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ORIGINAL RESEARCH

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Functional outcomes and post-discharge care sought by patients with COVID-19 compared to matched controls after completing inpatient acute rehabilitation

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Abstract

Introduction: A subset of patients with coronavirus disease 19 (COVID-19) can develop severe illness, resulting in significant functional and cognitive deficits that require acute inpatient rehabilitation. Guidelines following discharge from acute inpatient rehabilitation have not yet been established. This study seeks to establish outcomes of rehabilitation patients with COVID-19 and characterize their need for long-term care.

Objective: To determine the functional outcomes and utilization of follow-up medical care for patients with COVID-19 90 days following discharge from acute inpatient rehabilitation, as compared to rehabilitation impairment and age-matched controls.

Design: Prospective, single-center cohort study.

Setting: Inpatient rehabilitation facility (IRF).

Patients: Sixty-four patients recovering from COVID-19 and 64 age and impairment group category controls were identified to answer survey questions following discharge from inpatient rehabilitation. A total of 36 patients participated in the study (18 patients with COVID-19 and 18 controls).

Interventions: Not applicable.

Main Outcome Measure(s): Functional outcomes at discharge (GG Self-Care and Mobility Activities items of the IRF-PAI Version 3.0), hospital readmissions, and follow-up care sought by patients.

Results: The COVID-19 patient group had similar improvements in functional outcomes as compared to controls. Patients with COVID-19 required fewer 0–90 day readmissions than their matched controls (22.2% vs 61.1%, $P < .05$), but there were no differences in 0–90 day urgent care/emergency department visits, clinic visits and use of outpatient therapies.

Conclusions: Patients with functional deficits as a result of COVID-19 who require multiple therapy disciplines should be considered for acute inpatient rehabilitation as this study demonstrates their ability to participate in and benefit from IRF level care.

INTRODUCTION

In January 2020, the first confirmed case of coronavirus disease (COVID-19) was reported in Washington State. Soon after, the World Health Organization declared the disease a global pandemic.[1] Since the detection of COVID-19, there have been more than 30 million confirmed cases and approaching 600,000 deaths in the United States alone.[2] Research in COVID-19 has been ongoing and focused on identifying vulnerable populations.

For most patients with COVID-19, symptoms during recovery are usually mild and do not require extensive resources of care. However, a subset of patients are diagnosed with severe COVID-19 and may develop critical illness, often requiring mechanical ventilation and a prolonged hospital stay.[3-5] Debility can be the result of illness myopathy/polyneuropathy and may be accompanied by cognitive dysfunction and respiratory failure. As a result, these patients frequently require post-acute rehabilitation before they can return home.[3-6]

Currently, there is little research on the long-term effects of COVID-19, including the outcomes of patients with rehabilitation needs.[7,8] Existing literature suggests that many patients develop a decline in function following critical illness, including those without COVID-19. Critical illness myopathy/polyneuropathy has been reported at rates of 25% to 83% depending on the illness.[9] These complications lead to an increased number of hospital readmissions, outpatient appointments, and assistance from home care services and inpatient rehabilitation facilities (IRFs).[10-12] Even with rehabilitation, patients with debility are at high risk for being readmitted to the hospital.[13-14]

The primary objective of our study was to examine the acute rehabilitation course and its efficacy for patients admitted to an inpatient acute rehabilitation facility due to COVID-19 sequalae and compare their outcomes to those of non-COVID-19 patients presenting in the same age and impairment group. Our secondary objective was to determine the COVID-19 group's self-reported utilization of health care resources post-discharge as compared to utilization of these services by the non-COVID-19 cohort.

METHODS

This was a prospective, single-center cohort study of patients admitted to a regional acute rehabilitation facility. This study was approved by the institution's institutional review board. Sixty-four IRF discharges of COVID-19 patients were identified using rehabilitation outcomes software (erehabdata.com). Sixty-four matched controls were selected based on having the same admitting impairment group category (IGC) and similar age (±5 years). Patients were admitted between April 9 to September 1, 2020 and were older than 18 years.

