

## Physical Conditioning in Patients with COVID-19 during Hospital In-Ward and ICU Stay

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### Abstract

Since December 2019, there has been talked of the COVID-19 disease, caused by coronavirus type 2 (SARS-Cov 2), within the scientific evidence released, those that most interested us as a group of clinical sports medicine were the severe respiratory compromise and physical deconditioning that these patients present, we want to share the hospital pulmonary rehabilitation protocol (phase I) that we use in these patients through the use of technological aids and evaluate the impact of pulmonary rehabilitation therapy in patients hospitalized with suspected severe acute respiratory syndrome - coronavirus type 2 (SARS-Cov 2).

The intervention through pulmonary rehabilitation therapy and physical conditioning in this pathology is of great importance for an adequate clinical evolution.

**Keywords:** COVID-19; Hospital In-Ward; ICU Stay

### Justification

In December 2019 in a province of China, Wuhan, an outbreak of pneumonia of unknown origin began in the Hunan seafood market, with more than 50 people [1], in January 2020 the virus was isolated as a new coronavirus  $\beta$  group member named as SARS-CoV-2 (Coronavirus of Severe or Acute Respiratory Syndrome 2) and the disease as COVID 19 (Coronavirus Disease 2019, COVID-19), this virus came along with a higher transmission rate Compared to the SARS CoV of 2003, perhaps due to a genetic recombination event in the S protein in the RBD region of SARS CoV-2 [2]. On March 11<sup>th</sup>, 2020, the WHO declares COVID-19 as a pandemic. On March 6<sup>th</sup>, 2020, the first case of SARS CoV-2 infection in Colombia was confirmed in the city of Bogotá in a woman coming from Italy [4].

Currently, as per the date of this review, there are 110.000.000 confirmed cases 62.100.000 recovered, 2.440.000 death in the world in 250 affected countries.

In Colombia, according to the National Institute of Health (INS), there are 2.210.000 confirmed cases 2.110.000 recovered, 58.338 deaths [3].

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COVID-19 is a disease caused by Sars-Cov-2. Which is transmitted by drops, entering through the mucous membranes. The access routes described are the eyes, nasal mucosa and mouth. Significant pulmonary, cardiovascular, hypercoagulability involvement; neuropathies, and physical deconditioning along with myositis and sarcopenia have been seen in the course of the disease, which are established more quickly during hospitalization.

The incubation period is generally 3 to 7 days, with the longest period not exceeding 14 days. The main manifestations are fever, fatigue and a dry cough. A small number of patients are accompanied by nasal congestion, runny nose, diarrhea, and other symptoms [1].

In the city of Bogotá, Hospital de San José since March 2020 began to receive in its facilities patients suspected of COVID-19 which have required multidisciplinary in-hospital management.

### Purpose of the Study

Safely propose physical conditioning sessions for patients hospitalized at the Hospital de San José with a diagnosis of COVID-19 using PPE technologies, with which it is reduced by more than 98% contact with the patient.

### Scope

This guide applies to all hospitalized patients at the Hospital de San Jose regardless of sex and age, it is part of the Program for the development of evidence-based Clinical Practice Guidelines to aid in clinical decision-making with pathologies associated with COVID-19.

### Definition

Taking into account the “coronavirus management protocol HSJ V10 29 March” we establish our definitions.

#### Criteria case 1

Based on the national definition for the event Acute Respiratory Infection or Serious Acute Respiratory Infection - SARI (Code 348), the following definition is specified for intensified surveillance:

- Probable case 1: Patient with a quantified fever greater than or equal to 38°C and cough, with a picture of severe acute respiratory infection that develops an unusual or unexpected clinical course, especially a sudden deterioration despite adequate treatment, which, does require hospitalization (unusual SARI - Code 348) and meets at least one of the following conditions:
- History of travel to areas with circulation of cases of the new coronavirus disease 2019 (COVID-19) in the 14 days prior to the onset of symptoms. (See table published on the INS microsite: <http://www.ins.gov.co/Noticias/Paginas/Coronavirus.aspx>).
- Health worker or other hospital personnel who have had close contact \* with a confirmed case of novel coronavirus disease (COVID-19).
- History of close contact \* in the last 14 days with a confirmed case of severe acute respiratory infection associated with the 2019 novel coronavirus (COVID-19).

