TITLE: Outpatient Physical Therapy Management of a Post-COVID Patient: Full Body Exercises for Return to Work

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ABSTRACT:

Objective: The purpose of this case report is to present physical therapist management and clinical presentation for a patient with critical illness myopathy and post-COVID syndrome. The focus will be to highlight treatment strategies aimed at return to work function.

Method (Case Description): A 52-year old male tested positive for SARS-CoV-2 on April 21, 2020. He was initially asymptomatic and was isolated at home. After a few days at home, the patient began having dyspnea and called the Health Center who sent an Ambulance. He was admitted to the hospital and symptoms continued to worsen. The patient was placed on mechanical ventilation and treated with convalescent plasma. He was weaned from the ventilator after 19 days. The patient was discharged from the hospital on July 1, 2020. At this point he was referred to outpatient physical therapy in order to prepare him to return to work. The patient was evaluated on July 2nd, 2020. Presenting with deficits in exercise capacity, upper extremity weakness, and lower extremity weakness. He was able to walk 1 min 40 seconds of a 6 min walk test complete 218 feet, 5x sit to stand 18 seconds**,** and a LEFS score of 14/80. Patient was on supplemental oxygen via nasal canula.

Results: The patient participated in out-patient physical therapy with an initial script of three visits a week for 8 weeks. The plan of care was extended, and patient the was seen 28 visits over 10 weeks. Therapy included aerobic training and strengthening exercises. The intensity of his program increased as tolerated, and progressed to return to work activities. His strength, physical function, and exercise capacity improved. Upon discontinuing physical therapy, the patient was able to walk greater than 15 minutes without supplemental oxygen, demonstrated improvement in upper and lower extremity strength, improved his 5 times sit to stand to 12 seconds, and was cleared by his physician for return to work.

Conclusion: This case report described the clinical presentation and physical therapy management of a person with critical illness myopathy and post-COVID syndrome. Due to the novel nature of this condition (patient was seen within the first year of emergence of this disease), there was little evidence to guide rehabilitation examination and interventions. Exercises and progressing for this patient were managed based on research completed on patients with Chronic Obstructed Pulmonary Disease and other cardiopulmonary illnesses.

Impact: This case shows the role out-patient orthopedic physical therapy played in the treatment of physical debility caused by post-COVID syndrome.

Background and Purpose

COVID-19 caused by SARS-CoV-2 is a devasting cardiopulmonary viral infection that has become increasingly well known since its discovery in late 2019 and first US reported case in Washington in January 2020. Individuals testing positive for this infection range from asymptomatic presentation to critical illness requiring intensive care admission and mechanical ventilation.[1] Many individuals who may be asymptomatic and many who have recovered from more serious infection are exhibiting persistent disease symptoms now being referred to as "post-COVID syndromes."[2] Post-COVID syndrome and adverse effects from COVID have led to many individuals being unable to return to their usual state of health even weeks after diagnosis.[3] Of those with severe infections that require ICU stays, some (like this referenced patient) acquire ICU-acquired weakness presenting as generalized, symmetrical, affecting proximal more than distal limbs and respiratory muscles.[4,5] Physical rehabilitation in both an inpatient hospital based setting and during acute recovery following discharge is recommended for improving physical function in patients with severe COVID-19 and critical illness myopathy that develop acute respiratory failure.[5,6]

The purpose of this case study is to present a patient with COVID-19 who was hospitalized, placed on mechanical ventilation, and developed Critical Illness Myopathy due to complications from COVID-19. This case will describe the outpatient physical therapy management to address symptoms of dyspnea, weakness, and deconditioning in efforts to return a patient to work and minimize long term health care utilization costs associated with ICU stays and prolonged mechanical ventilation.[7]

Due to the novel presentation of this disease, research regarding other pulmonary conditions and physical therapy was used to create a treatment plan. Use of standardized objective testing

helped to track progress of this patient throughout his duration of care. The five times sit to stand test has been validated for use with healthy community-dwelling adults and is being validated with patients that have Chronic Obstructive Pulmonary Disease (COPD).[8] This test is correlated with measures of exercise capacity, lower limb strength, and dyspnea.[8] The Six Meter Walk Test has also been validated for use with patients that have COPD and is used as a predictor of morbidity and mortality.[9] Due to treating diagnosis of Critical Illness Myopathy and desire to return to a physically demanding job, the Lower Extremity Function Scale was used as a subjective outcome measure as it addresses walking, stair climbing, standing, heavy activity, squatting, and work related activities required for this patient to return to prior level of function.

