed "long-haulers" or persons with post-acute sequelae of SARS-CoV-2 (PASC) infection, suffer from fatal, chronic, and constantly changing symptoms that can persist for weeks or even more than a year following SARS-CoV-2 infection. Millions of long-haul travelers have been affected by COVID-19 globally, and our understanding of the illness's diagnosis and course of therapy is limited. There's no way to become better. [88]

Regarding diagnosis, therapy, and the medical, social, and cultural resources required to best assist survivors in their rehabilitation, we know very little about PASC. The frequency of PASC, risk factors for developing PASC, specific symptoms and symptom clusters, and symptoms that change over time in patients who are not hospitalized are also poorly understood. Small sample sizes and the exclusion of non-hospitalized survivors (defined as "mild" to "moderate" infection) have hampered PASC research to this point, restricting population-level data that are crucial for the creation of evidence-based management guidelines for PASC. [88]

The strategies that help people with the long-term effects of COVID-19 are: [89-91]

- Getting adequate sleep and rest helps the body recover.
- Exercising as much as the body would allow, starting with gentle activities and gradually increasing the intensity and duration.
- Seeking medical advice and treatment for specific symptoms, such as cough suppressants, anti-inflammatories, physical therapy, or cognitive exercises.
- Monitoring the oxygen level with a home pulse oximeter if experiencing breathlessness, and contacting a doctor if it drops below 92%.
- Following up with a primary care provider or a specialist clinic that focuses on long-term COVID, especially if experiencing new, persistent, or progressive symptoms that affect the respiratory, cardiac, or neurological systems.
- Assessing the psychosocial needs and seeking support from family, friends, or mental health professionals if feeling anxious, depressed, or isolated.

Some of the common themes and strategies for building resilience and coping during the pandemic are: [92-94]

- Practicing positive emotions, such as gratitude, hope, and humor, to counteract the negative effects of stress and trauma.
- Developing self-efficacy, or the belief in one's ability to overcome challenges and achieve goals, by setting realistic and attainable tasks and celebrating small successes.
- Seeking social support and connection from family, friends, or community groups, and offering help to others in need.
- Focusing on the present moment and the things that are within one's control, rather than worrying about the future or ruminating on the past.
- Engaging in healthy habits, such as eating well, exercising regularly, sleeping enough, and avoiding substance abuse, to maintain physical and mental well-being.

Patient Education and Empowerment

Throughout the COVID-19 pandemic, there have been alterations to the ways that healthcare systems have engaged with patients and caregivers (known as modes of patient engagement). The pandemic brought about a significant change in the way the health system operated, which had an impact on patient and family engagement as partners and the way care was provided. For instance, visitor limits were imposed in hospitals and long-term care institutions globally [95,96], research unrelated to COVID-19 was halted in certain situations [97,98], and a large number of patient and family advisory committees were discontinued, at least in the context of North America.

Health systems have been attempting to involve patients and families more over the past few decades through engagement initiatives like creating patient and caregiver advisory committees, looking for input on policies or procedures, gathering patient and caregiver feedback to encourage changes in the healthcare system and care delivery, and collaborating with partners to create new programs and service delivery models through co-design techniques [99-101].

The collaboration of patients, families, and medical professionals at all levels of the healthcare system to enhance healthcare and health is known as patient engagement [102].

Informing and engaging patients in their recovery process for COVID-19 can have several benefits, such as: [103-105]

- Improving patient safety and quality of care by reducing the risk of healthcare-associated infections and enhancing adherence to infection prevention and control measures.
- Empowering patients to participate in decision-making and self-management of their health conditions, and respecting their rights and preferences.
- Enhancing patient satisfaction and trust in the healthcare system and providers, and reducing anxiety and distress.

- Supporting patient and family well-being and resilience, and addressing their psychosocial needs and challenges.

IX. Conclusion

COVID-19 is a global health crisis that has profound effects on the functional independence of many patients, both during and after the infection. Rehabilitation is a vital part of the COVID-19 response, as it can help patients regain their physical, mental, and social functioning and enhance their quality of life. Occupational therapy (OT), speech therapy (ST), and physical therapy (PT) are essential components of the multidisciplinary rehabilitation team that can address the diverse and complex needs of these patients across the care continuum. OT, ST, and PT can provide individualized assessment and intervention to optimize the patients' occupational performance, communication, swallowing, airway, and physical functions. Physical therapy can help them improve their mobility, endurance, and cardiopulmonary health, as well as reduce the risk of complications from bed rest or ventilation. Physical therapy can also involve various strategies to enhance their physical and mental well-being, and enable them to return to their normal lives and activities. Physical therapy is a vital part of the rehabilitation team that can address the diverse and complex needs of COVID-19 patients. The article discusses the importance and challenges of restoring functional independence for COVID-19 patients, who may suffer from various impairments and limitations due to the infection.

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