To clear out the afebrile state of the person, ask if they are taking anti-inflammatory drugs or acetaminophen.

### Criteria case 2

Person with acute respiratory infection syndromic picture - ARI - mild or moderate that DOES NOT require hospitalization (ARI due to new virus - Code 346) and who meets at least one of the following conditions:

- History of travel to areas with circulation of cases of the new coronavirus disease 2019 (COVID-19) in the 14 days prior to the onset of symptoms. See table published on the INS website. <http://www.ins.gov.co/Noticias/Paginas/Coronavirus.aspx>.
- Healthcare worker or other hospital personnel who have had close contact \* with a confirmed case of novel coronavirus disease (COVID-19).
- History of close contact in the last 14 days with a confirmed case of severe acute respiratory infection associated with the 2019 novel coronavirus (COVID-19).

**And that meets at least one of the following symptoms:**

- Fever quantified greater than or equal to 38°C
- Cough,
- Shortness of breath,
- Odynophagia,
- Fatigue/dynamic.

To clear out the afebrile state of the person, ask if they are taking anti-inflammatory drugs or acetaminophen.

### Criteria case 3

Case of intensified surveillance for SARI:

- Person with acute respiratory infection with a history of fever and cough no more than 10 days old, requiring in-ward hospital management.

The cases of this strategy must be notified in the "SARI-345" file by epidemiology when applicable. The cases that have a history of travel or contact with a confirmed case for COVID-19 or occupational exposure, corresponds to what is written for cases 1 or 2.

Explanatory note from hospital San Jose: For practical purposes, all patients with fever and respiratory symptoms will enter intensified surveillance. This type of patient does not have any of the factors for the epidemiological nexus of COVID-19 (such as cases 1 and 2), but what is intended is to start with the surveillance of possible autochthonous circulation of the virus. In this type of patients, form 345 is filled out, samples are taken for COVID-19, respiratory panel (hospitalized patient) or Film Array (patient in ICU) and drop isolation and contact and air are started in case of procedures that generate aerosols.

It is the responsibility of the services where each patient is hospitalized to verify that the patient meets the definition of a probable case. In the event that it is considered that it does not meet the case definition, the Infections Committee (Adult Services) or Epidemiology (Pediatrics and Gynecology) should be contacted for a third review. If it definitely does not meet the case definition, a clarifying note should be written in the medical record and the order for sample processing for INS, Rapid Respiratory Panel order, and Film Array should be eliminated.

### Criteria case 4

Probable death from COVID-19:

- All deaths from severe acute respiratory infection with a clinical picture of unknown etiology. The cases of this strategy must be notified in the “SARI-348” file.
- In death of a child under 5 years of age:
- If you have positive ante-mortem tests for SARS-CoV-2, NO necropsy or post-mortem sampling is performed. If the test for SARS-CoV-2 was negative or in progress, a necropsy must be performed within 6 hours of death and post-mortem samples taken from the tracheal aspirate and obtained respiratory tissue sections.
- In patients over 5 years of age in whom ante-mortem samples were not taken, a post-mortem tracheal aspirate sample can be taken in the first 6 hours.

### Criteria case 5

Asymptomatic:

- Close contact of a confirmed COVID-19 case that has not manifested symptoms in the first 7 days after the last unprotected exposure.
- The cases of this strategy must be registered in the format “Follow-up to contacts of positive COVID-19 cases” which, for the cases of health workers and residents, must be filled out by the leader of each assistance service that was in contact with the patient and subsequently sent for the proper epidemiological follow-up. This format is attached to the notification of cases 346 and 348.