Sociodemographic data were gathered from the hospital's information in erehabdata.com. The following elements were obtained for each patient: age; sex; ethnicity; body mass index (BMI); co-morbidities such as heart disease (including coronary arterial disease and congestive heart failure), hypertension, lung disease (including asthma and chronic obstructive pulmonary disease [COPD]), chronic kidney disease, cognitive dysfunction, fatigue, muscle weakness, difficulty walking; The GG Self-Care and Mobility Activities Items (Section GG0130 and GG0170) of the CMS issued IRF-PAI Version 3.0. were included to assess functional abilities at admission and at discharge. The GG subscale is the sum of functional independence assessments for eating, oral hygiene, toileting hygiene, showering/bathing, upper body dressing, lower body dressing, putting on/taking off footwear, sit to lying, lying to sitting on side of bed, sit to stand, chair/bed-to-chair transfers, toilet transfers, walking 10 ft, walking 50 ft with two turns, walking 150 ft, and 1 step (curb). The 16 individual items are ranked on a scale of 1 to 6, with 6 representing complete functional independence for the activity. GG subscale scores range from 16 to 96. Brief Interview for Mental Status (BIMS) were included as an overall indicator of mental status.

Post-discharge health resource utilization data were collected from patient responses to a brief standardized questionnaire administered following patient discharge via phone with a verbal informed consent. The questionnaire was generated by the authors, for the purpose of this study. Sixty-two surviving COVID-19 patients and their matched controls were called up to three times on three separate occasions following IRF discharge and queried using a scripted set of questions regarding the frequency and reasons for any hospital readmissions, urgent care/emergency room (ER) visits, outpatient, and home visits occurring within 90 days of IRF discharge. Fifty-two patients, including 23 patients with COVID-19 and 29 control patients agreed to participate in phone survey. Eighteen COVID-19 patients and 18 matched controls were identified.

Statistical analysis

Data were analyzed using SPSS (IBM) Statistical Software (V26). Fisher's exact tests were used for categorical variable comparisons. Independent sample *t* tests were used in the comparison of continuous variables. A *P* value of <.05 was used to determine statistical significance. A post hoc power analysis using GPower found the power of the study sample to be 0.80 for the detection of a small effect. This calculation assumes an α-error probability of 0.05.

RESULTS

There were 64 adult patients admitted to inpatient rehabilitation following acute hospitalization with COVID-19 during the study period of April 9 to September 1, 2020. Age and impairment matched controls were identified for these patients. A total of 23 patients recovering from COVID-19 and 29 control patients agreed to participate in a post-discharge phone assessment. Eighteen age and rehabilitation impairment group controls were included in the study. Figure 1 describes the number of patients participating or reasons for exclusion.

Patient characteristics and functional outcomes

Table 1 compares the baseline characteristics of all patients admitted to post-acute rehabilitation following COVID-19 to the patients who participated in our study. When compared, study participants were found to be

similar in terms of race, sex, age, and BMI. Of all COVID-19 admissions, most patients were admitted for debility (66.1%) followed by right hemisphere stroke (6.5%), non-traumatic brain injury (4.8%), polyneuropathy (4.8%), and neuromuscular disorders (4.8%). Of patients who answered the questionnaire, most presented with debility (94.4%) (Table 1). There was no significant difference in acute hospitalization length of stay or rehabilitation length of stay between all COVID-19 patients admitted and the COVID-19 patients who completed the questionnaire (Table 1). Functional independence levels assessed by the GG subscale were not found to be statistically different at admission or discharge between patients in our study as compared to COVID-19 rehabilitation admissions overall. The COVID-19 patients surveyed had a similar discharge destination to all COVID-19 admissions. In most cases COVID-19 patients returned home following rehabilitation. Subacute nursing facility (SNF) discharges were low (4.7%) among all COVID-19 patients, and there were no SNF discharges included in the patients surveyed. Two patients with COVID-19 passed away while in rehabilitation.

