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**Effects of Respiratory Therapy and Physical Rehabilitation in a Reduction of Length of ICU Stay among Covid-19 Patients – A Narrative Review**

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**Abstract**

**Purpose:**

The purpose is to determine the effect of both Respiratory Therapy and Physical Rehabilitation in a reduction of length of ICU stay among COVID-19 patients.

**Materials and Methods:**

A narrative review of the literature was performed by reviewing 61 articles with actual content based on inclusion/exclusion criteria. The articles were searched using various electronic databases like PubMed, Pedro, APTA, WHO, WCPT, Medscape, Scholar, Research-gate. The search strategy included RCTs, cross-sectional study and cohort study.

**Results:**

We identified a total of 82 articles from the various electronic database. Among them, 61 articles were shortlisted with actual content-based. The study reported physical rehabilitation and respiratory therapy has improved the physical functioning of ICU patients and has benefitted in respiratory care by enhancing airway clearance and decreased the likelihood of developing ICU associated weakness and leads to reducing the length of ICU stay of COVID-19 patients.

**Conclusion:**

This study concluded that both Respiratory therapy and Physical rehabilitation showed a greater effect in reducing the length of ICU stay among COVID-19 patients by reducing the ICU associated complications and enhancing the QOL of patients also has reduced the length of ICU

stay by 1.4-2.7 days among COVID-19 patients by improving function and decreasing ICU associated complications.

**Keywords:** COVID-19 critical illness, COVID-19 patients ICU acquired weakness, ICU patient Physical rehabilitation, COVID-19 Patients care, ICU physiotherapy, Respiratory therapy.

### **1. Introduction:**

Severe acute respiratory syndrome coronavirus 2 is a new coronavirus that emerged in 2019 and causes COVID-19. (Del Rio C et al 2020, Sohrabi C et al 2020, Guan WJ 2020). This contagious virus is transmitted from one person to another through respiratory secretions. The droplets from coughing, sneezing or rhinorrhoea land on surfaces within 2 meters of the infected person. SARS-CoV-2 remains viable for at least 24 hours on hard surfaces and up to 8hours on soft surfaces. (Van Doremalen N et al 2020).

The World Health Organization emergency medical team recommended that rehabilitation is a core component of patients centre care. Rehabilitation providers must develop plans to receive a large number of patients from acute care facilities, directly from the ICU. ( McNeary L et al 2020, WHO 2016)

Rehabilitation professionals play an important role in speeding up the recovery of those survivors who are admitted to ICU. (Grabowski DC et al 2020). Patients who are admitted to ICU are initially prescribed bed rest, however, causes inactivity and immobility that may lead to significant ICU-related weakness including critical illness polyneuropathy and myopathy report in almost 48%-96% respectively. (Herridge MS et al 2020, Stevens RD et al 2007)

Other physical sequelae of ICU stay causes:

-cardiorespiratory deconditioning, postural instability, venous thrombo-embolism in approximately 23% of patients. (Klok FA et al 2020), muscle shortening and contracture, pressure injuries (Zorowitz RD et al 2020), Ventilator-associated pneumonia in about 19% of ICU patients. (A. Schauwvlieghe et al 2020), Hypoxic Respiratory Failure in about 16% of patients.

A study stated that providing physiotherapy services to the admitted patients with confirmed Covid-19 in ICU helps patients being early discharge into wards (Guan W.J et al 2020). Physiotherapy is beneficial in respiratory treatment as well as in the physical treatment of patients with COVID-19. In particular, Cardiorespiratory Physiotherapy focuses on the management of both acute and chronic respiratory conditions and aims to improve physical recovery following an ICU illness. Those Physiotherapists who practice in the ICU environment provides an airway clearance technique (percussion, vibration, autogenic drainage, FET) for mechanically ventilated patients who show signs of inadequate airway clearance and they assist patients in positioning with severe respiratory failure associated with COVID-19, which includes the use of prone position to optimize oxygenation. (Kress J.P et al 2014, Stiller K et al 2020)

Early Active and Passive mobilization in the ICU has been an important part of Physical therapy to promoting and optimizing functional independence in activities of daily living as well as to diminish the long ICU stay of patients. Early Active/Passive mobilization is associated with improved muscle strength, better mobility status and improves circulation in the body. (SIMFER guidelines 2020, Tipping CJ et al 2017). The Surveys of physiotherapists from European and Australian ICUs reported that Primary responsibility was to perform respiratory therapy includes airway suctioning, postural drainage (PD), and weaning from mechanical ventilation (MV) (Chaboyer W et al 2004, Norrenberg M et al 2020). Physiotherapy initiated in ICU improves functional status up to one year after discharge from the ICU and can reduce mortality by 25%. (Tomasi CD et al 2020, Wild. D et al 2011).

