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Original Research

Screening Testing for SARS-CoV-2 upon Admission to Rehabilitation Hospitals in a High COVID-19 Prevalence Community

Steven C. Kirshblum, MD, Gabrielle DeLauter, MPH, Maeve C. Lopreiato, BSN, MPH, Bruce Pomeranz, MD, MMM, Amanda Dawson, PhD, Samuel Hammerman, MD, Bruce M. Gans, MD

Abstract

Background: While planning for the care of coronavirus disease 2019 (COVID-19) patients during the pandemic crisis has dominated the focus of leaders of inpatient rehabilitation facilities (IRFs), patients with injuries/illnesses unrelated to COVID-19 continue to need inpatient rehabilitation admission. To maintain a safe environment for all patients and staff, we established an admission screening plan of testing for severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) to determine the presence of asymptomatic patients who were infected with the virus upon admission.
Objective: To determine the prevalence of patients who test positive for SARS-CoV-2 but were presumed to be COVID-19 negative at the time of admission to IRF in New Jersey.
Design: Retrospective analysis of SARS-CoV-2 testing results.
Setting: Four freestanding IRFs in New Jersey operated as one system.
Patients: All (N = 103) patients sequentially admitted from 4 to 27 April 2020 with no symptoms or evidence of COVID-19 disease at the time of transfer from the acute hospital.
Interventions: Specimens were collected for SARS-CoV-2 analysis at the time of admission to the IRF and patients were monitored for subsequent symptom development over the next 14 days.
Main Outcome Measures: Results of SARS-CoV-2 testing upon admission and evidence of development of clinical signs or symptoms of COVID-19.
Results: Seven asymptomatic persons (6.8% of admissions) without clinical signs/symptoms of COVID-19 tested positive on admission. Of these, five developed symptoms of COVID-19, with a mean onset of 3.2 (range of 2-5) days. Five additional patients became symptomatic and tested positive within the next 3 to 10 days (mean of 5.2 days). Overall, 11.6% of admissions (12/103) had a positive test within 14 days of admission.
Conclusions: Admission testing to postacute centers for SARS-CoV-2 can help identify presymptomatic or asymptomatic individuals, especially in areas where COVID-19 is prevalent. Negative results, however, do not preclude COVID-19 and should not be used as the sole basis for patient management decisions.

Introduction

Coronavirus disease 2019 (COVID-19) is caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2). COVID-19 commonly presents with persistent dry cough, fever, chills, and shortness of breath, although many other signs and symptoms have been described.[1] The virus has infected millions of people around the world and has killed more than 244 000 patients worldwide to date and over 64 000 in the United States as of 3 May 2020.[2] On 11 March 2020, the World Health Organization labeled COVID-19 a global pandemic.[3] Since that date, the virus has spread rapidly across the United States, drastically affecting all health care organizations and providers as they prepared for and dealt with surges of disease prevalence. New York City (NYC) and northern New Jersey (NJ) have been particularly hard hit and were the hot spots with the most cases in the United States as of 25 April 2020.[4]

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Although hospitals have been inundated with persons diagnosed with COVID-19 in hot spots across the nation, they have continued to admit individuals who required hospitalization for diagnoses unrelated to COVID-19, such as stroke (not due to COVID-19), spinal cord injury, and brain injury. These patients are commonly referred to inpatient rehabilitation facilities (IRFs). Though not diagnosed with COVID-19, these patients are at risk of having been exposed to the virus in the community or even in the acute care hospitals experiencing surges of COVID-19 patients.