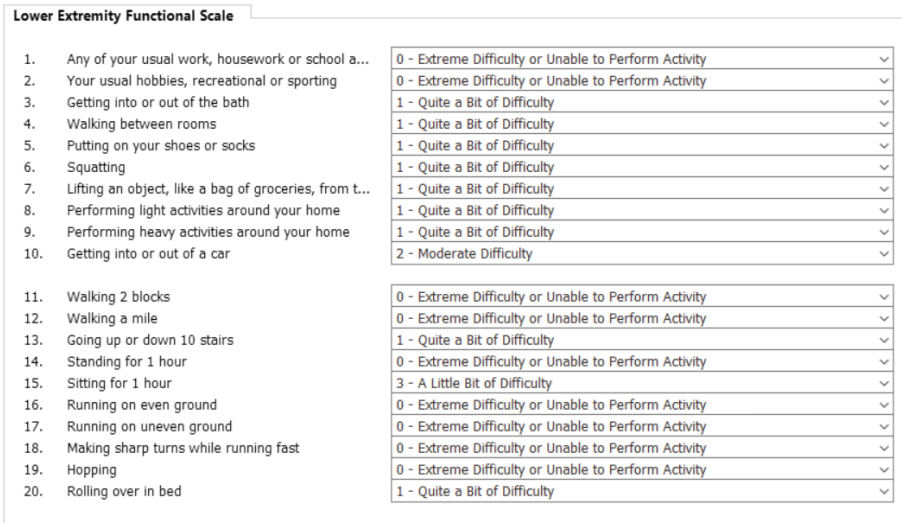
Case Description:

Patient Demographics: The patient is a 52-year-old Mexican-American male. The patient is 5 feet seven inches tall, with a weight of 218 pounds, and a body mass index of 34.14. The patient's past medical history was unremarkable except for referring diagnosis of critical illness myopathy following hospitalization for novel corona virus. The patient works as Line Lead at ConAgra Brands production plant where he needs to lift 50 pounds from floor to waist. The patient was exposed to corona virus along with approximately 20 other employees prompting the plant to temporarily suspend operations.

Predisposing factors for this patient include inability to fully social distance at work, shortage of PPE in factory setting, prevalence of asymptomatic viral spreading, and initial shortage of rapid-tests.[10]

Information: The patient was referred by his family medicine/internist physician upon discharge for the hospital. The referring diagnosis was Malaise and Critical Illness Myopathy. At initial

evaluation, patient's primary complaint was shortness of breath, difficulty with stairs, and decreased activity tolerance. At rest his pulse was 102 BPM, blood pressure was 112/95, and O2 saturation at 95%. The patient was on 2L of O2 through nasal canula at rest with permission to increase titration as needed with activity. This patient completed a Lower Extremity Functional Scale questionnaire and scored 14/50, demonstrating greater than 80% but less than 100% impairment as shown in Figure 1.



Lower Extremity Functional Scale

1.	Any of your usual work, housework or school a...	0 - Extreme Difficulty or Unable to Perform Activity
2.	Your usual hobbies, recreational or sporting	0 - Extreme Difficulty or Unable to Perform Activity
3.	Getting into or out of the bath	1 - Quite a Bit of Difficulty
4.	Walking between rooms	1 - Quite a Bit of Difficulty
5.	Putting on your shoes or socks	1 - Quite a Bit of Difficulty
6.	Squatting	1 - Quite a Bit of Difficulty
7.	Lifting an object, like a bag of groceries, from t...	1 - Quite a Bit of Difficulty
8.	Performing light activities around your home	1 - Quite a Bit of Difficulty
9.	Performing heavy activities around your home	1 - Quite a Bit of Difficulty
10.	Getting into or out of a car	2 - Moderate Difficulty
11.	Walking 2 blocks	0 - Extreme Difficulty or Unable to Perform Activity
12.	Walking a mile	0 - Extreme Difficulty or Unable to Perform Activity
13.	Going up or down 10 stairs	1 - Quite a Bit of Difficulty
14.	Standing for 1 hour	0 - Extreme Difficulty or Unable to Perform Activity
15.	Sitting for 1 hour	3 - A Little Bit of Difficulty
16.	Running on even ground	0 - Extreme Difficulty or Unable to Perform Activity
17.	Running on uneven ground	0 - Extreme Difficulty or Unable to Perform Activity
18.	Making sharp turns while running fast	0 - Extreme Difficulty or Unable to Perform Activity
19.	Hopping	0 - Extreme Difficulty or Unable to Perform Activity
20.	Rolling over in bed	1 - Quite a Bit of Difficulty

