CASE RECORDS of the MASSACHUSETTS GENERAL HOSPITAL

Case 21-2020: A 66-Year-Old Homeless Man with Covid-19

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PRESENTATION OF CASE

Dr. Denise De Las Nueces: A 66-year-old homeless man who had sought refuge at a local men's congregate shelter for the past several years was evaluated for cough and rhinorrhea during the pandemic of coronavirus disease 2019 (Covid-19), the disease caused by severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2).

Nine days before the current evaluation, the patient presented to a Boston Health Care for the Homeless Program (BHCHP) clinic at a local homeless shelter for evaluation of dry cough and rhinorrhea that had developed earlier that morning. He reported no fever, chills, sore throat, anosmia, myalgias, headache, chest pain, shortness of breath, hemoptysis, diarrhea, nausea, vomiting, or fatigue. He had had no known sick contacts or exposure to anyone with a diagnosis of Covid-19. He had received a seasonal influenza vaccination. A review of systems was notable for cough, rhinorrhea, insomnia, and chronic musculoskeletal pain.

The patient's medical history was notable for ischemic stroke 9 years earlier with residual mild ambulatory deficits, type 2 diabetes mellitus, hypertension, hyperlipidemia, abdominal aortic aneurysm, hyperthyroidism, and obesity. Medications included aspirin, atorvastatin, insulin glargine, metformin, empagliflozin, dulaglutide, losartan, chlorthalidone, amlodipine, metoprolol, and methimazole, along with trazodone, gabapentin, and acetaminophen as needed. All the patient's medications were stored at the BHCHP clinic at the shelter, which provided access to a refrigerator dedicated for proper storage of temperature-sensitive medications. He had no known adverse reactions to medications.

The patient had immigrated to the United States from the Caribbean more than 30 years earlier. He had a history of alcohol use disorder but had abstained from drinking for several years. He had smoked one pack of cigarettes daily for 30 years but had quit 4 years earlier. There was no history of illicit substance use. His family medical history was unknown.

On examination, the temperature was 36.8°C, the blood pressure 127/57 mm Hg,

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This article was published on June 24, 2020, at NEJM.org.

DOI: 10.1056/NEJMcpc2002421

the heart rate 71 beats per minute, the respiratory rate 16 breaths per minute, and the oxygen saturation 98% while the patient was breathing ambient air. The body-mass index (the weight in kilograms divided by the square of the height in meters) was 31.6. The patient appeared to be well and in no distress. He was alert and oriented. The oropharynx was clear and moist. The lungs were clear on auscultation. The remainder of the examination was normal. Point-of-care blood testing revealed an elevated postprandial glucose level of 260 mg per deciliter (14.4 mmol per liter; normal range, <180 mg per deciliter [10 mmol per liter]). No additional laboratory testing or imaging was performed. Rest and oral hydration were recommended, along with ibuprofen and over-the-counter cough suppressants as needed for symptom relief. The patient returned to the congregate shelter.

Seven days later, in response to a newly recognized cluster of Covid-19 cases at the shelter and with the support of the state public health authority, the BHCHP launched a campaign for universal testing of all guests at the shelter.[1] A nasopharyngeal swab was obtained from the patient at a testing tent adjacent to the shelter and was sent to the Massachusetts State Public Health Laboratory to be tested for SARS-CoV-2 RNA. At the time that the specimen was obtained, the patient reported no new symptoms.

Two days later, the test returned positive for SARS-CoV-2 RNA. The shelter staff were notified of the result, and an alert was placed on the shelter intake database. When the patient presented to the shelter that evening, management decisions were made.

CARE AT A MEDICAL RESPITE FACILITY

Dr. David G. Munson: When the shelter staff received the alert that the patient had SARS-CoV-2 infection, he was transferred to the new Covid-19 ward at the BHCHP medical respite facility for medical isolation.

Medical respite is short-term medical care for homeless people who are too sick to be on the street or in a shelter but do not require inpatient hospital care. There are more than 70 such programs across the United States, with the oldest and largest program being the BHCHP Barbara McInnis House in Boston.

As the Covid-19 epidemic spread in the United States in March 2020, a Covid-19 isolation ward was created at the Barbara McInnis House. The first step in creating this ward was to establish proper infection-control measures in order to provide a safe environment for patients and staff. Areas within the existing clinical space were designated as either "hot" or "cold" environments (i.e., environments with or without exposure to the virus), and separate areas were designated for putting on and taking off personal protective equipment (PPE). The staff were trained on the use of appropriate PPE, and specific workflows were developed for admission, clinical care, and discharge. The ward was designed to accept patients with Covid-19 who were coming directly from a shelter, local hospital, or other isolation or quarantine site when hospital care was not required.