To prevent the spread of infectious diseases within IRFs, proper infection control techniques and early disease detection are critical. A key factor in the transmission of SARS-CoV-2 is the high level of viral shedding from the upper respiratory tract among presymptomatic patients. Studies have shown that patients begin to shed virus at least 1 to 2 days prior to showing any symptoms.[5,6] This allows enough time for an asymptomatic patient to infect others without their knowledge. In fact, one study conducted in Singapore found that presymptomatic spread of the virus may account for 6.4% of the acquired COVID-19 cases.[7] Another recent study described the spread of the virus from a health care provider in a Washington State nursing home, where screening showed that over half of the residents (27 of 48) who tested positive were asymptomatic at that time.[5]

In communities with high prevalence of COVID-19, infection control practices within the IRFs became highly rigorous to keep patients and staff safe. All patients believed to be free of COVID-19 were admitted to single occupancy rooms and kept under droplet and contact isolation for at least 7 days. Knowing when patients are truly not infectious is a key determinant in relaxing isolation practices. The rationale for 7 days was based upon the understanding that asymptomatic individuals in their incubation period usually have viral loads peak in the first week after hospitalization.[8] Given that the individuals' exposure was primarily community spread rather than exposure in the acute care hospital given that each hospital was utilizing appropriate personal protective equipment (PPE) and allowing no outside visitors, we believed that a negative polymerase chain reaction (PCR) test on rehabilitation admission along with their asymptomatic status at that time would be taking appropriate precaution. Even after 7 days, all patients remained in private rooms and all therapy gyms were closed resulting in therapy being conducted individually within patient rooms.

Given the risk of asymptomatic infectivity, newly admitted individuals in an IRF can be a source of transmission of SARS-CoV-2 to other patients (a vulnerable population) and staff. Screening therefore is critical at admission to determining if and when an asymptomatic patient could be treated as truly free of COVID-19 and not a risk to others.

The main objective of this study was to determine the prevalence of COVID-19 in asymptomatic individuals referred for admission to an IRF in a high prevalence community setting. This knowledge is essential for adopting proper isolation and infection control practices. This information would help any postacute provider to decide if routine COVID-19 testing should be utilized in the early management of these patients.

Methods

Our system of care includes four IRFs. Two of them are located in Bergen and Essex counties in Northern NJ. These counties have had the largest numbers of COVID-19 cases in the state and are close to NYC. A third IRF is located in northwestern NJ and the fourth is in the southern part of the state. Each of these IRFs experienced surges of COVID-19 patients (and staff infections) at different times, with those closest to NYC surging sooner. Testing was initiated at each of the IRFs as the infection rate in that area started to increase.

To handle the patients being referred to our IRFs with known diagnoses of COVID-19, dedicated isolation units were established at each of the IRFs. These units had emergency renovations performed to support the needed isolation standards and were specially staffed and managed to keep them from contaminating other patients or staff not on those units.

We adopted criteria for determining if a patient should be presumed free of COVID-19. They included a review of records for a previous positive diagnosis of COVID-19; unexplained fever (>100 °F), pneumonia, or gastrointestinal symptoms present for >48 hours, shortness of breath or respiratory distress (unless ventilator dependent for other reasons including high-level acute spinal cord injury); and no recent travel to countries or travel on a cruise to an area of widespread disease within the prior 14 days where isolation was required. NJ state regulations prevented our IRFs from requiring testing for COVID-19 as an admission criteria prior to transferring from acute care facilities, so we could not depend on the presence of negative tests as a regular factor to be considered.

Despite these criteria, because of the high prevalence of the disease and the unavailability at times of test results in the acute care hospital, we initiated testing for SARS-CoV-2 for all new presumed negative (patients with no known positive SARS-CoV-2 test prior to IRF admission) admissions in early April 2020. After initial testing, we monitored the patients for at least 7 days (not discontinuing over the weekend) for signs or symptoms prior to removing the droplet precautions (use of gown along with the eye protection for all room entry). All patients however remained in private rooms and with therapy conducted individually within their room. Universal surgical masks and gloves were maintained along with protective eyewear for face-to-face encounters. If new signs or symptoms (eg, fever, shortness of breath, cough, or sore throat) developed, the patient was

retested. If a person tested positive on admission, they were moved to the dedicated COVID-19 unit.

After institutional review board review and approval, medical records of all presumed negative persons who were screened for COVID-19 at the time of admission from our four IRFs, from 6 April to 27 April 2020, were reviewed. Exclusion criteria included patients not being tested on admission due to IRF or patient decision; however, all admissions underwent testing and as such no patients needed to be excluded. Data were obtained from the electronic medical record. Demographic factors are shown in Table 1. In addition, previous testing results for SARS-CoV-2 from the referring acute hospital, results of admission SARS-CoV-2 from the testing at our IRF, and subsequent symptoms necessitating repeat testing were recorded.