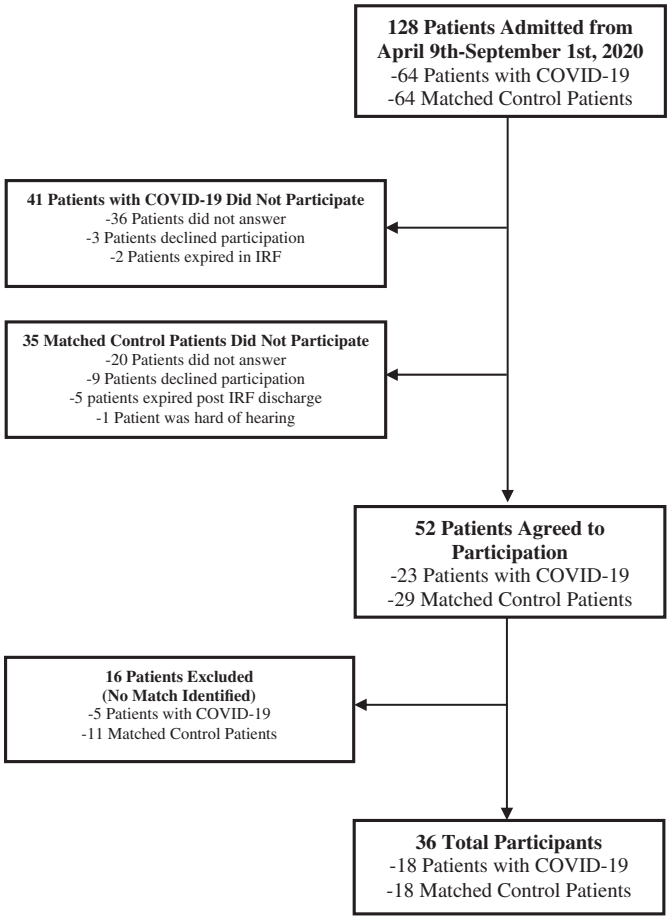

FIGURE 1 Flowchart for rehabilitation patients enrolled in the study. IRF, inpatient rehabilitation facility

Table 2 compares the matched control group participants to the 18 patients with COVID-19. A comparison of patient demographics revealed no statistically significant difference in race, sex, age, and BMI. Patients with COVID-19 compared to the control group had a significantly longer acute hospitalization length of stay of 18 days as compared to 9 days, respectively (Table 2, 95% confidence interval [CI]: 0.39-15.2, $P < .05$). More patients with COVID-19 required oxygen during acute hospitalization as compared to controls (Table 2). In terms of the condition prior to hospitalization, there was no significant difference between prior self-care, functional cognition, and prior living setting. Patients in the control group did have significantly more comorbidities as compared to the COVID-19 group (Tables 2, 95% CI: 1.4-8.4, $P < .01$).

On admission assessments, physicians and advanced practice practitioner believed that 94% of the COVID cohort had cognitive dysfunction as compared to 44.4% of the cohort. A Montreal Cognitive Assessment (MoCA) was completed in 16 of the COVID-19 cohort patients during their admissions. These assessments indicated mild to moderate impairment (scores <26) in 10 of 16 patients, with an average score of 23. There was no evidence of a comorbid neurological diagnosis for any of the COVID-19 cohort members. Nervousness and anxiety were more frequently documented in COVID-19 patients (61.1%) compared to patients in the control cohort (22.2%). A comparison of the GG subscale scores at admission revealed similar levels of impairments in the functional independence levels of patients in both cohorts. Furthermore, patients in the COVID-19 cohort were found to reach functional independence levels at discharge similar to their matched controls. All patients were discharged home, with the majority of patients in both cohorts receiving home care services such as visiting nurses or therapy.

Readmission and follow-up care

Table 3 compares the answers to the questionnaire between patients of the control group and patients with COVID-19. Rehospitalizations occurred at a rate of 22.2% in patients with COVID-19 infection. All four hospital readmissions for COVID-19 occurred within the first 30 days of discharge. Two of these rehospitalizations were determined to be related to sequala of COVID-19. The 30-day hospital readmission rate did not differ between patients with COVID-19 and patients of the control group. There was a significant difference between groups in hospital readmissions between 30 and 90 days. Hospital readmissions were not present between 30 and 90 days within the COVID-19 group, compared 38.9% of control patients requiring a hospital readmission ($P < .05$). Urgent care and emerency room visits were found to occur at similar

TABLE 1 Comparison of the Characteristics of Patients with COVID-19: Total COVID-19 Rehabilitation Admissions vs Group Surveyed

