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Challenges and Lessons Learned for Acute Inpatient Rehabilitation of Persons With COVID-19

Clinical Presentation, Assessment, Needs, and Services Utilization

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Objective: The aim of the study was to present: (1) physiatric care delivery amid the SARS-CoV-2 pandemic, (2) challenges, (3) data from the first cohort of post–COVID-19 inpatient rehabilitation facility patients, and (4) lessons learned by a research consortium of New York and New Jersey rehabilitation institutions.

Design: For this clinical descriptive retrospective study, data were extracted from post–COVID-19 patient records treated at a research consortium of New York and New Jersey rehabilitation inpatient rehabilitation facilities (May 1–June 30, 2020) to characterize admission criteria, physical space, precautions, bed numbers, staffing, employee wellness, leadership, and family communication. For comparison, data from the Uniform Data System and eRehabData databases were analyzed. The research consortium of New York and New Jersey rehabilitation members discussed experiences and lessons learned.

Results: The COVID-19 patients ($N = 320$) were treated during the study period. Most patients were male, average age of 61.9 yrs, and 40.9% were White. The average acute care length of stay before inpatient rehabilitation facility admission was 24.5 days; mean length of stay at inpatient rehabilitation facilities was 15.2 days. The rehabilitation research consortium of New York and New Jersey rehabilitation institutions reported a greater proportion of COVID-19 patients discharged to home compared with prepandemic data. Some institutions reported higher changes in functional scores during rehabilitation admission, compared with prepandemic data.

Conclusions: The COVID-19 pandemic acutely affected patient care and overall institutional operations. The research consortium of New York and New Jersey rehabilitation institutions responded dynamically to bed expansions/contractions, staff deployment, and innovations that facilitated safe and effective patient care.

What Is Known

- The COVID-19 pandemic posed challenges to delivering physiatric care for COVID-19 patients.

What Is New

- In response to the COVID-19 pandemic, we formed a research consortium of rehabilitation institutions in New York-New Jersey Rehabilitation Consortium (NY-NJ-RC) to discuss challenges encountered and approaches adapted for delivering physiatric care for COVID-19 patients. Here, we discuss our experiences and present summary data from 320 patients treated at consortium institutions, where the average length of stay was 15.2 days. Many NY-NJ-RC institutions reported a greater proportion of COVID-19 patients discharged to home compared with Uniform Data System and eRehabData. Some institutions reported higher changes in functional scores during rehabilitation admission, compared with prepandemic data. These data support the concept that inpatient rehabilitation is beneficial for COVID-19 patients.

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In 2020, the novel coronavirus 2 (SARS-Cov-2) resulted in the ongoing global pandemic. The first confirmed case of coronavirus disease 2019 (COVID-19) in the United States (US) was reported on January 21, 2020.[1,2] The first cases in New York (NY) and New Jersey (NJ) were reported on February 29 and March 4, 2020.[3,4] Subsequently, the NY-NJ metropolitan area became the first US epicenter of the pandemic. Early in the pandemic, COVID-19 testing was limited to patients admitted to the hospital; patients with mild symptoms (e.g., fever) were sent home from the emergency department to quarantine. Within weeks, the local healthcare system was overwhelmed, with drastic shortages of hospital beds, equipment, and personal protective equipment. The hospital bed crisis led to mandates by NY and NJ governors requiring each hospital to increase capacity by 50% to accommodate acute medical needs of COVID-19 patients.[5,6]

Patients with moderate to severe COVID-19 are at high risk of hospital admission and developing acute respiratory distress syndrome requiring intensive care unit admission. In March 2020, 5700 patients with COVID-19 were admitted to an NY-based health system: 20% of patients required mechanical ventilation, of whom 20.4% died.[7] In April 2020, 2490 patients with COVID-19 were admitted to another NY-based system: 22% of patients required mechanical ventilation (JH, Mount Sinai Hospital, New York City, NY). Prolonged stay and immobilization in an intensive care unit can lead to lasting physical, cognitive, and psychological impairments that are part of the postintensive care syndrome.[8–10] Previous longitudinal studies of acute respiratory distress syndrome survivors, not necessarily related to COVID-19, showed persistent weakness affecting as many as 65% of survivors, with functional deficits resulting in the inability to return to work 1 yr after hospital discharge.[11] Persons with intensive care unit–related debility have significantly lower strength, function, and quality of life, as well as higher mortality, up to 5 yrs later.[12,13]