COVID-19 testing was performed using Quest and Virtua commercial laboratories real-time reverse transcriptase polymerase chain reaction (RT-PCR) SARS-CoV-2 tests from nasopharyngeal mucosal lining swabs.

The primary outcome measure was the percentage of patients who tested positive upon admission to our IRF. A secondary outcome was predictors of a positive test upon admission. A third outcome was the number of patients who were asymptomatic and tested negative on admission but later developed test-proven COVID-19 within the first 14 days of admission to our IRF.

Analysis

Several analyses were conducted on the data using SAS 9.4 (SAS, Cary, NC). The first analysis compared persons admitted to the four IRFs who were found to be COVID-19 positive upon admission against those initially found to be COVID-19 negative. A second analysis was conducted to compare all patients who tested COVID-19 positive within 14 days of admission with those found to be COVID-19 negative. Fisher's exact test and Welch's *t*-test were utilized. Results were considered statistically significant for $P < .05$.

Results

One hundred and three persons presumed to be COVID-19 free at the time of admission to our inpatient rehabilitation IRFs underwent RT-PCR SARS-CoV-2 testing. One hundred and one patients were transfers from acute care hospitals, one patient transferred from a long-term acute care hospital, and one patient was admitted from a skilled nursing facility. Their characteristics are shown in Table 1. Seven individuals (6.8%) tested positive on admission. Of these, five subsequently developed symptoms, an average of 3.2 days (range of 2-5) after admission (Table 2). The remaining two patients remained asymptomatic through their IRF admission.

Nine other individuals were retested when they developed new symptoms suggestive of COVID-19. Of these, five tested positive (Table 3). The occurrence of symptoms that led to retesting was a mean of 5.2 days (range 3-10) days after admission.

Overall, 12 of the 103 (11.6%) presumed COVID-19 negative individuals tested positive at IRF admission or within the first 14 days. Interestingly, seven of these 12 had tested negative (for SARS-CoV-2) at the acute care facility prior to transfer, including three persons who tested positive on day of admission to rehabilitation. There were no statistically significant associations between the demographic factors or preexisting diseases with that of a positive SARS-CoV-2 test upon IRF admission. However, there was a statistically significant difference between positive SAR-CoV-2 tests upon admission to the IRF or within 14 days of admission and age, ($P = .037$), wherein patients who tested negative throughout the first 14 days of admission were younger than those who initially or subsequently tested positive (Table 1).

Discussion

Although the rehabilitation care of patients who have survived the COVID-19 pandemic dominated the planning of our IRFs, we did not want to lose sight of all the other patients with injuries and illnesses who would also need inpatient rehabilitation services.[9] When persons free of COVID-19 are admitted from an environment (home and hospital) where the virus is highly prevalent, the risk of infection is high. Admitting asymptomatic infected patients can expose all others in the hospital leading to potential transmission to other patients and staff. Identifying individuals who may be presymptomatic or asymptomatic upon admission is paramount to preventing spread among a vulnerable group of patients.

We found a 6.8% rate of positive RT-PCR tests on admission and five of the seven (71%) of these patients subsequently developed significant symptoms of COVID-19 within a mean of 3.2 days.

Five additional patients who tested negative upon admission (5.2% of the remaining sample) became symptomatic and tested positive in a mean of 5.2 days (range 3-10) days after admission. In total, 11.6% (12 of the 103) of the patients presumed to be COVID-19 negative at the time of admission tested positive for COVID-19 during the first 14 days of their stay. Because seven of these individuals had tested negative for COVID-19 just prior to transfer from the acute care hospital, including three who tested positive on day of admission, it is clear that negative tests, at best, represent only a patient's status at that moment in time or a false negative result. We also found that the pattern of COVID-19 infection being detected in the postacute setting occurred more often for elderly patients. This places our patients at an increased risk as the average age seen within our facilities is 76.1 years old. Although it may not seem surprising, given that the elderly are at a higher risk for severe illness from COVID-19, one might also expect that their