### The close contact of a probable or confirmed case of COVID-19 is defined as:

- Community close contact: any person, with unprotected exposure†, who has shared in a space less than two meters and for more than 15 minutes with a person with a confirmed diagnosis of COVID-19 during their symptomatic period (this can include people who live together, work, visitors to place of residence); also having been in contact without adequate protection with infectious secretions (for example: secretions or respiratory fluids or the manipulation of used tissues). Note that short-term, eye contact, or casual interactions are NOT considered close contact.
- On airplanes or other means of transportation, close contact is considered to be the crew who had unprotected contact or exposure† with a person with a confirmed diagnosis of COVID-19 (flight attendants) and the passengers within a two-seat radius around the case that had unprotected contact or exposure.
- Examples of unprotected exposure: exposure to confirmed case cough without respiratory protection, inadequate hand hygiene after direct contact with respiratory secretions.
- Close contact of health personnel: Any worker in the hospital or outpatient setting with unprotected exposure: o IF: the health worker did not use a N95 respirator during the care of the confirmed case of COVID-19 in procedures that generate aerosols (for

example: cardiopulmonary resuscitation, intubation, extubation, bronchoscope, endoscopy, nebulizer therapy, sputum induction, procedures that stimulate the cough reflex). or Hospital worker provided clinical care (physical examination, collection of samples, intubation, aspiration of secretions, etc.) or user care (administrative staff) to confirmed COVID-19 patients and did not use full personal protection items and properly. or Healthcare personnel exposures also include contact within two meters for more than 15 minutes with a COVID-19 case or had face contact with potentially infectious COVID-19 material and did not use full personal protective equipment and adequately.

### Physical condition

It is defined as physical fitness, it is the state of a person after integrating 5 parameters, aerobic capacity, muscular strength, flexibility, balance and body composition. Which is maintained or improved with healthy habits, which include regular exercise, a balanced diet and stress management. Each of these parameters is qualifiable, varies according to sex, age and health conditions.

### Physical deconditioning

It is defined as a deficit in physical condition greater than 10%, once the physical condition is estimated in the 5 parameters, the diagnosis of physical deconditioning is made.

In clinical settings, it is calculated with the exercise tolerance test, it can be related to residual functional capacity, that is, different scales are used for patients with some pathologies than for the general population. The intervention code will be that of kinetic modalities of therapy.

### Physical activity

It is defined as any voluntary movement derived from a muscular contraction and that requires energy expenditure. It is equivalent to activities of daily life such as personal care, housework, walking, going up or down stairs, moving, occupational or work activities and leisure time activities. It is usually related to an approximate energy expenditure of 2 or 3 metabolic equivalents (METs) that doubles or triples the energy expenditure of rest or sitting called "Basal Metabolic Rate" and corresponds to 1 MET or an oxygen consumption of 3.5 mlO<sub>2</sub>/Kg/min or 1 Calorie/Kg/h.

### Exercise

It is a type of planned, systematic or routine physical activity whose objective is to improve physical condition or health. Therapeutic exercise or different rehabilitation training strategies are included. It is carried out in rehabilitation units, physical conditioning centers, gyms, at home, parks, schools and sports facilities under special plans somehow recommended by cardiologists, physiatrists, Sports Medicine Physicians, among others and prescribed by Sports Medicine Physicians and in some countries Clinical Exercise Physiologist and assisted, directed and controlled, by coaches professionals (physical and occupational therapists, nurses, graduates among others).

### Target population

Case 1 - That requires hospital management.

Confirmed cases of SARS CoV-2 infection, symptomatic, requiring in-hospital management.