The purpose of the study is to determine the effect of Physiotherapy Interventions particularly Respiratory Therapy and Physical Rehabilitation on the reduction of length of ICU stay among COVID-19 patients. The study aims to evaluate the effect of Respiratory Therapy and Physical rehabilitation to reduce the length of ICU stay among Covid-19 patients.

**Review of literature:**

Respiratory therapy is defined as chest physical therapy which is used to mobilize or lose secretions in the lungs and respiratory tract and helps to drain the lungs and keep respiratory muscle to function properly. (Maximilian S et al, 2008) Respiratory physiotherapy involves external mechanical techniques, such as percussion, postural drainage, mechanical vibration, to augment mobilization and airway clearance secretions, inspiratory muscle training, diaphragmatic breathing with pursed-lip breathing, coughing and controlled coughing. (Maximilian S et al, 2008).

Physical rehabilitation is a multidisciplinary approach focus on early rehabilitation improves physical function neuro-muscular weakness and enhances the quality of life. (Kayambu G et al. 2013). Physical rehabilitation involves an active and passive range of exercises, muscle strengthening, upper limb and lower limb strengthening, ambulation. (Li Z et al, 2013).

All over the world, more than 5 million cases have been confirmed and 400, 000 deaths were reported by the World Health Organization (WHO) as of June 9, 2020. The American region has been shown for the highest number of cases and deaths which was more than 3 million and 200,000 respectively. The European region has been shown for the second-highest confirmed cases and death which were more than 2 million confirmed cases and 183 thousand deaths. The confirmed total number of cases and death in the Eastern Mediterranean region accounted for approximately 660, 000, and 15,000 respectively. (WHO, Report 2020).

The Meta-Analysis was performed to the pooled prevalence of mortality in patients with coronavirus disease in ICU without giving proper care. The 646 articles were identified from different electronic databases and 50 articles were selected for evaluation. Thirty-seven Articles with 24983 participants were included. The Meta-Analysis showed that the prevalence of mortality among ICU admitted patients with Coronavirus was 39%. The analysis of the pooled prevalence of mortality among ICU admitted patients with COVID-19 showed that the

prevalence of ICU mortality among patients with severe acute respiratory syndrome (SARS-CoV-2) was 31% (95% CI: 26 to 36). (Abate et al, 2020; Ahmed Ali et al, 2020).

Respiratory Intervention like Postural drainage, breathing exercises techniques and secretion clearance techniques are potentially aerosol-generating procedures. (SIMFER guidelines, 2020), Mobilization, Passive and active range of motion should be considered to be important as it leads to coughing or expectoration of secretions. (SIMFER guidelines, 2020, Xie J et al, 2020).

- Physiotherapy in the ICU improves patients' physical wellbeing and quality of Life (QOL): (Dionne F et al, 2012)
- Early mobilization results in decreased length of stay (LOS) in ICU and decreased overall hospital stay. (Morris PE et al 2020).
- Those physiotherapists who are constantly treating patients in the ICU enhance in building a relationship with patients. Also, it has a significant impact on the patient and provide satisfaction. (Dionne F et al, 2012)
- It has already been stated that physical therapy in ICU prevents ICU-related complications, improving bodily functions and enhance QOL. (Dionne F et al 2012, Morris PE et al 2020).

## **2. Materials and Methods:**

A narrative review of the literature was performed in which a structured Literature search was done using various Electronic databases like PubMed, Pedro, American physical therapy Association(APTA), World health organization(WHO), World confederation Physical therapy(WCPT), Medscape, Scholar, Research-gate Embase. The search strategy included Clinical trials, randomized controlled trials and cross-sectional study and cohort study. The searching for articles was limited to English literature only.

The search was done by using the following key terms such as; COVID-19 critical illness, COVID-19 patient's ICU acquired weakness, ICU patient Physical rehabilitation, COVID-19 Patients care, ICU physiotherapy, exercise therapy, functional training, the activity of daily living, motor activity, early mobilization, Respiratory therapy, decreased ICU stay, breathing technique.