This clinical model includes a daily visit with a provider and multiple visits with nurses per day. The isolation ward accommodates patients who are unable to administer their own medications, as well as those who are receiving concurrent intravenous antibiotic agents, wound care services, or detoxification from substances in addition to receiving supportive care while they recover from Covid-19.

CLINICAL COURSE

On admission to the medical respite facility, the patient reported that he did not feel well, with a cough, nasal congestion, fatigue, headache, and a sore throat. The temperature was 38.1°C, the blood pressure 110/55 mm Hg, the heart rate 74 beats per minute, the respiratory rate 20 breaths per minute, and the oxygen saturation 98% while he was breathing ambient air. The results of the physical examination were unchanged. Acetaminophen was administered as needed for symptom management.

During the next 5 days, fever (with a temperature of up to 38.1°C) and nonproductive cough persisted, and intermittent malaise and anorexia developed. The patient did not receive supplemental oxygen, although he had oxygen saturation measurements as low as 90% while he was breathing ambient air. Repeat auscultation of the lungs revealed faint bilateral wheezing. He was encouraged to spend time out of bed and to walk around the ward. The oxygen saturation increased to 95% without any additional inter-

ventions. The medical staff reduced the dose of insulin glargine because of asymptomatic hypoglycemia.

On the patient's sixth day in the medical respite facility, the temperature decreased to 37.3°C, the oxygen saturation was stabilized at 98% while he was breathing ambient air, the cough frequency decreased, and the chest was clear on auscultation. A discussion took place regarding when to discharge the patient from the medical respite facility.

DISCHARGE

The decision to discharge a patient from the Covid-19 ward to a congregate shelter is made in concert with the Boston Public Health Commission and in accordance with guidelines for symptom-based clearance put forth by the Centers for Disease Control and Prevention.[2] Such guidance states that discharge may be considered for a patient with Covid-19 if at least 10 days have passed since the onset of symptoms and the patient has been completely asymptomatic for 3 full days, with no fever while receiving no antipyretic medication. The BHCHP and the Boston Public Health Commission work closely with local shelter leadership to ensure a smooth transition back to the community. At the time of this writing, 206 patients have been discharged from the Covid-19 ward at the Barbara McInnis House; the average length of stay has been 12.0 days.

COVID-19 RESPONSE SYSTEM FOR THE HOMELESS POPULATION

Dr. Jessie M. Gaeta: The Covid-19 epidemic is an unprecedented disruption to the social fabric and health care system in the United States. At the time of this writing, Covid-19 has caused more than 110,000 deaths in the United States thus far[3] and has been projected to cause more than 125,000 deaths in total.[4] Although initial reports suggested that the infection results in symptoms ranging from mild cough and dyspnea to respiratory failure and sepsis, we now know that people with the infection can be asymptomatic.[5] Because of this, there are concerns that asymptomatic people will unknowingly spread the virus. This possibility has implications for the general population and especially for certain vulnerable populations, including those in congregate settings such as homeless shelters. In addition, homeless people are known to have a high burden of chronic heart disease,[6] chronic lung disease,[7] and accelerated aging,[8] all of which are risk factors for severe Covid-19.[1] The BHCHP, a nonprofit Federally Qualified Health Center that provides health care to homeless people at more than 40 sites across Boston, proactively developed a Covid-19 response system for the homeless population (Fig. 1). This response system features several core capabilities for containing and mitigating the spread of SARS-CoV-2.[9] The response system was launched in partnership with city and state public health entities, Boston homeless shelters, Boston Medical Center, and other community stakeholders, even before the first case of Covid-19 in a homeless person was identified in Boston.[10]

PLANNING AND COORDINATION

The first domain of the response system is focused on careful planning and coordination, with a centralized approach to decision making and resource deployment. This domain includes the following core capabilities: establishment of an internal team and framework for the response; engagement in cross-sector collaboration and transparent, frequent communication; use of a case-tracking database and adherence to procedures for data collection; organization of a shift away from standard clinical services; promotion of an early increase in infection-control practices within shelters; and development of a PPE prioritization strategy that would inform PPE conservation and use during periods of constrained supply.