## Classified according to ICD-10

ICD-10 code three characters	Description of three-character codes	ICD-10 code four characters	Four-character code description
J12	Viral Pneumonia, Not Classified Elsewhere	J128	Pneumonia due to other viruses
J12	Viral Pneumonia, Not Elsewhere Classified	J129	Viral pneumonia, unspecified
J16	Pneumonia due to other infectious microorganisms, not classified elsewhere	J168	Pneumonia due to other specified infectious organisms
J17	Pneumonia in Diseases Classified Elsewhere	J171	Pneumonia in viral diseases classified elsewhere
J17	Pneumonia in Diseases Classified Elsewhere	J178	Pneumonia in other diseases classified elsewhere
J18	Pneumonia, Unspecified Organism	J180	Bronchopneumonia, unspecified
J18	Pneumonia, Unspecified Organism	J181	Lobar pneumonia, unspecified
J18	Pneumonia, Unspecified Organism	J182	Hypostatic pneumonia, unspecified
J18	Pneumonia, Unspecified Organism	J188	Other pneumonia, of unspecified organism
J18	Pneumonia, Unspecified Organism	J189	Pneumonia, unspecified
J22	Acute Unspecified Infection of The Lower Respiratory Tracts	J22X	Acute infection of the lower respiratory tract, unspecified
J80	Adult Respiratory Distress Syndrome	J80X	Adult respiratory distress syndrome
J84	Other Lung Diseases Intersticiales	J840	Alveolar disorders
J84	Other Interstitial Lung Diseases	J841	Other interstitial lung diseases with fibrosis
J84	Other Interstitial Lung Diseases	J848	Other specified interstitial lung diseases
J84	Other Interstitial Lung Diseases	J849	Interstitial lung disease, unspecified
J96	Respiratory Failure Not Classified Elsewhere	J960	Severe respiratory insufficiency
J96	Respiratory Failure Not Classified Elsewhere	J961	Chronic respiratory failure
J96	Respiratory Failure Not Classified Elsewhere	J969	Respiratory failure, unspecified
J98	Other Respiratory Disorders	J981	Lung collapse
J98	Other Respiratory Disorders	J984	Other lung disorders
J98	Other Respiratory Disorders	J988	Other specified respiratory disorders
J98	Other Respiratory Disorders	J989	Respiratory disorder, unspecified
J99	Respiratory Disorders in Diseases Classified Elsewhere	J991	Respiratory disorders in other diffuse connective tissue disorders
J99	Respiratory Disorders in Diseases Classified Elsewhere	J998	Respiratory disorders in other diseases classified elsewhere
R91	Abnormal Findings in Lung Diagnostic Imaging	R91X	Abnormal findings on lung imaging
U04	Severe Acute Respiratory Syndrome [SARS]	U049	Severe acute respiratory syndrome [SARS], unspecified
U07	COVID 19	U071	COVID 19, confirmed
U07	COVID 19	U072	COVID 19, not confirmed

Table 1

### Classification and identification of evidence

Following the recommendations established in the GATISO-ASMA Guidelines of the Ministry of Social Protection published in 2007, adapted according to the guidelines for the classification of evidence proposed by the Scottish Intercollegiate Guidelines Network (SIGN) and the U.S. Preventive Task Force. We perform the following classification of the evidence [3]. A systematic review of the literature was carried out with Mesh criteria rehabilitation, exercise and COVID-19. Published from December 2019 to April 15, 2020. We found 20 articles of which intervention protocols only mentioned them in 4 articles.

Most of the literature comes from China, although we also took into account Italian and Spanish studies. For practical purposes, the classification in this guide includes clinical studies whose hierarchy level is classified as level 3.2, 3.3 and 4.

With grades of recommendation B and C.

### Interpretation of evidence

Evidence	Level of evidence - Grade of recommendation
Gear for mobilizations and therapeutic exercise: the use of this in patients with COVID19 must be carefully considered and be agreed with the personnel of the "infection monitoring and risk prevention" service, ensuring that it can be disinfected correctly.	3.2 - B
The prescription of mobilization and therapeutic exercise should be carefully considered according to the patient's condition (e.g. clinically stable, respiratory and hemodynamic function included).	1 - A
Use Gear for individual use for each patient. For example, elastic bands (Theraband® type) instead of dumbbells.	3.2 - B
Larger equipment (e.g. mobility aids, ergometers, chairs, tilt tables) should be easily disinfected.	1 - A
Advice for coughing (Cough etiquette): patients and healthcare professionals should implement the measures for a correct cough (to avoid the dispersion of aerosols) and subsequent hygiene. During the maneuvers that produce the cough, it is necessary to educate the patient on how to cough correctly and on hygiene measures.	1 - A
Those patients who can, must cough into a handkerchief, which will later be discarded, and then carry out hand washing. Patients who are unable to perform these steps independently will receive assistance from staff.	1 - A
It is recommended to mobilize the patient early to reduce severity and promote rapid recovery. Hospitalization for various causes / for COVID-19.	1 - A / 3.2 - B
4S respiratory rehabilitation can be carried out from ICU until discharged.	1 - A
Full-body exercise can be started from supine position.	3.2 - B
The intensity of each exercise and movement is adjusted by the patient according to their comfort level. The principle is to guarantee the maximum amount of exercise under the premise of comfort.	3.2 - B
The proposed exercise load volume is 2 sessions per day, each exercise 15 - 20 times per session, in cases where it is tolerated to perform 3 series.	3.2 - B
If the patient presents with hypoxemia or dyspnea, he will require oxygen supplementation during the conditioning and rehabilitation session; if there is breathing difficulty, it can be done under non-invasive ventilation.	1 - A