	All COVID-19 admissions N = 64	**COVID-19 phone call participants N = 18**
Demographics		
Race—N (%)		
Asian	16 (25.0)	2 (11.1)
African American	6 (9.4)	2 (11.1)
Hispanic Latino	6 (9.4)	0 (0)
Pacific Island	1 (1.6)	1 (5.6)
White	35 (54.7)	13 (72.2)
Sex—N (% female)	27 (42.2)	8 (44.4)
Age (years)—median (IQR)	64 (55–76)	66 (58–72)
BMI (kg/m^2)—median (IQR)	26.0 (22.5–29.4)	28.7 (25.8–30.5)
Acute hospitalization		
Length of stay (days), median, (IQR)	18 (10–28)	18 (11–31)
Rehab hospitalization		
Length of stay (days), median (IQR)	13 (8–20)	10 (7–16)
Impairment group category—N (%)		
Right hemisphere stroke/L paresis	4 (6.3)	0
Left hemisphere stroke/R paresis	1 (1.6)	0
Stroke no paresis	1 (1.6)	0
Nontraumatic brain injury	3 (4.7)	0
Polyneuropathy	2 (3.1)	0
Guillain-Barr syndrome	1 (1.6)	0
Neuromuscular disorders	3 (4.7)	0
Hip fracture	1 (1.6)	0
Cardiac	2 (3.1)	0
COPD	1 (1.6)	1 (5.6)
Brain and multiple fractures	1 (1.6)	0
Debility	44 (68.8)	17 (94.4)*
BIMS	14 (11–15)	15 (13–15)
Functional measures		
GG subscale on admission—score		
Median (IQR)	49 (33–59)	56 (45–61)
GG Subscale on discharge—score		
Median (IQR)	86 (68–94)	89 (75–94)
Discharge living setting		
Home	22 (34.4)	7 (38.9)
Home with Home Health Service Org	34 (53.1)	10 (55.6)
Acute hospital	3 (4.7%)	1 (5.8)
Subacute nursing facility	3 (4.7)	0 (0)
Died	2 (3.1%)	0 (0)

Categorical variables (race, sex, impairment group category) were compared using Fisher's exact tests. Continuous variables (age, BMI, length of hospitalizations, CAREtool scores) were compared using independent sample *t*-tests. "*" indicates a significant difference as compared to control, $P < .05$. BMI, body mass index; BIMS, Brief Interview for Mental Status; COPD, chronic obstructive pulmonary disease; IQR, interquartile range

rates for patients with COVID-19 and control patients, 22.2% and 16.7%, respectively (Table 3).

Follow-up appointments with outpatient providers occurred at a rate of 100% for both cohorts. There was no significant difference in the percentage of patients who followed up with their primary care physician following discharge between patients with COVID-19 and the control group, 82.4% and 70.6%, respectively. Patients with COVID-19 were found to make twice as many visits to their primary care physician as patients

TABLE 2 Comparison of Control and COVID-19 Patients who Completed Phone Surveys

	Control phone call group N = 18	**COVID-19 phone call group N = 18**
Demographics		
Race—N (%)		
Asian	1 (5.6)	2 (11.1)
African American	0 (0)	2 (11.1)
Pacific Island	0 (0)	1 (5.6)
White	17 (94.4)	13 (72.2)
Sex—N (% female)	12 (66.7)	8 (44.4)
Age (years)—median (IQR)	68 (61–78)	66 (58–72)
BMI—kg/m^2	27.8 (24.2–33.3)	28.7 (25.8–30.5)
Prior condition		
Prior self care (n, % Indep.)	17 (94)	18 (100)
Prior functional cognition (n,% Indep)	15 (83.3)	17 (94.4)
Prior living setting (n, % home)	18 (100)	17 (94.4)
Prior oxygen use (n,%)	3 (17.6)	0 (0)
Acute hospitalization		
O_2 use (n,%)	11 (61.1)	17 (94.4%)*
Trach placed (n,%)	1 (5.6)	2 (11.8)
LOS (median, IQR)	9 (5–16)	18 (11–31)*
Rehab hospitalization		
Length of stay (median, IQR)	10 (7–13)	10 (6–15)
Impairment group category—N (%)		
Debility	17 (94.4)	17 (94.4)
COPD	1 (5.6)	1 (5.6)
BIMS (median, IQR)	15 (13–15)	15 (13–15)
Total number of comorbidities per patient—N (%)	20 (15–25)	15 (12–18)*
Asthma	3 (16.7)	2 (11.1)
Chronic kidney disease	6 (33.3)	1 (5.6)
COPD	6 (33.3)	2 (11.1)
Coronary artery disease	5 (27.8)	4 (22.2)
Difficulty walking	8 (44.4)	9 (50)
Fatigue	13(72.2)	17 (94.4)
Hyperlipidemia	8 (44.4)	8 (44.4)
Hypertension	14 (77.8)	16 (88.9)
Muscle weakness	11 (61)	9 (50)
Symptoms involving cog function and awareness	8 (44.4)	17 (94.4)*
Anxiety/nervousness	4 (22.2)	11(61.1)*
Major depressive disorder	7 (38.9)	2 (11.1)
GG subscale admit (median, IQR)	55 (47–60)	56 (45–61)
GG subscale discharge (median, IQR)	87 (73–95)	89 (75–94)—see note
Discharge living setting (% with home care)		
Home	8 (44.4)	7 (38.9)
Home with Home Health Service Org	10 (55.6)	10 (55.6)
Acute hospital	0 (0)	1 (5.6)