COVID-19 survivors can develop complications beyond physical and psychosocial manifestations of traditional acute respiratory distress syndrome. Preliminary studies showed up to 50% of people with COVID-19 developed neurological manifestations, including ischemic and hemorrhagic stroke, disorders of consciousness, encephalopathy, and polyneuropathy, whereas others experienced digit and/or limb amputations, dysphagia, and pressure injuries.[14–16] Other studies reported persistent symptoms of dysautonomia in COVID-19 survivors.[17] After discharge from acute care hospitals, many COVID-19 survivors required intensive rehabilitation because of significant weakness, muscle wasting, psychological issues, neurological, and musculoskeletal impairments.[16]

Early in the pandemic, little was known regarding how to best promote recovery from and rehabilitation for survivors of severe COVID-19; however, optimization of functional and medical status before returning home was paramount. The first surge of acute care COVID-19 patients catalyzed inpatient rehabilitation facilities (IRFs) in the NY-NJ area to develop novel practice methods and clinical algorithms to deliver care to rehabilitation patients.[18] In response to the pandemic, the NY-NJ COVID-19 Rehabilitation Consortium (NY-NJ-RC) formed to share knowledge and best practices during this crisis. The objectives of this report are to present: (1) approaches to care delivery amid the pandemic; (2) challenges encountered at institutions amid changing institutional, local, state, and federal guidelines/mandates; (3) demographic and clinical data from the first cohort of COVID-19 IRF patients from NY-NJ-RC institutions; and (4) lessons learned from our experiences.

METHODS

Institutional members of NY-NJ-RC are: Donald and Barbara Zucker School of Medicine at Hofstra Northwell, Albert Einstein College of Medicine/Burke Rehabilitation Hospital (Burke)/Montefiore Health System, Icahn School of Medicine at Mount Sinai (Mount Sinai), Kessler Institute for Rehabilitation (Kessler), JFK Johnson Rehabilitation Institute at HMH/Rutgers-Robert Wood Johnson Medical School and Hackensack Meridian School of Medicine (JFK Johnson), NY Presbyterian/Columbia University College of Physicians and Surgeons/Weill Cornell School of Medicine (NYP), and Rusk Rehabilitation/NYU Grossman School of Medicine, NYU Langone Health (NYU). The NY-NJ-RC met regularly via electronic platforms to share challenges, experiences, and best practices. Local institutional regulatory board permission was granted at each institution before study commencement; written informed consent was not required for this retrospective study. To address our first two objectives, study personnel at each institution identified common themes, which were refined through iterative discussions: admission criteria, physical space, precautions, bed expansion/contraction, staffing, employee wellness, and leadership (Table 1).

To address the third objective, data were collected retrospectively from COVID-19 patient charts at NY-NJ-RC IRFs treated from May 1 to June 30, 2020. Institutions provided aggregate data (demographics, clinical outcomes); because of logistical and regulatory issues, individual patient data were not shared. Six institutions provided aggregate data from the first 50 hospitalized patients they admitted, and one (Mount Sinai) provided data from 20 patients, because of temporary closure of their IRF. Functional changes were extracted from medical records using a validated standardized scoring system that has replaced the Functional Independence Measure in IRFs, in accordance with scores from the US Centers for Medicare and Medicaid Services (CMS) mandated section GG Functional Abilities and Goals of the Improving Post-Acute Care Transformation Act (Table 2). GG scores measure changes related to self-care (GG0130) and mobility (GG0170). The scales range from 1 to 6, where 1 indicates "dependent" and 6 indicates "independent." A greater change in GG score indicates greater improvement in functional independence. Summary statistics (means, SDs, proportions) on demographic variables such as age, sex, race/ethnicity, and clinical outcomes (hospital length of stay [LOS], rehabilitation unit LOS, discharge disposition, impairment group, changes in GG self-care, and GG mobility scores) are provided.

For comparison, we extracted summary data from the Uniform Data System (UDS) and eRehabData (eRehabData) databases for patients treated for "debility" during the last quarter of 2019 (prepandemic). The impairment group code (IGC) from the CMS that consortium members collectively decided best characterized the diagnosis of COVID-19 was "debility" (IGC 16; Table 3). Hence, data extracted from these databases were for patients fitting the Debility IGC. We assumed that the

TABLE 1. Approaches to acute rehabilitation care delivery amid the COVID-19 pandemic: comparisons across institutions