Figure 1. LEFS Weboutcomes measure

Physical Exam: Upon physical examination, the following objective measurements were included: upper (Figure 2) and lower extremity (Figure 3) gross strength measured bilaterally using handheld dynamometer in pounds of force, aerobic capacity/endurance, balance/fall risk, and functional lower extremity strength. His functional lower extremity strength, balance, and fall risk were measured using the 5-times sit to stand test at 18 seconds with O2 saturation dropping to 90%. His aerobic capacity was measured using a 6-minute walk test with 218 feet of distance covered in 1 minute and 40 seconds, test was ended due to oxygen saturation dropping

below 85%.

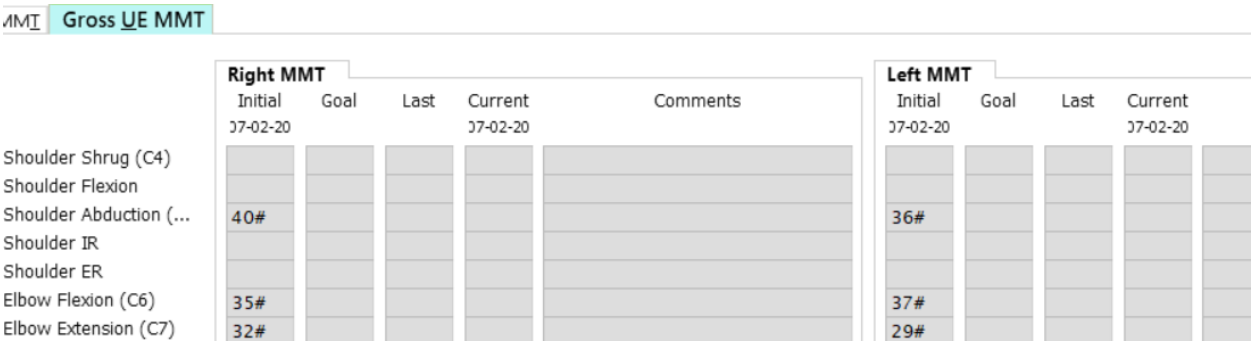


Figure 2. Gross Upper Extremity MMT

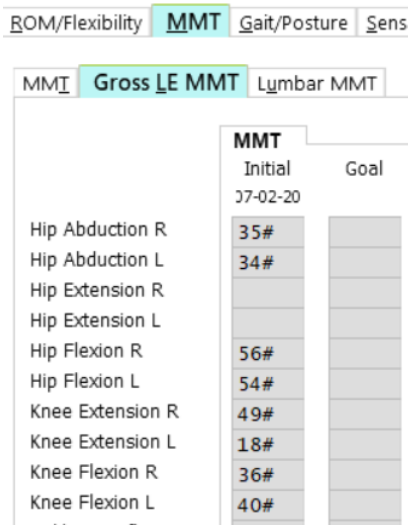


Figure 3. Lower extremity strength

Intervention: Exercises prescribed focused on aerobic capacity, global strengthening, and functional training as suggested by previous literature involving patients surviving ICU stays and prospective protocols for COVID-19 patients.[11,2] Walking exercise intensity was prescribed based off of the results of 6-minute walk test, with 70-80% average 6MWT speed producing high but tolerable exercise intensity that results in training benefits.[11,12] Walking was used as a warm up activity. Initially the patient completed warm up walking with 2L of supplemental oxygen, but was able to wean off the oxygen when he could complete the warm up without his SpO2