CREATION OF ALTERNATIVE CARE SITES

The second domain of the response system is centered on the rapid development of alternative care sites for the isolation and quarantine of people who are homeless or cannot isolate safely at home. Locations were secured and developed in partnership with Boston Medical Center and the City of Boston, as well as with a local construction company and design firm. Simultaneously with the creation of the Covid-19 ward at the Barbara McInnis House, two large medical tents (Fig. 2) were constructed over the course of 1 week in a parking lot abutting a local homeless shelter: one tent has served as an isolation site for symptomatic people who are awaiting test results, and the other tent has served as a quarantine site

	Core Capabilities	Key Adaptations
Planning and Coordination	Creating an internal team and framework Engaging in cross-sector collaboration Using a case-tracking database Pivoting away from typical operations Promoting infection control within shelters Developing a PPE prioritization strategy	Setting up "mission control" to coordinate placements at alternative care sites Improving data management and tracking Adjusting the PPE prioritization strategy
Creation of Alternative Care Sites (isolation and quarantine)	Creating new isolation and quarantine opportunities for people who are homeless or cannot isolate safely at home	Vastly expanding isolation opportunities Using dormitories to limit congestion in shelters Phasing out quarantine for people with exposure
Case Identification	Screening at shelters for exposure and symptoms Testing symptomatic people Performing contact investigations	Conducting a trial of universal testing at one shelter Deprioritizing exposure and symptom screens Phasing out contact investigations Expanding universal testing Introducing rapid testing at shelters Starting universal testing of shelter staff
Phase of Pandemic Response in Boston	Late January through March: containment	Since early April: mitigation and pandemic management

Figure 1. Design of the Covid-19 Response System for the Homeless Population.

The Covid-19 response system for the homeless population has three main domains: planning and coordination, creation of alternative care sites, and case identification. The core capabilities for each domain are shown, along with adaptations that have been necessary as the number of Covid-19 cases among homeless people has risen in Boston and the response to the pandemic has shifted from containment to mitigation.

for asymptomatic people with known or suspected exposure to the virus.

CASE IDENTIFICATION

The third domain of the response system is the identification of people who have been exposed to and possibly infected by the virus. In the first weeks of the pandemic, efforts were focused on screening shelter guests at the front door for exposure and symptoms, testing symptomatic people, and performing contact investigations. The BHCHP two-item screening tool has been used to assess shelter guests for cough and shortness of breath. If a guest indicates that either of these symptoms is present, the body temperature is taken. Those who have a temperature of 37.8°C or higher are referred to a BHCHP pop-up testing site; several of these sites have been developed in areas with a high density of homeless services. The BHCHP has conducted contact investigations to identify additional people to be referred for isolation or quarantine. A "mission control" team was established to coordinate referrals to and placements at an increasing number of alternative care sites, to facilitate transportation to such sites, and to coordinate care and discharge planning with local hospitals. The BHCHP has continuously improved its data management and tracking system and refined its PPE prioritization strategy as supplies have waxed and waned and cases have continued to mount.

ADAPTATIONS

Three additional sites have been identified for further expansion of Covid-19 services in Boston. In collaboration with the Commonwealth of Massachusetts, Boston Medical Center undertook renovation, staffing, and infection control at the decommissioned hospital East Newton Pavilion, and the building has since been used as an isolation site for homeless people with Covid-19.

Figure 2. Alternative Care Sites.

During the Covid-19 pandemic, the Boston Health Care for the Homeless Program worked with local design and construction companies and government to create temporary structures that would serve as alternative care sites for the quarantine and isolation of homeless patients (Panel A). The tents have a separate entrance for patients, as well as designated space for the staff to put on and take off personal protective equipment. Patients are separated into "pods," which are rooms that allow patients to stay 6 ft apart and are built with floor-to-ceiling dividers made of heavy plastic, a material that can be easily cleaned between patient stays (Panel B). Each pod has a bed, storage space, an electrical outlet, a garbage pail, and a vital-sign monitoring station, which can be seen hanging in a basket (Panel C).

Simultaneously, the City of Boston undertook renovation at another decommissioned hospital with the intention of using the building to supplement the capacity at tent locations. Finally, the City of Boston secured the Boston Convention and Exhibition Center to serve as an isolation site called "Boston Hope," providing 500 beds dedicated for patients with Covid-19 who are either homeless or unable to isolate safely at home. As the focus of the BHCHP progressed from containment to mitigation and pandemic management, the program phased out quarantine sites for asymptomatic people who had been exposed to the virus and expanded isolation sites for infected people. In turn, local homeless shelters have used nearby university dormitories to decongest crowded facilities.