	Northwell	NYP	Burke	JFK Johnson	Kessler	NYU	Montefiore	Mount Sinai
Admission criteria for COVID-19 + patients	Must be 7 d from initial symptom onset, at least 3 d since fever resolution, improvement in respiratory symptoms	Patients who could not tolerate 3 hrs of therapy were accepted if felt they would progress to 3 hrs of therapy	Demonstrating clinical recovery of symptoms, having rehabilitation goals	Must be 7 d from initial symptom onset, at least 3 d since fever resolution, without fever-reducing meds, improvement in respiratory symptoms	Must be 10 d from symptoms onset, 48 hrs afebrile	Must be 7 d from initial symptom onset, at least 3 d since fever resolution.		Closed initially, when reopened patients had to have negative COVID-19 test or be cleared by infection control
Oxygen criteria	<5 L	X	<6 L	< or equal to 5 L	<5 L or 40% FiO$_2$	X	NA	X
COVID-19 unit	✓	X	X	✓	✓	✓	NA	X
Separate therapy space	✓	X	X	✓	✓	✓	NA	X
Droplet, contact, and eye precautions	✓	✓	✓	✓	✓	✓	NA	X
Bed expansion/contraction	+10	+18	+14	−40	−50%	+14	NA	X
IRF physician	IRF	IRF	IRF	IRF	IRF	IRF	Inpatient consults	Redeployed COVID monitoring program.
Outpatient physician								
• Telehealth	✓✓	✓✓	✓✓✓	✓✓	✓	X	✓✓	X
• Redeployed	✓✓	✓	✓	X	X	✓✓	✓✓	✓
• Back-up consult/consult service			✓	✓	X	✓✓		
• Other			X "weekly Burke is Buoyant newsletter"				COVID monitoring program	
Therapy								
• Proning teams	✓	✓	X	✓✓	X	X	✓✓	X
• Redeployed to acute care, rehab, or testing	X	X	✓	✓✓	X	✓	✓✓	✓
Staff wellness								
• Recharge room/respite	✓	X	✓	✓	X	X	✓	✓
• Free or donated food	✓	X	✓	✓	X	✓	✓	✓
• Mental health services		✓		✓	✓	X	✓	✓

(Continued on next page)

TABLE 1. (Continued)

	Northwell	NYP	Burke	JFK Johnson	Kessler	NYU	Montefiore	Mount Sinai
Departmental or hospital-wide calls/updates	✓	✓	✓	✓	✓	✓	✓	✓
Biggest challenge								
• Disease management	✓	✓	✓	✓	X	✓	✓	✓
• Staff anxiety/uncertainty	✓	✓	✓	✓	✓	✓	✓	✓
• Other						Burnout, social isolation	Loss of IRF beds, redeployment of rehabilitation clinicians	

✓, occurred at that site; X, did not occur at that site; Montefiore, Albert Einstein College of Medicine, Montefiore Hospital, Montefiore Health System; NA, not applicable at that site because of temporary closure; Northwell, Glen Cove Hospital.

means and proportions obtained during this period, which were based on large sample sizes, were a good estimate of the pre-COVID sample means and proportions. These data were selected because NY-NJ-RC IRFs use either UDS or eRehab to track and report their outcomes to CMS.

For a specific continuous variable of interest (e.g., age, mobility scores, length of hospital stay, etc.), under the assumption of normality, we applied the one-sample t test to compare each institution's mean value to the assumed population mean value from the corresponding national (UDS or eRehab) database. For categorical variables (e.g., sex, race, disposition), the χ^2 test was used to compare the observed proportions in each institution to the corresponding hypothesized distribution from the national database. All statistical tests (2-tailed, $\alpha = 0.05$) were performed using SAS 9.4 (Cary, NC). The t test was applied to variables that may have had skewed or nonnormal distribution related to LOS (onset days, rehabilitation LOS), as well as GG scores (mobility and self-care), as we were unable to determine normality of the data, because we only had summary or aggregate data.

To address our fourth objective, NY-NJ-RC members present their experiences (Results, Discussion, Table 1). Members met weekly for unstructured discussions of challenges faced and lessons learned from delivering care during the pandemic. The first author created a written draft of Table 1, consisting of themes that were raised by consortium members. Table 1 was circulated to members to answer questions posed and to characterize common themes/experiences in natural language. Interviews were not transcribed, but written notes on themes and issues presented in the table were exchanged by members.

RESULTS

To address the first objective, describing approaches to care delivery amid the pandemic, section 1A–F includes a narrative discussion of major challenges faced and approaches to meeting them at IRFs (Table 1): physical facility, admissions process, staffing, delivery of care, discharge planning, and leadership. To address the second objective, section 2 includes a narrative description of challenges encountered. To address the third objective, section 3 presents demographic and clinical data from the first cohort of COVID-19 IRF patients treated at consortium institutions (Tables 2, 3). To address the fourth objective, the Discussion shares more of our experiences and lessons learned.