dropping. High intensity whole-body interval training has been studied as intervention for patients with COPD and has shown to increase cardiorespiratory fitness and exercise capacity but due to the acute nature of this patient, moderate intensity intervals were used.[13] Studies have also shown that muscle power is reduced in survivors of critical illness, so interventions were also introduced to increase functional improvement.[14] Per physician, the patient was able to increase supplemental O2 to 4L as needed with higher demand exercises and did so if his O2 took longer than one minute to increase to baseline.

At the initial evaluation, the therapist prescribed a home exercise program of active walking and body weight mini squats. The goal was for the home exercises to be very easily reproduced at home with little to no equipment to allow for improved outcomes.[15]

Exercise monitoring: The patient wore a pulse oximeter to monitor heart rate and SpO2 levels throughout the session and was told to rest exercises if O2 dropped below 90% or he had severe sudden dyspnea.[2,16] He was to resume exercises when SpO2 was 95% or greater. Intensity of exercise was self-reported by patient as a verbal low, moderate, or high.

Visit # (excluding initial evaluation)	Visit 2	Visit 3	Visit 4	Visit 5
Therapeutic Activity	Active walking 4 laps of 60 ft x 2 repetitions, seated recovery break between repetitions Body weight squats: 3 rounds of 10 Shoulder circuit: -bilateral shoulder flexion,	Active walking 4 laps of 60 ft x 2 repetitions, seated recovery break between repetitions Body weight squats: 3 rounds of 10 Shoulder circuit: -bilateral shoulder flexion,	Active walking 4 laps of 60 ft x 3 repetitions, seated recovery break between repetitions Body weight squats: 3 rounds of 10 Shoulder circuit: -bilateral shoulder flexion,	Shoulder circuit: -bilateral shoulder flexion, shoulder press, side to side with 5# weighted cane Shoulder resistance band strengthening: pull downs and rows with green resistance band

	shoulder press, side to side with 5# weighted cane Shoulder resistance band strengthening: pull downs and rows with green resistance band	shoulder press, side to side with 5# weighted cane Shoulder resistance band strengthening: pull downs and rows with green resistance band	shoulder press, side to side with 5# weighted cane Shoulder resistance band strengthening: pull downs and rows with green resistance band	Ball slams with 7# weighted ball 2x10 Sled push 2 rounds of 60 feet Step ups onto 6 in step 3x10 with each leg, breaks as needed
Self-Care Management/ ADL Training				Active walking 11 minutes, standing rest break as needed Body weight squats: 3 rounds of 10 Step ups onto 6 in step 3x10 with each leg, breaks as needed
Visit #	Visit 6	Visit 7	Visit 8	Visit 9
Therapeutic Activity	Shoulder circuit Shoulder resistance band strengthening: pull downs and rows with green resistance band Ball slams with 10# weighted ball 2x10 Sled push 2 rounds of 60 feet	Shoulder circuit Shoulder resistance band strengthening: pull downs and rows with green resistance band Ball slams with 10# weighted ball 2x10 Sled push 2 rounds of 60 feet	Shoulder circuit Shoulder resistance band strengthening: pull downs and rows with green resistance band Ball slams with 10# weighted ball 2x10 Sled push 2 rounds of 60 feet	Shoulder circuit Shoulder resistance band strengthening: pull downs and rows with green resistance band Ball slams with 10# weighted ball 2x10 Sled push 2 rounds of 60 feet

