



# IASEM-TUMS COVID-19 Virtual Pulmonary Rehabilitation Framework; Exercise Prescription for Recovered COVID-19 Patients

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## 1. Background

Coronavirus disease-2019 (COVID-19) is an extremely communicable disease that leads to high mortality and morbidity worldwide. Coronavirus can easily be transmitted from person-to-person through respiratory droplets or aerosols resulting from sneezing or coughing. The droplets can be contagious for at least 24 hours on hard surfaces and up to eight hours on soft surfaces. Therefore, it could be transferred through hand contact while touching the mouth, nose, or eyes (1, 2).

One of the major problems in these patients is respiratory system involvement, which leads to symptoms of respiratory tract infection such as dry cough, dyspnea, and shortness of breath, as well as severe pneumonia with respiratory and multi-organ failure and/or death. Reports estimate that 80% of cases are asymptomatic or have mild symptoms, and only 15% - 20% of cases are severe who may require oxygen and ventilation support. The mortality rate of COVID-19 seems to be 3 to 5%, with new reports of up to 9% (1).

This infection causes respiratory as well as physical and psychological dysfunction. In patients infected by COVID-19, it seems that some symptoms such as shortness of breath, muscle weakness, and fatigue could remain after discharge, which reduces their functional capacity and thus the quality of life. Moreover, physical inactivity during the isolation period after discharge can further reduce functional capacity and worsen general and respiratory muscle weakness (3-5).

The effect of physical activity and exercise is not only to improve the patient's functional capacity but also to better control stress, have better feelings, reduce the risk factors for metabolic diseases, and improve quality of life (2, 6). Hence, general and pulmonary rehabilitation can be one of the most essential strategies for these patients that would relieve the symptoms of dyspnea and eventually improve physical function as well as quality of life (5, 7). Enhancing the function of the respiratory and immune systems may be achieved by aerobic capability improvement. An increased level of antibodies and better performance of WBCs are related to enhanced aerobic capacity, as are decreased anxiety and depression. Furthermore, cellular and physiological changes in the pulmonary system due to better aerobic function may lead to a lower risk of COVID-19 development (8).

Pulmonary rehabilitation can be done in a supervised inpatient or outpatient setting. For isolated patients or after discharge from the hospital, outpatient pulmonary rehabilitation guidance can be administered through a virtual setting and educational videos. Thus, home-based pulmonary rehabilitation can be an effective, convenient, accessible, and also cost-effective way for this period (4, 5, 7).

Consequently, in order to prevent the transmission of infection to medical staff as well as to improve the treatment status of these patients, we decided to design an outpatient virtual pulmonary rehabilitation and general muscle exercise program for these patients.

## 2. Framework

A web-based virtual online sports medicine consultation is suggested for COVID-19 patients discharged from hospital or quarantined at home or public centers with respiratory symptoms or general weakness by the Iranian Association of Sports and Exercise Medicine (IASSEM) and Department of Sports and Exercise Medicine of Tehran University of Medical Sciences (TUMS).

At our virtual clinic, patients can sign in and register through the website and schedule a virtual visit by selecting a sports medicine physician. The patient fills out an online questionnaire before their visit (Appendix 1 Supplementary File) (9, 10). The questionnaire consists of demographic and hospital admission data, present illness, dyspnea symptoms, stress and depression assessment tools, and past medical history. A remote visit is conducted in scheduled time by voice or video call as well as text methods on our web-based platform with a sports medicine physician, and all important acquired data is evaluated and rechecked by the physician during the virtual visit for exercise prescription. More investigations and follow ups were arranged according to the needs of the patient (e.g. refer to other physicians, do more para clinical evaluations, and so on).

Patients are categorized into three main groups for exercise prescription based on their chief complaint, history, and comorbidities, as well as symptoms (Table 1):

- Group 1 (G1): Mainly need general exercises.
- Group 2 (G2): Equally need both respiratory (Table 2) and general exercises including stretching, aerobic, strengthening, and balance exercises (Table 3).
- Group 3 (G3): Mainly need respiratory exercises (breathing techniques and chest wall expansion exercises).

**Table 1.** Grouping the COVID-19 Patients According to Given Data

Patient Groups	History		
	Intubation	In/Outpatient	Productive Cough
G1	No	Outpatient	No
	No	General Ward	No
G2	No	Outpatient	Yes
	No	General Ward	Yes
	No	ICU	Yes/No
G3	Yes	ICU	Yes/No
	No	In/Outpatient athlete	Yes/No

## 3. Exercise Prescription

Prescribed exercise had two main parts, breathing and general exercise. The breathing exercises included breathing techniques education (pursed-lip and diaphragmatic breathing), chest expansion and walking with breathing techniques, airway clearance techniques, inspiratory muscle training by using pictures and short videos that demonstrate correct techniques. General exercises were begun with stretching exercises, aerobic exercises, light upper and lower strengthening exercises, core stability, and neuromuscular and balance training.