Approaches to the Pandemic

Physical Facility Challenges for IRF Units

At IRFs, patients typically spend a significant amount of time in communal spaces. Historically, there is a considerable amount of comingling and social interactions between patients and staff, as well as use of shared equipment. In NY-NJ-RC IRFs in early 2020, physical space was adapted to comply with social distancing and infection control policies recommended by the CDC and local hospital guidelines. Decisions on standard operating procedures included consideration of obtaining personal protective equipment, feasibility of mixing practitioners between units, rooms, and patient populations to optimize therapy delivery, and complying with new, evolving guidelines. New spaces, such as therapy gyms and units, were

TABLE 2. Clinical and demographic characteristics of COVID-19 patients

2A. Sex Distribution				2B. Age Distribution	
Institution	Male (*n* = 207), *n* (%)	Female (*n* = 113), *n* (%)	*P*[a]	Age, Mean ± SD, yr	*P*[a]
Northwell (*n* = 50)	33 (66%)	17 (34%)	0.0108	60.42 ± 15.06	<0.0001
Burke (*n* = 50)	29 (58%)	21 (42%)	0.3958	67.66 ± 12.13	0.5206
Mount Sinai (*n* = 20)	13 (65%)	7 (35%)	0.1281	6200 ± 12.84	0.0012
Kessler (*n* = 50)	28 (56%)	22 (44%)	0.5713	63.80 ± 16.62	0.0396
NYP (*n* = 50)	29 (58%)	21 (42%)	0.1570	56.20 ± 14.20	<0.0001
NYU (*n* = 50)	42 (84%)	8 (16%)	<0.0001	58.84 ± 16.75	<0.0001
JFK Johnson (*n* = 50)	33 (66%)	17 (34%)	0.0475	64.54 ± 12.16	0.0175
UDS (*n* = 534)	48%	52%		72.90	
eRehabData (*n* = 30,865)	52%	48%		68.77	

2C. Race/Ethnicity	White	Other	Asian	Black	Hispanic	Unknown
Institution	*n*	*n*	*n*	*n*	*n*	*n*
Northwell	15	8	6	5	1	15
Burke	25	1	2	13	9	0
Mount Sinai	4	1	3	6	6	0
Kessler	26	4	3	17	0	0
NYP	10	6	4	7	14	9
NYU	27	10	7	4	2	0
JFK Johnson	14	1	9	15	11	0
Total, *n*	121	31	34	67	43	24
Total, %	40.88	10.47	11.49	22.64	14.53	8.11
UDS data 2019, *n*	372	3	15	82	41	
UDS data 2019, %	69.60%	4.10%	2.80%	15.40%	7.60%	
eRehabData 2019, *n*	Not available					
eRehabData 2019, %	Not available					

2D. Onset (Acute Hospital Stay) Distribution			2E. Rehab LOS Distribution	
Institution	Onset, Mean ± SD, d	*P*[a]	Rehab LOS, Mean ± SD, d	*P*[a]
Northwell (*n* = 50)	23.48 ± 15.30	0.0001	16.42 ± 7.79	0.0006
Burke (*n* = 50)	9.94 ± 10.56	0.0022	15.56 ± 11.91	0.8179
Mount Sinai (*n* = 20)	42.00 ± 17.70	<0.0001	17.30 ± 6.56	0.0034
Kessler (*n* = 50)	13.60 ± 10.43	0.4354	18.56 ± 9.66	0.0166
NYP (*n* = 50)	28.88 ± 22.08	<0.0001	10.94 ± 5.87	0.0849
NYU (*n* = 50)	24.51 ± 11.82	<0.0001	11.77 ± 7.79	0.5700
JFK Johnson (*n* = 50)	29.42 ± 23.45	<0.0001	15.72 ± 6.65	0.5613
UDS data (*n* = 534), mean SD = NA	14.50		12.40	
eRehabData (*n* = 30,865), mean SD = NA	14.76		15.17	

Note: Northwell, Mount Sinai, NYP, and NYU contribute to UDS database; Burke, Kessler, and JFK Johnson contribute to the eRehab database.

[a]*P* value compares each institution's values to the corresponding assumed population distribution from the database to which institution contributes.