Self-Care Management/ ADL Training	Active walking 11 minutes Body weight squats Step ups onto 6 in step 3x10	Active walking 11 minutes Body weight squats Step ups onto 6 in step 3x10	Active walking 11 minutes Body weight squats Step ups onto 6 in step 3x10	Active walking 11 minutes Body weight squats Step ups onto 6 in step 3x10
Visit #	Visit 10	Visit 11	Visit 12	Visit 13
Therapeutic Activity	Shoulder circuit: 10# Ball slams Sled push Kettle Bell Swings 5#	Shoulder circuit: 10# Ball slams Sled push Kettle Bell Swings 5#	Shoulder circuit: 10# Ball slams Sled push Kettle Bell Swings 5#	Shoulder circuit: 10# Ball slams 3x10 Sled push 2 Kettle Bell Swings 5#
Self-Care Management/ADL Training	Active walking 11 minutes Body weight squats Step ups	Active walking 11 minutes Body weight squats Step ups	Active walking 11 minutes Body weight squats Step ups	Active walking 11 minutes Body weight squats Step ups
Visit #	Visit 14	Visit 15	Visit 16	Visit 17
Therapeutic Activity	Shoulder circuit: 10# Ball slams Sled push Kettle Bell Swings 5#	Shoulder circuit: 10# Ball slams Sled push Kettle Bell Swings 5#	Shoulder circuit: 10# Ball slams Sled push Kettle Bell Swings 5#	Shoulder circuit: 10# Ball slams Sled push Kettle Bell Swings 5#
Self-Care Management/ ADL Training	Active walking 11 minutes Body weight squats Step ups	Active walking 11 minutes Body weight squats Step ups	Bike 11 minutes Body weight squats Step ups	Bike 11 minutes Body weight squats Step ups
Visit #	Visit 18	Visit 19	Visit 20	Visit 21
Therapeutic Activity	Shoulder circuit: 10#	Cable Machine Shoulder circuit:	Cable Machine Shoulder circuit: 40#	Cable Machine Shoulder circuit: 40#

	Ball slams Sled push Kettle Bell Swings 5#	Seated scapular Rows and Lat pull downs on Cable Machine 40# Ball slams with 10# weighted ball 2x10 Sled push +45# plate Kettle Bell Swings 5#	Ball slams with 10# weighted ball 2x10 Sled push +45# plate Kettle Bell Swings 5#	Ball slams with 10# weighted ball 2x10 Sled push+45# plate Kettle Bell Swings 5#
Self-Care Management/ ADL Training	Bike 11 minutes Body weight squats Step ups	Bike 11 minutes Body weight squats Step ups	Bike 11 minutes 20# Goblet Squat: 3 rounds of 10 Step ups	Bike 11 minutes 20# Goblet Squat: 3 rounds of 10 Step ups
Visit #	Visit 22	Visit 23	Visit 24	Visit 25
Therapeutic Activity	Cable Machine Shoulder circuit: 40# Ball slams Sled push +45# plate Kettle Bell Swings 5#	Cable Machine Shoulder circuit: 40# Ball slams Sled push +45# plate Kettle Bell Swings 5#	Cable Machine Shoulder circuit: 50# Ball slams Sled push +45# plate Kettle Bell Swings 10#	Cable Machine Shoulder circuit: 70# rows, 50# pull downs Ball slams Sled push+80# plate Kettle Bell Swings 10#
Self-Care Management/ ADL Training	Bike 11 minutes 20# Goblet Squat Step ups	Bike 11 minutes 20# Goblet Squat Step ups	Bike 11 minutes 20# Goblet Squat Step ups	Bike 11 minutes 20# Goblet Squat Step ups
Visit #	Visit 26	Visit 27	Visit 28	
Therapeutic Activity	Cable Machine Shoulder circuit: 70# rows, 50# pull downs	Cable Machine Shoulder circuit: 70# rows, 50# pull downs	Cable Machine Shoulder circuit: 70# rows, 50# pull downs	

	Ball slams Sled push+80# plate Kettle Bell Swings 10#	Ball slams Sled push+80# plate Kettle Bell Swings 10#	Ball slams Sled push+80# plate Kettle Bell Swings 10#	
Self-Care Management/ ADL Training	Bike 11 minutes 20# Goblet Squat Step ups	Bike 11 minutes 20# Goblet Squat Step ups	Bike 11 minutes 20# Goblet Squat Step ups	

Figure 4. Exercise flow sheet

Outcomes: Progress notes were performed at visits 12 and 22. At the first progress note the patient's LEFS score improved to 38, showing a 24-point improvement (MCID 9) and placing him in the 40-60% impaired range. His 5x sit to stand had improved to 12 seconds with SpO2 at 97%. He was able to complete a 1 rep max of 25# from floor to waist. His gross lower extremity strength had improved as shown in figure 5. He was able to complete warm up walking without supplemental O2 and was requiring just 2L of oxygen with more strenuous exercises of sled push, step ups, and kettle bell swing.