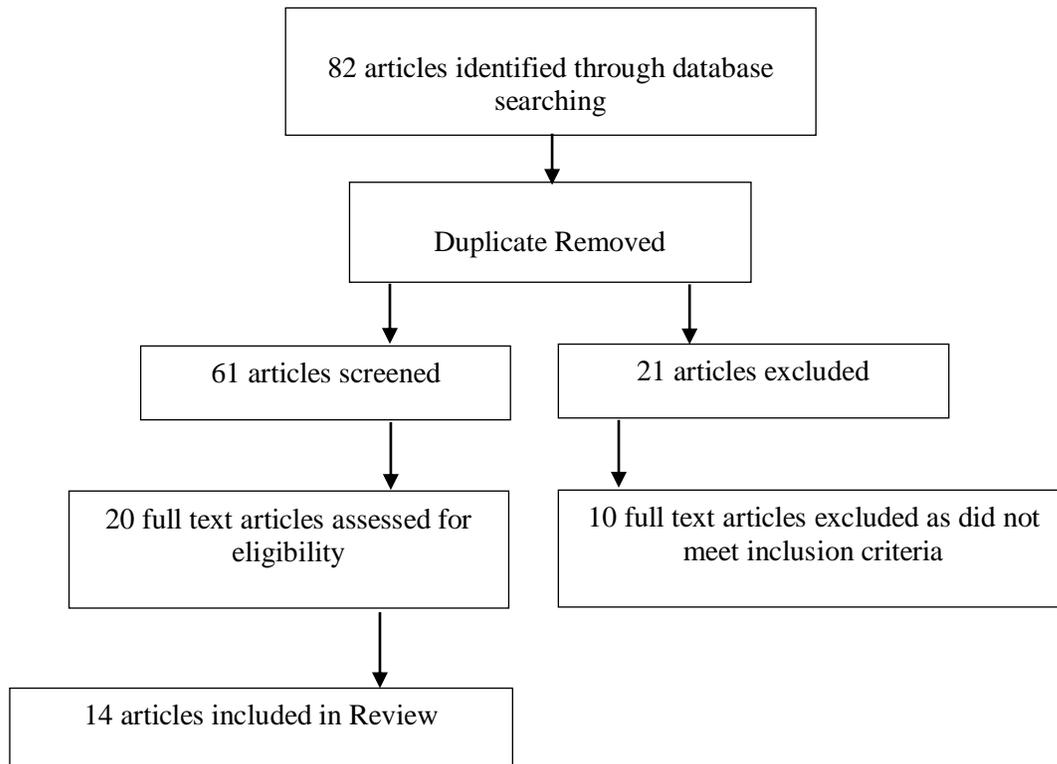
The articles were allocated based on inclusion and exclusion criteria:

**a. Inclusion criteria** Include studies with COVID-19 patients who were admitted in an intensive care unit (ICU); Articles regarding PT intervention particularly respiratory therapy and physical rehabilitation in ICU among COVID-19 patients; Articles regarding the importance of PT intervention in enhancing the Respiratory care and physical function and decreasing the length of ICU stay.

**b. Exclusion criteria** involve Exclusion of articles regarding patients admitted in ICU with neurological conditions such as stroke, Spinal cord injuries; Studies in which patients were not

admitted in ICU as well as hasn't received any role of Physiotherapy intervention among ICU patients.

The Review have done according to PRISMA



### 3. Results:

We identified a total of 82 articles from the various electronic database. Concerning physical therapy intervention i.e., physical rehabilitation and respiratory therapy, 61 articles were shortlisted with actual content based on Inclusion and exclusion criteria. The study reported both physical therapy intervention decreased the likelihood of developing ICU associated weakness therefore reduces the length of ICU stay of COVID-19 patients.

#### 3.1 Respiratory Physiotherapy:

It is defined as chest physical therapy which is used to mobilize or lose secretions in the lungs and respiratory tract and helps to drain the lungs and keep respiratory muscle to function properly. (Maximilian S et al, 2008).

Respiratory physiotherapy consists of external mechanical manoeuvres, such as percussions, postural drainage(PD), vibration, to augment mobilization and clearance of airway secretions, Inspiratory muscle training(IMT), diaphragmatic breathing with pursed-lip breathing, coughing and controlled coughing. (Maximilian S et al, 2008).

### **3.2 Physical Rehabilitation:**

It is a multidisciplinary approach focus on early rehabilitation to improve physical function neuro-muscular weakness and enhance the quality of life. (Kayambu G et al. 2013).

It involves an active and passive range of exercises, muscle strengthening, upper limb and lower limb strengthening, ambulation. (Li Z et al, 2013).