Montefiore, Albert Einstein College of Medicine, Montefiore Hospital, Montefiore Health System; NA, not applicable at that site because of temporary closure; Northwell, Glen Cove Hospital; SD, standard deviation; NA, not available.

created rapidly to enable therapy for patients on precautions (Table 1).

Inpatient Rehabilitation Facility Admissions Process

Transfer of COVID-19 patients from acute care hospitals to IRFs depended on the CDC guidance and State Department of Health (DOH) rules, which changed several times during March–June 2020. Challenges included admitting the most disabled patients, patients with tracheostomies who were at higher risk for aerosolizing, and patients who were still symptomatic with cough or dyspnea. Patient admission to an IRF can take 24–48 hrs and typically involves multiple disciplines. In the US, insurance authorization is often required for patients to transition to IRFs. This process can require both time and personnel resources. The CMS 1135 rule waiver issued during the pandemic declared a public health emergency including a waiver of the normal preauthorization process, reducing administrative barriers and enabling transfers from acute hospitals to IRFs.[19] This allowed some hospitals to increase available beds and expedite the admissions process.[18]

TABLE 3. Function-related clinical scores (A–D)

3A. IGC, n^a	Debility	Stroke	Neurological Conditions	Brain Dysfunction	Amputation	Cardiac	Nontraumatic Spinal Cord Dysfunction	Pulmonary	Medically Complex Infection	Orthopedic Disorders
Northwell	28	10	7	3	1	1	0	0	0	0
Burke	32	6	2	2	0	4	0	1	0	3
Mount Sinai	9	5	5	1	0	0	0	0	0	0
Kessler	5	15	1	1	1	0	1	0	17	1
NYP	0	0	0	0	0	0	0	50	50	0
NYU	50	0	0	0	0	0	0	0	50	0
JFK Johnson	10	3	0	0	0	0	1	36	0	0
Total n^a	134	39	15	7	2	5	2	87	117	4

UDS data 2019: all debility data
eRehabData 2019: unavailable at this time

3B. Change in GG Scores	Self-care, Mean ± SD	P	Mobility, Mean ± SD	P
Northwell	15.88 ± 7.59	0.0021	37.58 ± 7.03	0.0045
Burke	15.60 ± 5.20	<0.0001	27.00 ± 6.99	<0.0001
Mount Sinai	13.93 ± 6.80	0.3269	34.57 ± 17.01	0.2866
Kessler	15.00 ± 7.34	<0.0001	41.25 ± 14.66	<0.0001
NYP	10.43 ± 5.40	0.0129	12.13 ± 5.20	<0.0001
NYU	13.54 ± 7.17	0.2664	37.11 ± 13.84	0.0012
JFK Johnson	14.04 ± 6.93	<0.0001	32.68 ± 13.52	<0.0001
UDS data 2019 (change in scores), SD = NA	12.40		30.40	
eRehabData 2019 (change in scores facility observed), SD = NA	9.76		11.44	

3C. Discharge Disposition Institution	Home (*n* = 262), n (%)	Acute Hospital (*n* = 27), n (%)	SAR (*n* = 31), n (%)	P
Northwell (*n* = 50)	44 (88%)	2 (4%)	4 (8%)	0.0085
Burke (*n* = 50)	31 (62%)	8 (16%)	11 (22%)	0.3730
Mount Sinai (*n* = 20)	12 (60%)	5 (25%)	3 (15%)	0.6246
Kessler (*n* = 50)	37 (74%)	7 (14%)	6 (12%)	0.6171
NYP (*n* = 50)	46 (92%)	2 (4%)	2 (4%)	0.0013
NYU (*n* = 50)	46 (92%)	3 (6%)	1 (2%)	0.0012
JFK Johnson (*n* = 50)	46 (92%)	0 (0%)	4 (8%)	0.0032
UDS (*n* = 534)	363 (68%)	91 (17%)	80 (15%)	
eRehab (*n* = 30,865)	21,914 (71%)	3704 (12%)	5247 (17%)	

^{a}Note: Some sites used more than one impairment code per patient, so numbers do not equal the number of patients.

Montefiore, Albert Einstein College of Medicine, Montefiore Hospital, Montefiore Health System; Northwell, Glen Cove Hospital; SAR, subacute rehabilitation facility; SD, standard deviation; NA, not available.