Table 1
Demographics of sample

	All	Tests Negative	Tests Initially Positive	Retested SARS-CoV-2 Positive	All tested SAR-CoV-2 Positive
	(n = 103)	(n = 91)	(n = 7)	(n = 5)	(n = 12)
Age (y) Mean (range)	66.3 (27-99)	65.4 (27-99)	72.1 (47-84)	76.4 (67-92)	73.9 (47-92)*
Gender (Female: Male)	54:49	48:43	3:4	3:2	6:6
Race					
White	69	59	5	5	10
Black	31	29	2	0	2
Other	3	3	0	0	0
BMI					
Mean	27.7	27.3	32.1	28.3	30.5
Median	26.5	26.2	30.1	28.6	29.6
Range	15.2-47.1	15.2-44.3	22.4-47.1	22.9-30.6	22.4-47.1
Medical comorbidities					
HTN	76	70	6	4	10
DM	36	34	2	2	4
Kidney disease	21	19	2	1	3
Resp disease	36	34	2	3	5
Immunosuppression	10	10	0	1	2
Cardiac disease	41	40	1	2	3
Prescreened negative at acute care hospital	63	52	3	4	7
If yes, days prior to transfer (mean)	8	8	5	7	6
Duration of stay at acute care hospitalMean (range)	20.5 (2-214)	21.0 (2-214)	23.4 (5-93)	6.8 (3-14)	16.6 (3-93)
Primary ICD dx					
CIN	1	1	0	1	1
General debility	14	12	2	0	2
NT - SCI	7	6	1	0	1
NT - TBI (incl. stroke)	46	44	2	2	4
LE amputation	3	3	0	0	0
Orthopedic fracture	17	17	0	2	2
Other neurologic	5	4	1	0	1
TBI	7	6	1	0	1
Traumatic SCI	3	3	0	0	0

*Indicates a significant *P* value of <.05.
SARS-CoV-2 = severe acute respiratory syndrome coronavirus 2; BMI = body mass index; HTN = hypertension; DM = diabetes mellitus; Resp = respiratory; ICD = International Statistical Classification of Diseases and Related Health Problems; CIN = critical illness neuropathy; NT = non-traumatic; SCI = spinal cord injury; LE = lower extremity; TBI = traumatic brain injury.

heightened risk would translate to greater vigilance through testing during their acute care stay. A larger sample size would be needed to definitively conclude that age constitutes a risk factor for COVID-19 infection detected during postacute care.

These findings suggest that admission testing is beneficial in helping determine appropriate placement within a facility and using appropriate infection control practices. We admitted all presumed uninfected and asymptomatic patients to single occupancy rooms, and droplet and

Table 2
Clinical follow up of asymptomatic persons on admission who tested positive for RT-PCR SARS-CoV-2 to IRF

Patient	Admitting Diagnosis	Symptoms	Days from Admission	Outcomes
1	CVA	Asymptomatic	Up to 14 d	Still in IRF (post day 14)
2	CVA	Fever >100.4 °F; altered mental status	2 d; 5 d	ACT day # 5 for altered mental status changes
3	General Debility	Asymptomatic	Up to 14 d	D/C home day 14
4	General Debility	Fever 101.2 °F, dyspnea	4 d	ACT for worsening resp and renal issues
5	NT-SCI	Fever-101.1 °F; 103.4 °F	3 d; 5 d	D/C home day 21.
6	TBI	Cough and congestion	2 d	No further complications. Still in IRF (post day 14)
7	Other neurologic	Congestion; flulike symptoms	5 d; 6 d	Day 13 still in IRF

SARS-CoV-2 = severe acute respiratory syndrome coronavirus 2; CVA = cerebrovascular accident; RT-PCR = real-time reverse transcriptase polymerase chain reaction; ACT = acute care transfer; IRF = inpatient rehabilitation hospital; D/C = discharge; Resp = respiratory; NT = non-traumatic; SCI = spinal cord injury; TBI = traumatic brain injury.