Perhaps the most notable adaptation to the BHCHP response system was the introduction of universal testing of shelter guests for Covid-19.[11] Approximately 2 weeks into the pandemic, the BHCHP identified a cluster of Covid-19 cases from a single large shelter. In partnership with shelter leadership, the BHCHP conducted testing of more than 400 guests in 2 days, identifying nearly 150 new Covid-19 cases; most of these cases were not associated with symptoms. The identification of widespread transmission and exposure among asymptomatic shelter guests resulted in a decrease in contact investigations in this setting. In addition, it became apparent that the front-door screening tool was also not effective in detecting asymptomatic infections.

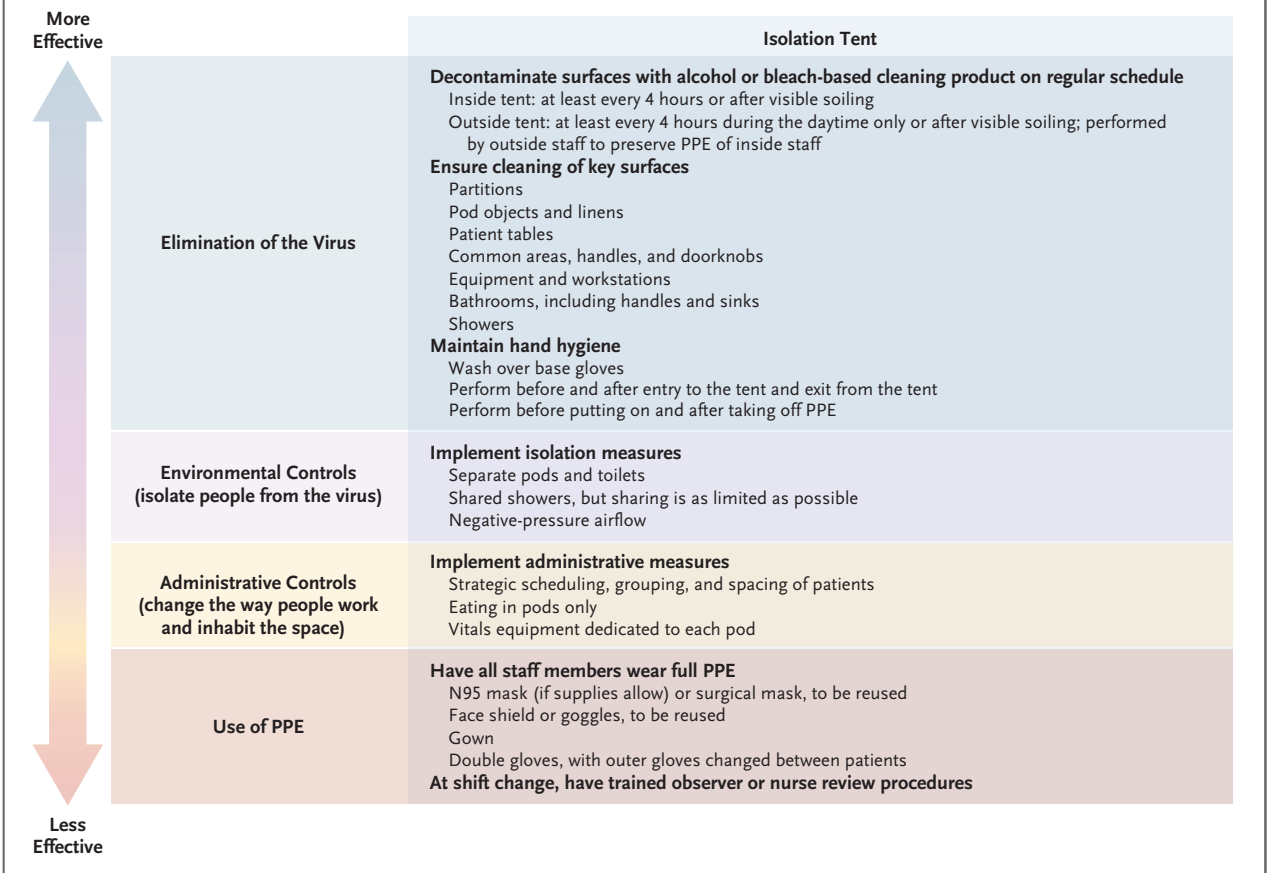

Figure 3. Hierarchy of Infection Controls.