Categorical variables (race, sex, impairment group category) were compared using Fisher's Exact tests. Continuous variables (age, BMI, length of hospitalizations, CAREtool scores) were compared using independent sample *t*-tests.''*'' indicates a significant difference as compared to control, $P < .05$. Note that CARETool discharge scores were only collected for 16 patients in the COVID-19 phone-call group due to having incomplete stays. BMI, body mass index; BIMS, Brief Interview for Mental Status; COPD, chronic obstructive pulmonary disease; IQR, interquartile range; LOS, length of stay

TABLE 3 Long-term outcomes for COVID-19 patients following rehabilitation

	Control phone call group Number (%)	COVID-19 phone call group Number (%)
Hospital readmissions		
Total 0–90 days (n,%)	11 (61.1)	4 (22.2)*
Due to rehab diagnosis (n,%)	3 (16.7)	2 (11.1%)
0–30 days (n,%)	5 (27.8)	4 (22.2)
30–90 days (n,%)	7 (38.9)	0 (0%)*
Urgent care/ER visits		
Total 0–90 days (n,%)	3 (16.7)	4 (22.2)
Due to rehab diagnosis (n,%)	2 (11.1)	2 (11.1)
Outpatient visits		
Total 0–90 days (N,%)	17 (100)	17 (100)
Total outpatient visits per patient (median, IQR)	5 (3–8)	4 (2–6)
PCP (n,%)	12 (70.6)	14 (82.4)
PCP visits per patient (median, IQR)	1 (0–2)	2 (1–3)*
Cardiology (n,%)	6 (35.3)	8 (47.1)
Cardiology visits per patient (median, IQR)	0 (0–2)	0 (0–2)
Pulmonary (n,%)	4 (23.5)	7 (41.2)
Pulmonary visits per patient (median, IQR)	0 (0–1)	0 (0–2)
Neurologist (n, %)	4 (23.5)	0 (0)
Neurologist median, IQR)	0 (0–1)	0 (0–0)
Other (n%)	11 (64.7)	5 (33.3)
Other (median, IQR)	2 (1–3)	0 (0–2)*
Outpatient PT/OT/speech (n,%)	5 (27.8)	2 (11.1)
Home care		
Total nursing (n,%)	11 (61.1)	9 (50)
Total PT/OT/speech (n,%)	8 (44.4)	7 (38.9)

Categorical variables (n,% of patients receiving care) were compared using Fisher's exact tests. Continuous variables (number of visits) were compared using independent sample *t*-tests.'"*"' indicates a significant difference as compared to control, $P < .05$. Note that outpatient follow-up data were collected only for 17 patients in each group. ER, emergency room; IQR, interquartile range; PCP, primary care provider; PT, physical therapy; OT, occupational therapy

in the control group (Table 3, CI: 0.02 to 1.9, $P < .05$). In addition, specialty outpatient providers, such as cardiology, pulmonology, and neurology, were not utilized at a different rate between patients. The control group had a significantly higher number of visits with specialty providers not included in our list, likely due to the larger variety of preexisting comorbidities (2 vs 0, $P < .05$, Table 3).

DISCUSSION

Patients with COVID-19 made significant functional recoveries during inpatient rehabilitation, and were discharged at functional independence levels comparable to their age- and impairment-matched controls. These patients will require significant medical resources and a continuum of care over several months to recover due to the severity and the resulting functional and cognitive deficits of their illness. Patients with COVID-19 in this study were, on average, in hospital level of care (acute care and IRF) for nearly a month recovering from their illness before transitioning home with additional support of home care or outpatient therapy.