**Table 2**

Concluding that by performing physical conditioning on hospitalized patients with a diagnosis of COVID-19, their morbidity and mortality will decrease, mitigating physical deconditioning due to hospitalization.

### Methodology

Pulmonary rehabilitation and physical conditioning are based on physical deconditioning secondary to pulmonary pathologies or hospital stays, which requires an evaluation and comprehensive knowledge of the patient's health status for its intervention. It is leveraged from various non-pharmacological measures to improve not only respiratory symptoms but also those triggered by hospitalization, including whole body exercise, breathing exercises, coordination exercises for coughing, rehabilitation education and associated risk factors.

4S Pulmonary Rehabilitation refers to (simple, safe, satisfy, save), for its acronym in English. Additionally, it is not affected by space (ICU, in ward or home care) since it does not require direct supervision. For this pathology, it is satisfactory for patients and medical personnel; In addition, medical expenses can decrease. The 4S pulmonary rehabilitation methodology can be used in physical conditioning to obtain similar results.

The physical conditioning or pulmonary rehabilitation sessions will be carried out by delivering an electronic device to guide the patient in real time in their intervention. Telemedicine - in ward teleintervention will be carried out in order to mitigate the risk of contagion.

### Team set up

The participating medical personnel, executing direction, coordination and control functions must have training and experience in physical conditioning and pulmonary rehabilitation, its different variants, clear knowledge of the clinical condition of each patient with COVID-19 and of the coronavirus H5N1 management protocol in turn of the updates to be made. The preparation of a very good clinical history focused on pathologies present in each patient, with the execution of physical conditioning sessions or pulmonary rehabilitation, as the case may be, using technologies, with which contact with the patient is reduced.

### Contraindications

The absolute contraindications to the intervention are:

- Patient with mechanical ventilation.
- Altered state of consciousness, drowsiness, stupor or coma.
- Hemodynamic instability.
- Systolic blood pressure > 160 mmHg and diastolic > 110 mmHg.
- Patient with a diagnosis of diabetes mellitus who has blood glucose levels higher than 300 mg/dL accompanied by ketosis.
- Valvular heart disease that generates hemodynamic changes.
- Acute myocardial infarction less than 48 hours.
- Medical criteria.

**Execution**

The physician specialized in physical activity and sports medicine (SEM) with experience in physical conditioning in hospitalized patients is the staff trained to perform the procedure and will assess each patient referred from the different services, to the Sports Medicine Service of the Hospital de San José.

- Assessment in the clinical history of the patient’s condition and the absence of contraindications to perform the intervention, in turn obtaining data from the nursing staff and medical personnel present in the ward.
- If the patient is suitable for intervention, the electronic device will be delivered to the head of the ward nurse, this device will be delivered covered by papel film (plastic wrap).
- The nursing staff will deliver the device to the patient.
- Through the device, making use of digital platforms that allow real-time video and sound connection, the intervention will be carried out.
- The Sports Medicine Physician will ask pertinent questions regarding patient’s condition, if there are no contraindications, the intervention with video calls will begin.
- The intensity of exercise will be monitored by the fatigue perception scale throughout the session.
- Once finished, patient will be advised to call the nursing staff for: 1. Vital sign collection and 2. electronic equipment return.
- Once the nursing staff leaves the room and during the removal of the personal protection elements, they will, in turn, carry out the removal of the papel film (plastic wrap) and the respective disinfection of the electronic equipment.
- The nursing staff will deliver the electronic equipment to the Sports Medicine Physician.