### **3.3 ICU based Rehabilitation:**

It is associated with early achievement of mobility milestone and improves muscle strength in relation to respiratory and limb strength. (Li Z et al.2013).

Additionally, an early rehabilitation program in ICU leads to reduced hospital and ICU length of stay, duration of mechanical ventilation and improves the quality of life.

(Needham DM et al. 2008).

### **3.4 Physiotherapy Management Categories in ICU patients with COVID-19:**

#### **Category A: Ventilated, Sedated patients-**

Includes patients who are critically ill, sedated, paralyzed and maybe in a prone position. The main goals of Physiotherapy intervention at this stage are:

- To minimize complications of the prolonged recumbent position.
- To facilitate oxygenation.

The physiotherapy management includes passive Range of Motion exercises and Therapeutic positioning. (SIMFER guidelines,2020).

#### **Category B: Ventilated-minimally sedated patients-**

Design an intervention based on patients conscious level, level of cooperation. The main goals of physiotherapy intervention at this stage are:

- To minimize complications of the prolonged recumbent position.
- To facilitate oxygenation.
- To improve functional independence.

The physiotherapy Management may include; Therapeutic positioning, Range of Motion(ROM) exercises and progressive mobilization. (SIMFER guidelines, 2020, Kallet RH et al 2020).

#### **Category C: Non-Mechanically ventilated patients:**

These patients are divided into 3 categories depending on a conscious level, and functional independence. The main goals of Physiotherapy interventions are:

- To reduce the work of breathing
- To improve lung capacity
- To facilitate oxygenation
- To improve functional capacity (Xie J et al, 2020)

**C1- Minimally Conscious & bedridden patients:**

Physiotherapy intervention may include Passive ROM exercises and therapeutic positioning. (Xie J et al 2020).

**C2- Conscious, Active and dependent patients:**

Physiotherapy intervention may include ROM exercises, Progressive strengthening exercises, progressive mobilization and exercises to improve coordination and balance. Treatment should be design on the patient's oxygen dependency, muscle power and functional independency to optimize functional capacity and promote independence. ((Xie j et al 2020).

**C3- Conscious, Active and independent patients:**

Physiotherapy intervention may include ROM exercises, progressive ambulation and breathing exercises. And exercise program should base on the patient's endurance. (Xie J et al, 2020).

**3.5 Therapeutic Evidence-based practice of Respiratory as well as Physical Intervention in ICU includes:**

- Respiratory Intervention like Postural drainage, Breathing exercises techniques and secretion clearance techniques are potentially aerosol-generating procedures. ( SIMFER guidelines, 2020)
- Mobilization should be considered to be important as it leads to coughing or expectoration of secretions. (SIMFER guidelines, 2020, Xie J et al, 2020))
- Passive and Active Range of Motion Exercises. ( Xie J et al, 2020))

**3.6 Benefits of Physiotherapy intervention (Respiratory Therapy and Physical rehabilitation) on patients experience in ICU:**

- Physiotherapy in the ICU improves patients physical wellbeing <sup>QOL</sup>. (Dionne F et al,2012).
- Early mobilization results in decreased length of stay( LOS) in ICU and decreased overall hospital stay. (Morris PE et al 2020 ).
- Consistency of physiotherapist treating patients in the ICU promotes relationship building and has a significant impact on patients and provider satisfaction. (Dionne F et al,2012)
- Physiotherapy in the ICU prevents ICU-related complications, improving functions and QOL. (Dionne F et al 2012, Morris PE et al 2020).

**4. Discussion:**

The findings from this study stated that early physiotherapy interventions (active mobilization, IMT) in the ICU has numerous benefits. Although positioning is used routinely and has its effects on the pulmonary system. To facilitate weaning, Early active mobilization and Inspiratory muscle training (IMT) needs to be administered early in the ICU. Administration of these physiotherapy techniques will facilitate weaning from mechanical ventilation. We identified that respiratory care and physical rehabilitation plays a vital role in decreasing the Length of ICU stay among COVID-19 patients by improving physical functioning and respiratory care.

In the study done in the U.S.A, the majority of physiotherapy (73.2%) required in ICU to treat critically ill patients with confirmed COVID-19. In this study, the evidence for ICU PT intervention suggested that positioning, Mobilization, Manual hyperinflation, percussion and vibrations, suctioning exercises, Active cycle of breathing techniques, Range of motion exercises play the main role fulfilled by the ICU physiotherapists. (Ntoumenopoulos G et al 2020).