We designed an every week follow-up for G1 and G2 patients by the same physician for symptom assessment and exercise adjustment and every two days follow-up for G3 patients by the same physician to ensure safety, and for symptom assessment and/or exercise adjustment. Exercise progression was done according to functional testing, patient's tolerance and exercise capacity. Functional testing was done in the first visit, 2nd week, and 4th week of the rehabilitation program. Testing was by squat and chair sit-to-stand for lower limbs and push-up or modified push-up for upper limb assessment.

Exercise protocols were comprehensive and illustrated using texts, videos, and photos to ensure about safety and correctness of doing prescribed exercises. More than 33 short-videos and 52 photos were prepared in seven directories to ensure safe and progressive exercise prescription.

## 4. Psychological Evaluation

In this study, we used two questionnaires, Patient Health questionnaire-2 (PHQ-2) and Perceived Stress scale-4 (PSS-4), for the screening of depression and stress, respectively. PSS-4 is a self-report questionnaire and established tool for measuring psychological stress that has been developed by Cohen et al. (11) in 1983 to measure "the degree to which individuals appraise situations in their lives as stressful". The PPS-4 rates personal beliefs about the characteristics of one's life (i.e., unpredictable, uncontrollable, and overloaded) during the past month (12). The PHQ-2 is a screening tool for depression, evaluating the rate of depressed mood and anhedonia in the previous fortnight. Positive results need additional evaluation with the PHQ-9 to make a diagnosis for the depressive disorders. The reliability and validity of this questionnaire have been approved in the Persian language (13).

Patients who need more evaluations and interventions according to these instruments are selected and referred to the psychologist or psychiatrist. Counseling is primarily

**Table 2.** Primary Breathing Exercise Prescription Options for Recovered COVID-19 Patients

Patient Groups	Breathing Exercises			
	Breathing Techniques <sup>a</sup>	Chest Expansion Ex.	Airway Clearance Tech.	IMT <sup>b</sup>
G1	+	1-2 exercises	-	-
	+	1-2 exercises	-	-
G2	+	2-3 exercises	+	-
	+	2-3 exercises	+	-
	+	2-3 exercises	±	-
G3	+	4 exercises	±	+
	+	4 exercises	±	+

Abbreviations: Ex., exercises; Tech., techniques.

<sup>a</sup>Pursed-lip and/or diaphragmatic breathing techniques.

<sup>b</sup>Inspiratory muscle training.

**Table 3.** Primary General Exercise Prescription Options for Recovered COVID-19 Patients

Patient Groups	General Exercises				
	Stretching Ex.	Aerobic Ex.	Strengthening Ex.	Core Stability Ex.	Balance Training Ex.
G1	+	+	+	+	Decreasing risk of falling; (1) Gait and balance difficulties; (2) Medical conditions with movement difficulties; (3) Vestibular disorder; (4) Osteoporosis; (5) Age-dependent; (6) History of dizziness
	+	+	+	+	
G2	+	+	-	+	
	+	+	-	+	
	+	±	-	+	
G3	+	±	-	-	
	+	+	+	+	

Abbreviations: Ex., exercises.

performed online or by phone. In some cases, face to face consultation is done considering the social distancing and protective equipment.

## 5. Conclusion

While an increasing number of patients have recovered from COVID-19, telerehabilitation seems to be essential concerning transport limitations and patient safety. Rehabilitation strongly correlates with better patient functional capacity by the improvement of respiratory symptoms and better stretching, cardiopulmonary endurance, strengthening, balance levels, and reduction of anxiety and depression.

Rehabilitation centers should turn to virtual services to reduce the risk of COVID-19 exposure to patients and healthcare providers.

## Supplementary Material

Supplementary material(s) is available [here](#) [To read supplementary materials, please refer to the journal website and open PDF/HTML].

## Footnotes

**Authors' Contribution:** MHPS and RN developed the original idea and the protocol and wrote the manuscript. SN, MN, and SES contributed to the development of the protocol, and prepared the manuscript.

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## References

1. Thomas P, Baldwin C, Bissett B, Boden I, Gosselink R, Granger CL, et al. Physiotherapy management for COVID-19 in the acute hospital setting: clinical practice recommendations. *J Physiother.* 2020;**66**(2):73-82. doi:10.1016/j.jphys.2020.03.011. [PubMed: 32312646]. [PubMed Central: PMC7165238].