MMT

	Initial	Goal	Last	Current
	07-02-20		07-02-20	07-28-20
Hip Abduction R	35#		35#	40#
Hip Abduction L	34#		34#	45#
Hip Extension R				
Hip Extension L				
Hip Flexion R	56#		56#	57#
Hip Flexion L	54#		54#	54#
Knee Extension R	49#		49#	61#
Knee Extension L	18#		18#	52#
Knee Flexion R	36#		36#	49#
Knee Flexion L	40#		40#	57#

Figure 5. Gross LE strength

At visit 22, his LEFS score had improved to 65, placing him in the 1-20% impaired range. He was able to complete 10 minutes of cardiovascular training on a recumbent bike with resistance without supplemental oxygen. His upper and lower extremity manual muscle testing were not completed. He continued to require supplemental oxygen at 2 liters for led push, step ups, and goblet squats.

The patient returned to his physician and was cleared to return to work and thus a no visit discharge was completed and measurements unable to be updated. Subjectively the patient reported improvement in ability to complete ADLs, integration back into the community without use of oxygen, and confident in ability to return to work. He was no longer using supplemental oxygen in the clinic at his last visit.

Discussion: Although this patient progressed well and was ultimately able to return to work, several factors may have been overlooked throughout treatment. With this patient no formal assessment of cognitive or emotional health was screened. This could potentially disguise and underlying deficit in quality of life despite physical improvement. Several articles suggest the use of a self-reported quality of life rating, and it is my belief that this patient could have benefited from this assessment as an adjunct.[17,18] A self-report of low, moderate, high was used to gage intensity of exercise, however the BORG Rate of Perceived Exertion (RPE) scale would have been a more definitive report and easier to track.[19] This patient may have also benefited from education and instruction on diaphragmatic breathing during times of recovery and with exertional activities, allowing for increased chest wall expansion and improved perfusion.[20] The research on this patient was conducted based on patients with COPD, but his progression did not necessarily follow that of someone with COPD. This could have been due to the ability for his lungs to heal and increase in lung capacity which would not happen in a patient with COPD.

Other limitations to this paper include the patient discharging for formal physical therapy without completing updated testing that could have shown further improvement. The reproducibility of this case study is small due to only having one patient to collect data on, further study is needed to increase generalizability of outcomes.

Conclusion: The findings of this case reports support the conclusion that individuals who initially present with asymptomatic positive testing for SARS-COV-2 but develop severe illness over time may benefit from outpatient physical therapy when released from the hospital. It supports that patients who required mechanical ventilation and ICU stays due to COVID-19 may also benefit from referral to out-patient physical therapy post discharge from the hospital.

References:

1. Richardson S, Hirsch JS, Narasimhan M, et al. Presenting characteristics, comorbidities, and outcomes among 5700 patients hospitalized with COVID-19 in the New York City area. *JAMA.* 2020;323(20):2052-2059.
2. Kabi A, Mohanty A, Mohanty AP, Kumar S. Post COVID-19 Syndrome: A Literature Review. *Journal of Advances in Medicine and Medical Research*. 2020:289-295. doi:10.9734/jammr/2020/v32i2430781
3. Tenforde MW KS, Lindsell CJ, et al. Symptom Duration and Risk Factors for Delayed Return to Usual Health Among Outpatients with COVID-19 in a Multistate Health Care Systems Network — United States, March–June 2020. MMWR Morb Mortal Wkly Rep 2020. 2020;69:993-998
4. Vanhorebeek, I., Latronico, N. & Van den Berghe, G. ICU-acquired weakness. Intensive Care Med 46, 637–653 (2020). https://doi.org/10.1007/s00134-020-05944-4
5. Falvey JR, Ferrante LE. Flattening the disability curve: Rehabilitation and recovery after COVID-19 infection. Heart & Lung: The Journal of Cardiopulmonary and Acute Care.
6. Shepherd S, Batra A, Lerner DP. Review of Critical Illness Myopathy and Neuropathy. *The Neurohospitalist*. 2016;7(1):41-48. doi:10.1177/1941874416663279
7. Hill AD, Fowler RA, Burns KE, Rose L, Pinto RL, Scales DC. Long-Term Outcomes and Health Care Utilization after Prolonged Mechanical Ventilation. *Ann Am Thorac Soc*. 2017;14(3):355-362. doi:10.1513/AnnalsATS.201610-792OC
8. Jones SE, Kon SS, Canavan JL, et al. The five-repetition sit-to-stand test as a functional outcome measure in COPD. *Thorax*. 2013;68(11):1015-1020. doi:10.1136/thoraxjnl-2013-203576
9. Hernandes NA, Wouters EF, Meijer K, Annegarn J, Pitta F, Spruit MA. Reproducibility of 6-minute walking test in patients with COPD. *European Respiratory Journal*. 2010;38(2):261-267. doi:10.1183/09031936.00142010
10. Stawicki SP, Jeanmonod R, Miller AC, Paladino L, et al. The 2019–2020 novel coronavirus (severe acute respiratory syndrome coronavirus 2) pandemic: A joint american college of academic international medicine-world academic council of emergency medicine multidisciplinary COVID-19 working group consensus paper. *J Global Infect Dis.* 2020;12:47-93
11. Denehy L, Skinner EH, Edbrooke L, et al. Exercise rehabilitation for patients with critical illness: a randomized controlled trial with 12 months of follow-up. Critical care (London, England). 2013;17(4):R156
12. Zainuldin R, Mackey MG, Alison JA. Prescription of Walking Exercise Intensity From the 6-Minute Walk Test in People With Chronic Obstructive Pulmonary Disease. *Journal of Cardiopulmonary Rehabilitation and Prevention.* 2015; 35(1): 65-69. doi: 10.1097/HCR.0000000000000074
13. Sawyer A, Cavalheri V, Hill K. Effects of high intensity interval training on exercise capacity in people with chronic pulmonary conditions: a narrative review. *BMC Sports Science, Medicine and Rehabilitation*. 2020;12(1). doi:10.1186/s13102-020-00167-y
14. Mayer KP, Welle MM, Evans CG, et al. Muscle Power is Related to Physical Function in Patients Surviving Acute Respiratory Failure: A Prospective Observational Study. *The American Journal of the Medical Sciences*. 2021;361(3):310-318.

15. Patel S, Palmer MD, Nolan CM, et al. Supervised pulmonary rehabilitation using minimal or specialist exercise equipment in COPD: a propensity-matched analysis. *Thorax*. 2020;76(3):264-271. doi:10.1136/thoraxjnl-2020-215281
16. Zhu Y, Wang Z, Zhou Y, et al. Summary of respiratory rehabilitation and physical therapy guidelines for patients with COVID-19 based on recommendations of World Confederation for physical therapy and National Association of Physical Therapy. *Journal of Physical Therapy Science*. 2020;32(8):545-549. doi:10.1589/jpts.32.545
17. Mayer KP, Steele AK, Joshi RR, et al. Optimizing Outcomes With Physical Therapy Treatment for IndividuALs Surviving an Intensive Care Units Admission for COVID-19 (OPTImAL)—A Protocol for a Single Center Prospective Study. *Cardiopulmonary Physical Therapy Journal*. 2020;32(1). doi:10.1097/cpt.0000000000000156
18. McPeake J, Shaw M, Iwashyna TJ, et al. Intensive Care Syndrome: Promoting Independence and Return to Employment (InS:PIRE). Early evaluation of a complex intervention. *PLOS ONE*. 2017;12(11). doi:10.1371/journal.pone.0188028
19. Crisafulli E, Clini EM. Measures of dyspnea in pulmonary rehabilitation. *Multidisciplinary Respiratory Medicine*. 2010;5. doi:10.4081/mrm.2010.529
20. Mayer KP, Steele AK, Soper MK, et al. Physical Therapy Management of an Individual With Post-COVID Syndrome: A Case Report. *Physical Therapy*. 2021. doi:10.1093/ptj/pzab098