In another study done in Australia, it is concluded that patients received routine chest PT, 55% stated every 4 h. The efficacy of “chest Physiotherapy,” defined as combinations of patients positioning, manual hyperinflation and percussion/vibrations, on short-term patient physiological outcomes has been studied earlier extensively. There is strong evidence to suggest that Physiotherapy treatment found to be extremely effective in recruiting alveoli, enhance secretion clearance, compliance, airway resistance, gas exchange, and reducing the incidence of ventilator acquired pneumonia (VAP) in ICU patients. Therefore, by preventing these ICU related complicated, there was a reduction in the length of ICU stay of about 1.6- 2.0 days (WHO 2020).

## **5. CONCLUSION:**

This review of literature has concluded that Physiotherapy interventions particularly Respiratory therapy and Physical rehabilitation showed a greater effect in reducing the length of ICU stay among COVID-19 patients by reducing the ICU associated complications and enhancing the quality of life (QOL) of patients.

The early mobilization and respiratory therapy were associated with a greater likelihood of being discharged onto wards from ICU.

The most evident reason for requiring intensive care has been Respiratory support. It is also concluded from several studies that Physiotherapy intervention has reduced ICU length of stay (LOS) by 1.4-2.7 days among COVID-19 patients by improving function and reducing the number of complications associated with an ICU.

## **Future research Recommendation**

The future recommendation can be to determine the efficacy of PT intervention in maintaining the long-term physical function after hospital discharge or To determine to what extent the ICU non-COVID-19 patients are at risk for prolonged respiratory, physical and functional limitations in need of rehabilitation.

## **Ethics approval and consent to participate**

Not applicable.

## **Availability of data and materials**

All data, a total of 61 studies, were analyzed during this study.

## **Funding**

This research has not received any specific grant from funding companies.

**Abbreviations:**

ICU- Intensive Care Unit

APTA- American Physical Therapy Association

WCPT- World Confederation for Physical Therapy

WHO- World Health Organization

QOL- Quality of Life

LOS- Length of Stay

ROM-Range of Motion

IMT- Inspiratory Muscle Training

SARS-Severe acute respiratory syndrome

CoV2 -coronavirus 2

FET- Forced Expiration Technique

PT- Physiotherapy

VAP- Ventilator acquired pneumonia

RMST-Respiratory muscle strength training

TEE-Thoracic expansion exercises

ADLs-Activities of daily living

MV- mechanical ventilation

PD- postural drainage

MDT- Multidisciplinary team

ICUAW-Intensive care unit acquired weakness

**Table 1**  
Characteristics of the included studies.

<b>Author</b>	<b>Study title</b>	<b>Intervention</b>	<b>Design</b>	<b>Summary Of relevant findings</b>
Tran DH et al 2020	Ambulatory Status is associated with successful Discharge home in survivors of Critical Illness from COVID-19	Early Mobilization in ICU patient	A retrospective cohort study	The study concluded that ambulating the patients have shown a higher possibility of being early discharged of Covid-19 patients from ICU, emphasizing the importance of early mobilization in ICU.
Tomas CD et al 2010	The beneficial effect of respiratory physiotherapy in ICU patients ventilated for more than 48 hours	Respiratory physiotherapy & mobilization	a randomized controlled trial	The study has shown that physiotherapy intervention in critical care has helped reduce the mortality rate by 25%, prevents ICU related complications and reduced the patient's stay in ICU as well as an overall hospital stay.
Hodgson C. L. et al 2014	Recommendations for active mobilization of mechanically ventilated critically ill adults	Early mobilization & limb physiotherapy	systemic literature review	The study stated that the recommendations of early mobilization in mechanically ventilated patients have the potential to minimize the risk of adverse effects associated with ICU and in turn improve the functional outcomes and reduced ICU and hospital length of stay.
Enrique et al 2013	Interventions to Improve the Physical Function of ICU Survivor	Physical rehab (exercises)	a systemic review of literature	The study concluded that early Exercises by Physiotherapists seems to be the only treatment shown to improve long-term physical functions of critically ill patients in ICU
Baidya et al 2016	Physiotherapy practice interventions in Intensive Care Units of Nepal	Chest physiotherapy	a cross-sectional study	The study concluded that the most common and effective type of Physiotherapy treatment performed on critically ill patients in ICU is Chest PT (53.8%) and positioning (21.2%)
Hosey	Survivorship	Evidence-	A	The study concluded that critically ill