2. Halabchi F, Ahmadinejad Z, Selk-Ghaffari M. COVID-19 Epidemic: Exercise or Not to Exercise; That is the Question!. *Asian J Sports Med*. 2020;**11**(1). doi: [10.5812/asjasm.102630](https://doi.org/10.5812/asjasm.102630).
3. Zhu C, Wu Y, Liu H, Ban Y, Ma X, Zhang Z. Early pulmonary rehabilitation for SARS-CoV-2 pneumonia: Experience from an intensive care unit outside of the Hubei province in China. *Heart Lung*. 2020;**49**(5):449–50. doi: [10.1016/j.hrtlng.2020.04.007](https://doi.org/10.1016/j.hrtlng.2020.04.007). [PubMed: [32312554](https://pubmed.ncbi.nlm.nih.gov/32312554/)]. [PubMed Central: [PMC7161510](https://pubmed.ncbi.nlm.nih.gov/PMC7161510/) interests].
4. Liu K, Zhang W, Yang Y, Zhang J, Li Y, Chen Y. Respiratory rehabilitation in elderly patients with COVID-19: A randomized controlled study. *Complement Ther Clin Pract*. 2020;**39**:101166. doi: [10.1016/j.ctcp.2020.101166](https://doi.org/10.1016/j.ctcp.2020.101166). [PubMed: [32379637](https://pubmed.ncbi.nlm.nih.gov/32379637/)]. [PubMed Central: [PMC7118596](https://pubmed.ncbi.nlm.nih.gov/PMC7118596/)].
5. Garvey C, Singer JP, Bruun AM, Soong A, Rigler J, Hays S. Moving Pulmonary Rehabilitation Into the Home: A CLINICAL REVIEW. *J Cardiopulm Rehabil Prev*. 2018;**38**(1):8–16. doi: [10.1097/HCR.000000000000287](https://doi.org/10.1097/HCR.000000000000287). [PubMed: [29251655](https://pubmed.ncbi.nlm.nih.gov/29251655/)].
6. Baradaran Mahdavi S, Kelishadi R. Impact of Sedentary Behavior on Bodily Pain While Staying at Home in COVID-19 Pandemic and Potential Preventive Strategies. *Asian J Sports Med*. 2020;**11**(2). doi: [10.5812/asjasm.103511](https://doi.org/10.5812/asjasm.103511).
7. Zhao HM, Xie YX, Wang C, Chinese Association of Rehabilitation M, Respiratory Rehabilitation Committee of Chinese Association of Rehabilitation M, Cardiopulmonary Rehabilitation Group of Chinese Society of Physical M, et al. Recommendations for respiratory rehabilitation in adults with coronavirus disease 2019. *Chin Med J (Engl)*. 2020;**133**(13):1595–602. doi: [10.1097/CM9.0000000000000848](https://doi.org/10.1097/CM9.0000000000000848). [PubMed: [32251002](https://pubmed.ncbi.nlm.nih.gov/32251002/)]. [PubMed Central: [PMC7470013](https://pubmed.ncbi.nlm.nih.gov/PMC7470013/)].
8. Mohamed AA, Alawna M. Role of increasing the aerobic capacity on improving the function of immune and respiratory systems in patients with coronavirus (COVID-19): A review. *Diabetes Metab Syndr*. 2020;**14**(4):489–96. doi: [10.1016/j.dsx.2020.04.038](https://doi.org/10.1016/j.dsx.2020.04.038). [PubMed: [32388326](https://pubmed.ncbi.nlm.nih.gov/32388326/)]. [PubMed Central: [PMC7186129](https://pubmed.ncbi.nlm.nih.gov/PMC7186129/)].
9. Mahler DA, Wells CK. Evaluation of Clinical Methods for Rating Dyspnea. *Chest*. 1988;**93**(3):580–6. doi: [10.1378/chest.93.3.580](https://doi.org/10.1378/chest.93.3.580). [PubMed: [3342669](https://pubmed.ncbi.nlm.nih.gov/3342669/)].
10. Kroenke K, Spitzer RL, Williams JB. The Patient Health Questionnaire-2: Validity of a two-item depression screener. *Med Care*. 2003;**41**(11):1284–92. doi: [10.1097/01.mlr.0000093487.78664.3c](https://doi.org/10.1097/01.mlr.0000093487.78664.3c). [PubMed: [14583691](https://pubmed.ncbi.nlm.nih.gov/14583691/)].
11. Cohen S, Kamarck T, Mermelstein R. A global measure of perceived stress. *J Health Soc Behav*. 1983;**24**(4):385–96. [PubMed: [6668417](https://pubmed.ncbi.nlm.nih.gov/6668417/)].
12. Maroufizadeh S, Zareiyan A, Sigari N. Reliability and validity of Persian version of perceived stress scale (PSS-10) in adults with asthma. *Arch Iran Med*. 2014;**17**(5):361–5. [PubMed: [24784866](https://pubmed.ncbi.nlm.nih.gov/24784866/)].
13. Dadfar M, Lester D. Psychometric characteristics of Patient Health Questionnaire-2 (PHQ-2) in Iranian psychiatric outpatients. *Austin J Psychiatry Behav Sci*. 2017;**4**(1):1059.