Staffing

During the first surge, understaffing was due to several reasons, including staff sickness (e.g., 45% of residency programs in NY City reported having at least one resident sick with COVID-19).[20] Platooning schedules for residents and attending physicians were used. The IRF staff members were also redeployed to other acute medical and COVID-19 units.[20] Flexibility and comradery among physicians, therapists, and other staff allowed IRFs to adapt to changing institutional needs (Table 1). Physical, occupational, and speech therapists provided vital services across the rehabilitation continuum. In the acute care setting, they participated in proning and mobilizing acutely ill patients. In IRFs, they treated patients who had high oxygen requirements, wounds, and/or autonomic dysfunction. All staff had to adapt to changes in space and equipment resulting from isolation precautions.

Delivery of Care

COVID-19 survivors presented unique challenges that required modifications to the standard IRF rehabilitation program. Tachypnea, oxygen desaturation with exertion, and tachycardia made patient mobilization challenging. High rates of delirium, cognitive dysfunction, anxiety, and malnutrition required specialized services for almost every patient.[15] Proning techniques to improve oxygenation in intensive care units may have contributed to entrapment neuropathies, as well as pressure wounds.[21] Treating many patients with stages 3 and 4 pressure injuries required ordering more specialized equipment. Having access to wound care teams to perform examinations and in-person debridements was critical. The CMS 1135 rule waiver allowed flexibility regarding therapy delivery by suspending therapy intensity requirements, "which traditionally requires 15 hours per week of inpatient therapy for patients

in IRFs, allowing telehealth to be used in lieu of face-to-face therapy."[22,23]

Discharge Planning, Process, and Longitudinal Follow-up

Family training is an integral part of rehabilitation care, facilitating safe discharge of patients. This became significantly challenging in the NY-NJ area when a "no visitors policy" was instituted at all area hospitals by the NY State Executive Order 202.10[5] and recommended by the NJ Hospital Association. Alternative solutions, such as telehealth platforms and off-site family trainings, were used.[24] Social workers and physicians were deployed to communicate with families of patients using remote video and telephone technology. Therapists also used remote video technology for family education. For patients needing extended rehabilitation, good communication and coordination with subacute rehabilitation facilities (SARs) were critical. Many families were initially fearful of having family members discharged to SARs, given their reported high rates of COVID-19–related fatalities. This affected rehabilitation throughput and may have contributed to increased LOS for some patients. As an example of the challenges faced in a changing regulatory environment, NY DOH orders regarding SARs evolved: initially, SARs could not accept COVID-19 patients (March 8, 2020 NY DOH) and then SARs were advised not to refuse admission of a patient based solely on their COVID-19 status (March 25, 2020 NY DOH).[5,6,25,26] Further complicating discharge planning, many home healthcare agencies required a negative test before sending personnel into patient homes. In addition, family members were frequently anxious regarding their own infection risk, requiring counseling, education, and provision of personal protective equipment.

Communication and Leadership

Communication between organizational leadership and staff is essential in any crisis. Departmental or hospital-wide calls and updates were held at all consortium institutions (Table 1) to disseminate information believed to be critical for patient care and staff safety, including fast and reliable information on the numbers of positive cases, hospitalizations, acute care hospital resources, departmental directives, staff changes, personal protective equipment recommendations, and availability. Communication meetings also provided an opportunity to assess potential mental health consequences on staff from prolonged emergency conditions. Communication with state, city, and county DOHs was also important. Leadership was updated on the most recent guidelines and compliance data on patient and staff exposure to COVID-19, travel, and visitor policies. At some institutions, "leadership" consisted of departmental chairpersons and vice chairpersons, whereas at others, it consisted of wider organizational leaders, such as hospital presidents, chief executive officers, chief medical offices, vice presidents, or other administrative leadership.

Challenges to IRF Facilities During the COVID-19 Pandemic

During the first surge, hospital bed shortages were common and stressed the healthcare system. Some IRFs were temporarily closed to contribute acute care beds and staff to COVID-19 units.[27] For IRFs that remained open, changes were made to maximize safety for patients, medical staff, and site personnel. Decisions regarding designing separate rehabilitation units, what patients were appropriate for admission, staffing, patient needs, and leadership changes were made based on logistic, medical, and practical implications at each institution (Table 1).