Table 3
Patients who became symptomatic and retested positive for RT-PCR SARS-CoV-2 during their rehabilitation stay

Patient	Admitting Diagnosis	Reasons for Testing	Days Post Admission	Outcomes
1	Orthopedic fracture	Fever (Tmax = 101.6 °F)	4	D/C home day 19
2	CIN	Dyspnea; Low grade temp (Tmax = 100.1 °F)	10	D/C nursing home day 17
3	NT-TBI	Cough; lethargy, Fever (Tmax = 100.9 °F)	8	D/C home day 19
4	NT-TBI	Lethargy; cough.	10	ACT on day 19 for worsening resp needs
5	Orthopedic fracture	Shortness of breath and lethargy	3	ACT for pneumonia day 3

SARS-CoV-2 = severe acute respiratory syndrome coronavirus 2; RT-PCR = real-time reverse transcriptase polymerase chain reaction; ACT = acute care transfer; CIN = critical illness neuropathy; NT = non-traumatic; TBI = traumatic brain injury; Tmax = maximum temperature leading to repeat testing; D/C = discharge; Resp = respiratory.

contact isolation protocols remained in place for at least 7 days (not discontinuing over the weekend). Our experience showed the value of comprehensive initial testing, the benefit of using universal masking and continued private room and individualized therapy, and potential benefit of maintaining droplet precautions for longer than 7 days from date of transfer to an IRF from another facility.

Limitations

There are some limitations of this preliminary report. We cannot absolutely rule out that exposure occurred in our IRFs as opposed to exposure that occurred before admission for those individuals who became positive while at our facilities. However, no other patient in our facilities developed COVID-19 related symptoms or tested positive after this 14 day period. We also retested patients with the RT-PCR test only if they became symptomatic during their IRF admission. It may be possible that patients subsequently became positive after their initial screening test but remained asymptomatic through the duration of their IRF stay and thus are not reflected within the results. There are known limits to the accuracy of the RT-PCR test, because of both sample collection flaws and the sensitivity of the test itself, particularly if performed early in the course of infection, leading to high rates of false negatives.[10,11] Additionally, because the number of patients in this study is small, further investigation is recommended (and ongoing at our IRFs) to determine if these findings remain consistent.

Conclusion

Screening for SARS-CoV-2 at the time of admission to an inpatient rehabilitation facility can identify presymptomatic or asymptomatic individuals, especially in communities where COVID-19 is highly prevalent. Negative results, however, do not preclude that a patient may subsequently develop COVID-19 and should not be used as the sole basis for patient management decisions. In areas of high prevalence of COVID-19, patients should be presumed at risk for becoming infectious, and proper protective isolation standards should be employed until the patient is free of risk for disease development.

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Disclosure

S.C.K. Kessler Institute for Rehabilitation, West Orange, NJ; Rutgers NJ Medical School, Newark, NJ; and Select Medical Corporation, Mechanicsburg, PA. Address correspondence to: S.C.K., Kessler Institute for Rehabilitation, 1199 Pleasant Valley Way, West Orange, NJ 07052; Professor and Chair; Department of Physical Medicine and Rehabilitation, Rutgers New Jersey Medical School, 183 S, Orange Ave. Newark, NJ 07103; e-mail: skirshblum@kessler-rehab.com.

G.D. Select Medical Corporation, Mechanicsburg, PA.

M.C.L. Kessler Institute for Rehabilitation, West Orange, NJ; and Rutgers NJ Medical School, Newark, NJ.

B.P. Kessler Institute for Rehabilitation, West Orange, NJ; Rutgers NJ Medical School, Newark, NJ; and Select Medical Corporation, Mechanicsburg, PA.

A.D. and S.H. Select Medical Corporation, Mechanicsburg, PA.

B.M.G. Kessler Institute for Rehabilitation, West Orange, NJ; Rutgers NJ Medical School, Newark, NJ; and Select Medical Corporation, Mechanicsburg, PA.

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