The chart shows the myriad infection controls that are implemented in the isolation tent, a temporary structure that has been rapidly constructed for the care of symptomatic patients with suspected Covid-19. Practices aimed at eliminating the virus or isolating symptomatic patients are thought to be more effective in reducing transmission than administrative controls or the use of personal protective equipment (PPE), even though the latter two strategies remain highly important features of the response to the Covid-19 pandemic. Of note, if PPE supplies are limited, items can be preserved across shifts.

In the subsequent days and weeks, symptom screening was continued when possible to identify people who needed expedited testing, but it was done with an awareness of its limitations and was deprioritized in the overall care model. In the case under discussion, it was indeed universal testing — not symptom screening — that led to the diagnosis of Covid-19. In the months that followed, the BHCHP implemented universal testing approximately every 2 weeks at a number of large congregate shelters for adults.

APPROACH TO INFECTION CONTROL

Dr. Joshua A. Barocas: Both the epidemic and our knowledge about Covid-19 have been evolving rapidly. Our infection-control measures are based on three factors: our growing knowledge about transmission of the virus, what we assume about how the virus would spread through the BHCHP population, and resource constraints. The hierarchy of controls is a systematic approach to classifying ways to limit the spread of the virus, protect staff and patients, and attempt to eliminate the virus in a given population (Fig. 3). Ideally, we would have had more certainty about clinical presentation, viral spread, and viral shedding, as well as the ability to decongest the shelters early in the containment phase.

We can categorize the BHCHP population into four groups: asymptomatic people with no known exposure to the virus who are in need of

physical distancing, asymptomatic people with known or suspected exposure to the virus, symptomatic people who are awaiting test results, and patients who have a confirmed diagnosis of Covid-19.

At the time of our initial planning, some data suggested that there could be substantial spread among asymptomatic people with exposure to the virus, so these patients were to be placed in the quarantine tent. This tent was designed with a separate entrance for patients and with negative-pressure airflow. Floor-to-ceiling dividers were built to create 22 separate "pods" (Fig. 2B), each with a bed, storage space, an electrical outlet, a garbage pail, and a vital-sign monitoring station (Fig. 2C). In this tent, meals are delivered to the bedside. Patients are allowed to share bathrooms and showers; these facilities are cleaned on a regular basis by a crew that wears full PPE, including a gown, double gloves, a face shield, and a face mask. Patients are permitted to step outside the tent but are instructed to maintain 6 ft (approximately 2 m) of physical distancing from others and to wear masks. Staff members wear masks and gloves, and they change their gloves after each patient interaction. Symptoms are recorded twice daily. Patients who become symptomatic are given a mask, taken to the testing tent, and then moved to the isolation tent to await the test results. Pods are decontaminated after each patient discharge.

The isolation tent is for symptomatic patients who are awaiting test results; in the initial weeks of the pandemic, it could take 5 to 7 days for test results to be reported. This tent was designed with a separate entrance for patients, in addition to a staff entrance and a staff exit. Inside, the tent is divided into two wards with separate staff: one ward is for patients with a high probability of infection (a group that initially included people with upper respiratory symptoms such as cough or rhinorrhea, gastrointestinal symptoms such as diarrhea, or fever), and the other is for patients with a low probability of infection. The staff entrance, where staff members put on PPE, is located on the low-probability side, and the staff exit, where they take off PPE, is located on the high-probability side. Staff members wear full PPE at all times while they are in the tent. The pods and equipment are set up in the same way in the two tents. However, patients in the isolation tent are assigned to their own bathrooms because of the possibility of fecal viral shedding.

Sites for patients who have received a diagnosis of Covid-19 were designed with a separate entrance for patients, but the patients are permitted to share rooms and bathrooms. There are separate spaces for the staff to put on and take off PPE; staff members must wear full PPE and are restricted from eating or drinking while they are on the ward. The cleaning crews are trained on proper use of PPE. Multiple simulations of infection scenarios are reviewed before these sites are opened. Experts in infectious diseases remain on call 24 hours per day to answer questions regarding infection control, disease progression, and disposition, as well as for case consultation.

At all sites, garbage is collected by a staff member who is wearing a gown, a mask, and gloves. The staff member places the garbage in a single large trash bag, twists and ties off the bag (and does not flip it over) to limit aerosolization, and then gives the bag to another staff member who is wearing a mask and gloves. The second staff member opens a new trash bag in a "cold" area (i.e., an area without exposure to the virus), places the full trash bag inside the new bag, twists and ties it, and then disposes of it in a designated receptacle. The same process is used for linens and biohazardous material.