Clinical and Demographic Characteristics of IRF COVID-19 Patients

Clinical and demographic features of 320 consecutively admitted COVID-19 patients treated by NY-NJ-RC facilities during the study are presented (Tables 2, 3). Age and sex data generally agreed with national CDC data, suggesting that men aged 50–70 yrs had a higher prevalence of severe COVID-19 infections.[28,29] However, there were several significant differences between demographic and clinical features of consortium COVID-19 patients with prepandemic data from UDS and eRehabData (Tables 2, 3). At Northwell, there was a significant difference in sex distribution at admission, with a higher proportion of males admitted to the IRF (66% vs. 48%, $P < 0.0108$) during the pandemic compared with the prepandemic period. Similarly, NYU's sex distribution at admission was significantly different from prepandemic data ($P < 0.0001$). There were no significant differences with respect to sex distribution at Burke, Sinai, Kessler, NYP, or JFK Johnson. COVID-19 patients in some consortium IRFs were significantly younger compared with prepandemic data. Northwell's mean age at admission was significantly lower than the prepandemic mean age at admission (60.42 vs. 72.90 yrs, $P < 0.0001$). Similarly, except for Burke ($P < 0.5206$), all other NY-NJ-RC institutions admitted significantly younger patients during the pandemic compared with the prepandemic period (all $P < 0.05$).

There was a broad range (9.9–42.0 days) for the LOS in an acute hospital before IRF admission, "onset days." This may reflect variability in the practice and process of patient referrals and in the composition of referring acute care hospitals (in-system vs. out-of-system) among IRFs. Some patients had a significantly prolonged COVID-19 disease course in the acute care setting, with longer onset days in five of seven consortium IRFs and shorter onset days in two consortium IRFs (Table 2). Five NY-NJ-RC institutions had a significantly longer mean onset days during the pandemic (all $P < 0.005$), whereas Burke and Kessler had significantly shorter mean onset days compared with the assumed prepandemic data (9.94 vs. 14.76, $P < 0.0022$). The mean IRF LOS for COVID-19 patients varied: Mount Sinai, Kessler, and Northwell had mean LOS that were significantly longer than the assumed prepandemic data (Table 2E), likely reflecting variability in medical complexity and disability of COVID-19 survivors, as well as increasing demand for patients to be discharged to home instead of to another facility. Length of stay may also have been influenced by lack of resources in the community, such as home oxygen, by apprehension among families about caring for patients who may have remained contagious, and availability of nursing home beds.

Acute care transfer rates varied among institutions and may be attributed to the onset days of illness at admission. The highest acute care transfer rates were in institutions with the shortest (Burke, Kessler) and longest (Mount Sinai) onset

days of illness. The acute care transfer rates in institutions with shorter onset days may reflect the precariousness of patients with COVID-19 in relatively early stages of their illness. The relatively high acute care transfer rate in institutions with the longest onset days may reflect the medical complexity of patients who survived COVID-19 ("sickest" patients). These results may be factored into decisions of when patients are considered for acute inpatient rehabilitation.

Clinical data related to functional abilities of COVID-19 patients are shown in Table 3. At IRF admission, the IGC of "Debility" was most commonly used among our institutions, although coding practices varied considerably (Table 3A). In addition, "medically complex," "pulmonary," and neurological IGCs were commonly used and sometimes coded as primary or secondary diagnoses.

There were some significant differences in functional changes indicated by GG scores for both mobility and self-care (Table 3B), with several IRFs reporting higher changes in COVID-19 patients compared with prepandemic data, demonstrating the importance of rehabilitation for COVID-19 patients. On average, each patient gained two levels, or points, on the functional and self-care outcomes. This is the equivalent of going from Maximal Assistance to Supervision levels, increasing the likelihood of discharging these patients to home. Compared to the prepandemic period, Northwell's mean GG self-care change scores were higher during the pandemic period (12.40 vs. 15.88, $P < 0.0021$), as were those of Burke, Kessler, NYU, and JFK Johnson (all $P < 0.01$). In contrast, NYP's mean GG self-care change scores were lower during the pandemic (12.40 vs. 10.43, $P < 0.0129$), whereas Sinai ($P < 0.3269$) and NYU ($P < 0.2664$) were not significantly different.

Compared with the prepandemic period, Northwell's mean GG mobility change scores were higher during the pandemic period (30.4 vs. 37.58, $P < 0.0045$), as were those of Burke, Mount Sinai, Kessler, NYU, and JFK Johnson (all $P < 0.01$). In contrast, NYP's mean GG mobility change scores were lower during the pandemic period (30.4 vs. 12.13, $P < 0.0001$. Note that some activities used to determine GG scores for mobility were not tested at NYP, because of medical complexity of patients and isolation precautions, so their GG score is noticeably lower than the other institutions).