, M.M et al 2020	after the COVID-19 ICU stay	based critical care intervention, prone-positioning, physical rehabilitation, early mobilization	randomized controlled trial	patients with COVID-19 will face physical and respiratory impairments. To optimize both survival and survivorship of critically ill patients in ICU, Evidence-based critical care interventions are required to deliver that includes prone-positioning, physical rehabilitation, early mobilization to reduce muscle weakness and duration of mechanical ventilation.
Simpson, R et al 2020	Rehabilitation after critical illness in patients with COVID-19 infection	Functional training & respiratory rehab.	a randomized controlled trial	The study concluded that Rehabilitation professionals will have a critical role in assisting patients from ICU associated illness, helps to optimize independent function, facilitate community re-integration and managing respiratory care.
Katherine E et al 2009	Physical therapy Utilization in Intensive care units (ICU) among critically Ill patients	therapeutic exercises and functional retraining & chronic physical therapy	a cross-sectional study	It is concluded that therapeutic exercises and functional retraining are commonly used for ICU patients recovering from critical illness and Based on the results of this study, a European Respiratory Society and European Society of Intensive Care Medicine Task Force concluded that there was expert opinion evidence regarding the effectiveness of long term or chronic physical therapy for critically ill adults.
Anup Bhat et al 2017	Role of physiotherapy in weaning of patients from mechanical ventilation in the Intensive Care Unit	Respiratory physiotherapy & early mobilization & Inspiratory muscle training	a randomized controlled trial	concluded that early initiation of physiotherapy through Early mobilization and Inspiratory muscle training (IMT) facilitates faster weaning of patients from ventilators and also decreased length of stay in ICU and the clinical benefits observed with early physiotherapy suggest the need to implement early physiotherapy to all critically ill patients admitted to the ICU
Dr Vittoria et al 2019	Respiratory physiotherapy in critically ill patients	Respiratory rehabilitation & physical function	Review of literature	They stated that the survival rate of patients with life-threatening conditions who are admitted to an ICU has significantly increased through physiotherapy And respiratory rehabilitation has become a cornerstone in the comprehensive

		rehabilitation.		management of ICU- patients that determine short-term benefits, preventing some ICU complications, such as PICS and ICUAW, and preserving or recovering patients' functionality. The strategies of intervention should be applied in the early stage of illness, as soon as the patient gets cardiorespiratory and neurological stabilization.
Bastian Meijer et al 2020	Recommendations for Physiotherapy intervention in COVID-19 for ICU patient	Early mobilization & physical function rehab.	a cross-sectional study	They concluded that there is increasing evidence that reducing bed rest and inactivity as much as possible by early mobilization in the chair and activation in the ICU, are promising PT interventions to prevent and reduce the consequences of bed rest, inactivity and critical illness and improves patients health in ICU
Karim M et al 2020	Recommendations for Hospital-Based Physical Therapists Managing Patients With COVID-19	Breathing exercises, ACBT, Respiratory muscle strength training, Mobility training.	review of literature	They concluded that when patients are critically ill and admitted to the ICU, and when patients are severely ill and admitted to the COVID ward. Physical therapist management for patients hospitalized with COVID-19 comprises elements of respiratory support and early mobilization. Respiratory support includes breathing techniques, thoracic expansion exercises(TEE), airway clearance techniques, and respiratory muscle strength training(SMST). The Recommendations toward Early mobilization include activities of bed mobility, active range of motion(ROM) exercises, active-assisted limb exercises, ADLs training, transfer training, cycling ergometer, pre-gait exercises, and ambulation
MS Ajims ha et al 2020	Acute Care Physiotherapy Management of COVID-19 Patients in Qatar: Consensus-	Early mobilization, pulmonary rehabilitation, physical	a randomized controlled trial	The study concluded that the rates of admission to an ICU are approximately 18-25% with critical illness and Physiotherapist are considered as an integral part of multidisciplinary team (MDT) of ICU and other critical wards. They focus on the early mobilization of critically ill patients along

	Based Recommendations	rehabilitation.		with their vital role in pulmonary hygiene. Physiotherapy found to be beneficial in the respiratory treatment and physical functional rehabilitation of patients with COVID-19 positive along with its proven role to prevent or delay ICU acquired weakness, delirium(confusion) and other complications arise from immobility induced from prolonged ventilation.
Anew DE et al 2020	Early rehabilitation reduces the likelihood of developing intensive care unit-acquired weakness	Early mobilization & physical rehabilitation	A randomized controlled trial	The study concluded that Early rehabilitation to ICU patients has decreased the likelihood of developing ICU associated weakness however reduced the prolonged ICU stay

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