HOSPITAL LEADERSHIP PERSPECTIVE IN THE RESPONSE TO COVID-19

Ms. Kathleen E. Walsh: Boston Medical Center is the largest safety-net hospital in New England and the teaching hospital for Boston University School of Medicine. Most of our patients are enrollees in MassHealth (the Massachusetts Medicaid program), and many are homeless. Our hospital is located directly across the street from the Barbara McInnis House, and we have a long-standing relationship with the BHCHP. We recognized early in the Covid-19 outbreak that a continued strong partnership was crucial to protecting this vulnerable population and containing this public health crisis.

As Boston Medical Center was preparing for the pandemic, we designated faculty and staff to work with the BHCHP, the Boston Public Health Commission, and the City of Boston to improve coordination and access to appropriate levels of

care. We recognized that the hospital was just one component of care in this outbreak, since people would be tested in the community and, in the absence of other resources, would probably be treated for Covid-19 at Boston Medical Center. Patients who were hospitalized would need smooth transitions back to the BHCHP and the shelters for follow-up care. Faculty in infectious diseases and general medicine volunteered to provide infection-control consultation for the shelter community. We designated discharge planners to work with the Barbara McInnis House, the isolation and quarantine tents, and the shelters to facilitate care among sites, and our operations and strategy team assisted in modeling demand to predict capacity needs for homeless people in our region.

In the early part of the pandemic, Boston Medical Center partnered with the Commonwealth of Massachusetts and the BHCHP to reopen a closed 250-bed hospital. This required teamwork and speed to action from physicians and staff in facilities, information technology, administration, nursing, and behavioral health to prepare the facility for safe isolation and medical respite for homeless people with known or suspected Covid-19.

Academic medical centers clearly have a distinct role in the pandemic response. We have learned that hospitals must participate in broader community efforts to ensure safe and effective transitions of care. Otherwise, our ability to care for the patients who need us the most could be severely hampered by the volume of homeless patients who simply need a safe place to stay while they are recovering. We are proud of our efforts and will look for other ways that this space can be repurposed to serve complex and vulnerable populations in the future.

FOLLOW-UP

Dr. De Las Nueces: In this case, the patient had acute clinical deterioration on day 17 of his stay at the medical respite facility, which was marked by a bout of emesis and diffuse abdominal pain. He was transferred to the local emergency department. Laboratory studies revealed severe diabetic ketoacidosis. A continuous infusion of insulin was begun, and he was admitted to the medical intensive care unit, where the diabetic ketoacidosis resolved. The next day, a test for SARS-CoV-2 came back negative. Given the ongoing presence of dry cough, strict droplet and contact precautions were continued. One day later, another test for SARS-CoV-2 returned negative, and droplet and contact precautions were discontinued. The patient was transferred to the general medicine service and then discharged in stable condition 6 days after hospital admission.

CONCLUDING REMARKS

Dr. Gaeta: In the United States, more than half a million people are homeless on any given night.[12] Those staying in congregate shelters — where SARS-CoV-2 may spread rapidly and among asymptomatic people — are at a particularly high risk for the development of Covid-19. The risk is even higher among the large proportion of homeless people who have underlying heart, lung, or metabolic disorders or are in an older age group. Universal testing for SARS-CoV-2 infection at shelters is valuable when community transmission is mounting or a shelter-based cluster of Covid-19 cases has been identified, and when resources permit. Symptom screening alone will miss a large number of cases in such instances. It is critical for patients to have private space to isolate and recover from Covid-19 in order to mitigate the spread of the virus, but private housing is a privilege that is not afforded to all. Collaborative efforts among health care entities, homeless service providers, and government must ensure that a Covid-19 response system for the homeless population includes the development of adequate isolation and quarantine sites. The toll that Covid-19 has taken — and will continue to take — on homeless people in Boston lays bare the health risks associated with having no home and is a stark reminder of the need to address widespread homelessness in our country.

FINAL DIAGNOSIS

Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) infection in a homeless patient.

Disclosure forms provided by the authors are available with the full text of this article at NEJM.org.

We thank Melanie Racine for her assistance with an earlier version of this manuscript, and Drs. Katrina Armstrong and Chana Sacks for help in organizing the conference.

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