Descriptive statistics for discharge dispositions were provided and compared between the pandemic and prepandemic periods. Northwell, NYU, NYP, and JFK Johnson had higher proportions of patients who were discharged home during the pandemic compared with the prepandemic period (Table 3C). Possible explanations for the variance and differences include: availability of caregiver, family and home resources, reduced levels of physical assistance often required after a stroke or spinal cord injury to support a transition home, different debility admission criteria, executive orders in NY changing guidance on admittance of COVID-19 patients to SARs,[26] and availability of medical support and resources in managing medical sequelae. There were no differences with respect to discharge disposition for Burke, Sinai, and Kessler (all $P > 0.05$).

DISCUSSION

The most significant findings in our report addressed our main objectives. For the first objective, through the cooperation of the consortium, we were able to summarize the various challenges faced by the NY-NJ-RC during an unprecedented pandemic. All centers provided care for COVID-19 patients and exercised precautions while expanding their beds and implementing new telehealth and staffing changes. All centers also implemented employee wellness and new communications strategies from the leadership to the staff. For our second objective, we showed that the management and medical teams adapted to rapidly changing regulations and rules from state and local authorities. This rapid response meant that many team members, such as social workers, therapists, and physicians had to adapt their roles and use new approaches to achieve safe discharge plans into the community. For our third objective, we showed characteristics of patients admitted with COVID-19, mostly with debility, to our IRFs. Despite higher medical acuity and need for supplemental oxygen, patients made excellent functional gains and mostly had rates of discharge to the community that were similar to prepandemic rates, with low complication rates. For our final objective, we presented adaptations performed during the pandemic, which allowed rehabilitation services to pivot to treat a new population of patients within a very short time.

Perhaps the most important lesson learned from this study is that demographic and clinical characteristics of 320 patients admitted with COVID-19 to 7 IRFs in the NY-NJ area reflected that COVID-19 patients who went to IRFs achieved functional recovery at least as well as traditional IRF patients and were able to return home, supporting that the key role that rehabilitation medicine has to play in medical responses to disasters. As evidenced by the admission GG scores for mobility and self-care and the prolonged acute care hospitalizations of COVID-19 patients, acute inpatient rehabilitation was able to adapt its skills to care for severely disabled patients.

Another key lesson learned was that to achieve that beneficial outcome, consortium IRFs shared challenges and approaches to rehabilitation care for COVID-19 survivors, including patient and staff safety measures, repurposing physical space, redeploying personnel, and meeting individual institutional guidelines and mandates that changed rapidly (Table 1). We believe that this real-time collaboration of centers in the NY/NJ region facilitated discussions that helped us craft approaches to rehabilitation for a new population. Functional outcomes were excellent and in line with historical outcomes for rehabilitation. We adapted care for patients with a wide array of medical consequences of COVID-19, such as profound hypoxia, tachycardia, pressure ulcers, and cognitive abnormalities.

Strengths of this article include that we describe the clinical practice and setting changes made during the initial wave of the COVID-19 pandemic to optimize patient and staff safety, health, and recovery in multiple medical centers. There are several limitations to our study. First, data were collected retrospectively. We attempted to standardize data collection and interpretation by consensus during weekly meetings. However, most of the institutions use different electronic medical records systems, and data collected thus varied. For data in Table 1, interviews were not transcribed, and this lack of standardization may be perceived as another limitation of the study. Other factors that may influence clinical outcomes, such as body mass index and comorbidities, were not available. There were also likely differences related to admission criteria that may have

influenced patient populations at each institution. Some patients who were candidates for acute IRFs may have been lost to home or SARs, because of discharge criteria. Although the NY-NJ area provided care for a large number of COVID-19 cases, here we report only basic information from a small portion of them, representing the first documented cases during the earliest surge. Medical and rehabilitation knowledge and practices that have evolved in subsequently are not described here. In addition, we do not have reliable data on prevalence of COVID-19 among staff or other issues that may have affected the institutions, such as financial limitations.

Future research including more detailed analysis of these and other constructs is needed. Comprehensive investigation of the clinical course and rehabilitation outcomes of COVID-19 survivors, as well as comparisons between these and other rehabilitation patients, will help inform the care needs of COVID-19 patients. Given the ongoing challenges of the pandemic, NY-NJ-RC expeditious dissemination of our early data may help rehabilitation facilities across the US and beyond prepare for and respond to rapidly evolving care needs.

CONCLUSIONS

The COVID-19 pandemic and responses at IRF in academic medical centers in the NY-NJ region supports the concept that with collaboration and data sharing, acute inpatient rehabilitation can be provided safely and effectively to new patient populations. We hope that our experiences and lessons learned may be used as a model for other rehabilitation centers dealing with COVID-19 surges and also as a model of collaboration and adaptation of IRFs for unforeseen medical pandemics or disasters in the future.

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