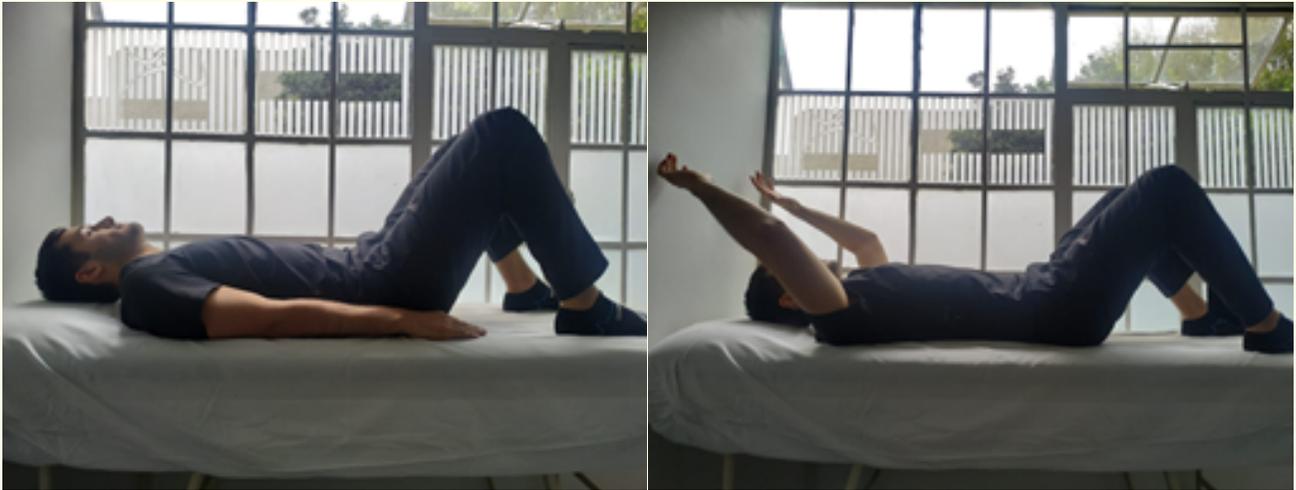
Constant Stability values	Stability values
Heart rate	< 100 lpm
Respiratory rate	< 24 RPM
Axillary temperature	< 37,2°C
Systolic blood pressure	> 90 mmHg
SatO <sub>2</sub>	> 90% if there was no previous respiratory failure
Level of consciousness	Adequate

**Table 3:** Measurement of vital signs and stability values.

According to the Colombian Ministry of Health. Clinical management of COVID-19: intensive care units. Published 19 March 2020.

Training plan: These are some exercises to execute during hospitalization. For this part patients will receive either a brochure or a video showing how to perform.

Raise your arms, while inhaling as much air as you can, lower your arms while exhaling all the air.



*Figure 1*

Breathe in as you pull your abdomen out and breathe out as you lower your abdomen.



*Figure 2*

Take a breath and release it with your mouth open as fast and hard as you can.



*Figure 3*

Rest your feet on the bed with your knees bent, lift your buttocks and squeeze them.



*Figure 4*

Change your position from lying down to sitting on the edge of the bed, if you can, stand up and take a few steps.