Both functional status and comorbidities have been shown to be predictors of 30-day readmissions following inpatient rehabilitation.[14] Although our study did not see a difference in the functional status between COVID-19 and other debility patients at discharge, patients in the control group did have many pre-existing comorbidities. The comorbidities that were most common in the control group were chronic obstructive pulmonary disease (COPD), asthma, chronic kidney disease, hypertension, and coronary artery disease. The control group also required more specialist provider follow-up care than did the COVID-19 group. It is likely that the presence of these comorbidities led to a higher rate of readmissions and follow-up care with a specialist in the control group. Primary care physicians tended to provide COVID-19 patients significant support upon their return to the community and were the main source of medical care after discharge from acute rehabilitation.

Although, many studies have identified risk factors that appear to predispose individuals to experience more severe illness from COVID-19, it is not yet fully understood which patients with these risk factors will progress on to develop severe illness. In acute care, we found COVID-19 patients that required rehabilitation before going home had twice as long of a length of stay (18 vs 9 days) as the control cohort. This is likely due to multiple factors such as severity of illness, need for intensive care unit (ICU) level care, oxygen requirements, as well as external factors such as skilled nursing facility bed availability in the community. Despite having longer acute hospitalizations, rehabilitation outcomes, including functional independence scores and length of rehabilitation stay, were similar.

Also of interest, 94% of patients with COVID-19 in this study carried the ICD-10 code of deficits of cognitive function and self-awareness. This reflects cognitive deficits in ''processing'' documented by the providers and advanced practice practitioners. This varied significantly from the control group at 44%. This was supported by MoCA scores obtained for the COVID-19 cohort indicating mild to moderate impairments present. It is hard to say if psychological factors contributed to low scores on the MoCA as nervousness or anxiety were diagnosed in 11 of 18 COVID-19 patients. More comprehensive cognitive assessments are warranted, as

cognitive dysfunction has been identified as a potential sequela of COVID-19[15-18] and nearly all the patients in this study had some form of cognitive dysfunction. The finding of cognitive dysfunction has been identified previously in COVID-19 patients; however, not to the extent seen in this cohort. Studies examining rates of delirium or other neurological symptoms among COVID-19 ICU patients have noted rates as high as 84%.[19] Although the exact etiology is unclear, it is likely that the severity of illness and prolonged hospitalization may be contributing factors.

Our study demonstrated that patients with COVID-19 had similar improvements in functional outcomes as compared to controls. We demonstrated that patients with COVID-19 required fewer readmissions than their matched controls in the 30- to 90-day periods and required fewer follow-up visits with specialists after discharge from inpatient rehabilitation. Patients who require acute rehabilitation due to severe COVID-19 may display cognitive dysfunction.

LIMITATIONS

These results represent the findings of a single institution cohort and may not be representative of patients at other IRFs. Patients in the study were admitted for rehabilitation between April and September of 2020, a time-frame in which the treatment strategies for COVID-19 were rapidly evolving. This may have increased the variability of our outcomes, and perhaps even impacted the long-term outcomes of the patients studied. Ninety-four percent of those surveyed were of the debility impairment group category. Patients with COVID-19 with other rehabilitation impairments, such as stroke, non-traumatic brain injury, or neuromuscular or cardiac-related impairments may have different needs post discharge. The survey data are limited by recall bias in those answering a phone survey. Given that most patients with COVID-19 were found to have some cognitive dysfunction while at rehabilitation, it is possible they were prone to over- or under-reporting. The accrual rate (28%) is low, but in line with other phone-response rates.[20] Not being able to connect with patients was the number 1 reason for low accrual in our study. Low accrual rates may lead to selection bias. The power of our analysis may allow for small or moderate differences in outcomes to go undetected.

CONCLUSIONS

The functional outcome data suggest that the COVID-19 patient group recovered with rehabilitation efficiencies similar to those of their controls. Patients with functional deficits as a result of COVID-19, requiring multiple therapy disciplines, should be considered for acute inpatient rehabilitation, as this study demonstrates their ability to participate in and benefit from IRF level care.

CONFLICTS OF INTEREST

None.

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