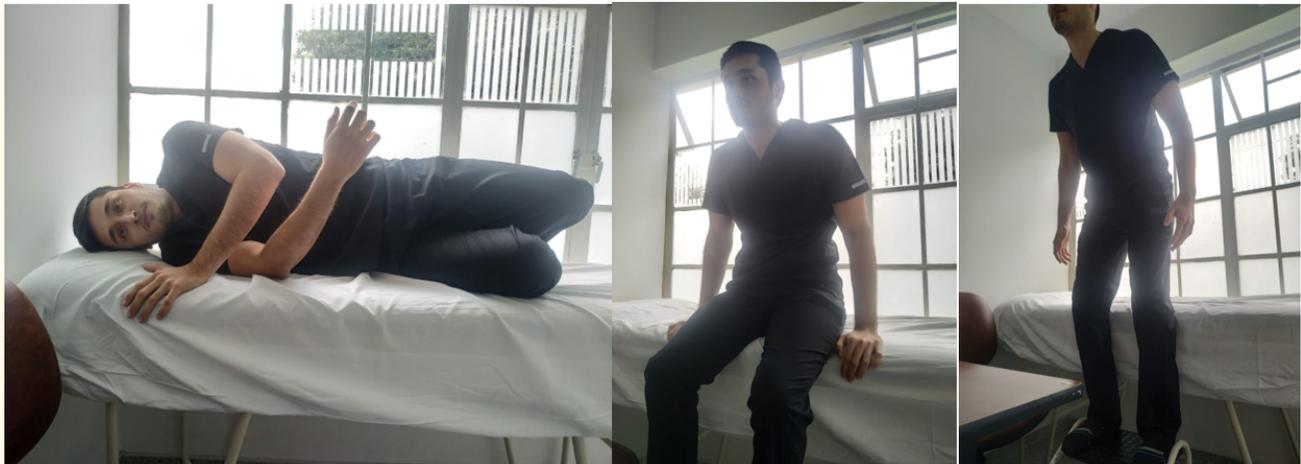


Figure 5

The patient will be expected to:

- Perform the exercises slowly without fatigue, always feeling comfortable.
- Allow 5 - 10 minutes for them.
- Do them frequently, if you can every hour.

### Session #1

Cardiovascular workout: Supervised ambulation with an intensity rated for perceived fatigue using a modified Borg scale, locating a perception of 3 - 4/10; the duration is 30 minutes divided into 3 sessions of 10 minutes of supervised walking.

Exercises with neuromuscular characteristics in standing or sitting, being worked upper limbs opening - chest, upper limbs front elevation, knee flexion extension (Leg extension) - by means of self-loading (40% of 1 RM) 3 sets of 15 repetitions, with cadence (tempo) 1: 1: 1 and rest time between sets (density) of 1 minute.

The session is completed by performing flexibility exercises emphasizing the muscles worked.

### Session # 2

Cardiovascular workout: Supervised ambulation with an intensity rated for perceived fatigue using a modified Borg scale, locating a perception of 3 - 4/10; the duration of cardiovascular work was 30 minutes divided into 3 sessions of 10 minutes.

Exercises with neuromuscular characteristics in standing or sitting position, working with upper limbs lateral flights, squat with support 45°, hip abduction, by means of self-loads (40% of 1 RM) 3 sets of 15 repetitions, with cadence 1: 1: 1 and rest time between sets (density) of 1 minute.

The session is concluded by performing flexibility exercises emphasizing the muscles worked and taking vital signs by the nursing staff.

### Session # 3

Cardiovascular workout: Supervised ambulation with an intensity rated for perceived fatigue using a modified Borg scale, locating a perception of 3 - 4/10; the duration of cardiovascular work was 45 minutes divided into 3 sessions of 15 minutes.

Exercises with neuromuscular characteristics in supine position, standing or sitting, core strengthening with isometric pressure of 10 seconds, unilateral lower limb elevation, opening of upper limbs with elbow flexion at 90 degrees by self-loading (40% of 1 RM) 3 sets of 15 repetitions, with cadence 1: 1: 1 and rest time between series (density) of 1 minute.

The session is concluded by performing flexibility exercises emphasizing the muscles worked and taking vital signs by the nursing staff.

### Session # 4

Cardiovascular workout: Supervised ambulation with an intensity rated for perceived fatigue using a modified Borg scale, locating a perception of 3-4/10; the duration of cardiovascular work was 45 minutes divided into 3 sessions of 15 minutes.

Exercises with neuromuscular characteristics in standing or short sitting bipedal are performed, lower limb back kick, triceps kick (upper limb back kick), lateral trunk flexion - lateral core, by means of self-loads (40% of 1 RM) 3 sets of 15 repetitions, with cadence (tempo) 1: 1: 1 and rest time between sets (density) of 1 minute.

The session is concluded by performing flexibility exercises emphasizing the muscles worked and taking vital signs by the nursing staff.

### Recommendations to the patient

- Recommendations on healthy lifestyle habits are given.
- Meal plan with specifications for each patient.
- Specific stretching and strengthening exercises for each case.
- In-clinic appointment scheduled once discharged from in-ward.

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