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Home monitoring for COVID-19

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■ ABSTRACT

Cleveland Clinic recognized the importance of mitigating community transmission of COVID-19 by keeping people at home. Patient-care activities quickly pivoted to remote touches, preserving continuity through a variety of digital and telephonic modalities. As the number of confirmed cases grew, standardizing home-based care became critical to managing high-risk patients, moderating the risk of exposure for healthcare workers, and reducing the amount of community spread through appropriate education on home-based care for exposed or infected individuals. This novel, team-based approach to caring for patients with COVID-19 incorporates a self-monitoring app for patient engagement, monitors symptoms for early intervention, and promotes a holistic view of care.

■ COVID-19 HOME-BASED INTERVENTIONS

Even before the first confirmed Ohio case of a COVID-19-positive person on March 9, 2020, Cleveland Clinic recognized the importance of mitigating community transmission by keeping people at home. Patient-care activities quickly pivoted to remote touches, preserving continuity through a variety of digital and telephonic modalities. As the number of confirmed cases grew, standardizing home-based care became critical to managing high-risk patients, moderating the risk of exposure for healthcare workers, and reducing the amount of community spread through appropriate education on home-based care for exposed or infected individuals.

As of March 31, the US Centers for Disease Control and Prevention (CDC)¹ reported patterns of hos-

pital admission in the United States similar to those in China and other countries. Patients admitted to the ICU or regular floor for COVID-19 are more likely to have at least one underlying health condition or risk factor (78% in ICU, 71% on regular floor). Conversely, patients with an underlying health condition who have COVID-19 are more likely to be admitted to the ICU (27.3%–29.8%) or regular floor (13.3%–14.5%) than those without underlying health conditions (7.2%–7.8%, 2.2%–2.4%). The most commonly reported conditions were diabetes mellitus, chronic lung disease, and cardiovascular disease.

Little has been described of the experience or success of home-based interventions in response to the COVID-19 pandemic. South Korea, which is touted as a global example of effective pandemic response, instituted dormitory-style “community treatment centers”² early to cohort infected patients with mild COVID-19 symptoms outside the hospital. To minimize exposure of healthcare workers, patients were asked to report their daily temperatures through a phone-based app while in the center, and the adherence rate was greater than 80%; 2.3% were eventually transferred to an inpatient unit, and to date 31% have been discharged home.² In Italy, two models of home screening and home-based care have been described for oncology patients,³ and patients with inflammatory bowel disease.⁴ Both aim to reduce the risk of exposure of patients and healthcare workers, while maintaining continuity of care. To date, the Cleveland Clinic COVID-19 disease monitoring program is the first described effort to implement a home-based intervention for a diverse range of conditions with associated risk of poor outcome from COVID-19.

A multidisciplinary working group made up of primary care physicians (internal medicine, family medicine, pediatrics), specialty physicians (pulmonary/critical care, infectious disease, emergency medicine), nurses, home-care providers, information technology,

The statements and opinions expressed in COVID-19 Curbside Consults are based on experience and the available literature as of the date posted. While we try to regularly update this content, any offered recommendations cannot be substituted for the clinical judgment of clinicians caring for individual patients.

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and the Cleveland Clinic Office of Patient Experience came together in mid-March 2020 to design the intervention. Key principles of the program were: (1) a population-based approach; (2) near-real-time monitoring of symptoms to detect and act on early signs of decompensation; (3) clinician-supported decision-making with telephonic and app-based outreach; (4) patient-centered approach during monitoring; (5) early incorporation of advance directives and end-of-life discussions.

Patients are identified for inclusion in the COVID-19 home monitoring program after testing positive to COVID-19, after the addition of COVID-19 diagnosis to the patient's list of active diagnoses in the electronic medical record (EMR), or through ordering home monitoring. COVID-19 testing is indicated for symptomatic patients (presence of fever with cough, shortness of breath, or diarrhea) with an associated risk factor for poor outcomes. These risk factors include age older than 60 or younger than 3, active immunosuppression, active cancer, end-stage renal disease on dialysis, diabetes, hypertension, coronary artery disease, heart failure with reduced ejection fraction, chronic lung disease, HIV/AIDS, and organ transplant. Test sample collection is performed at a central site to minimize healthcare worker exposure and to conserve personal protection equipment (PPE). The initial testing strategy included screening for influenza and respiratory syncytial virus along with the COVID-19 test; as flu cases declined, testing was limited to COVID-19. All patients tested are instructed to isolate at home until informed of test results.

Patients are enrolled into the home monitoring program after an ambulatory virtual assessment with a clinician, or after hospital discharge for COVID-19. All newly identified patients receive an outreach call to provide them with instructions on home isolation, to educate them about COVID-19, to screen for concerns about social support and home safety, and to invite them to engage with the MyChart Care Companion app, a patient-engagement platform available on smartphone and web-based platforms. Based on CDC guidelines, Cleveland Clinic partnered with EPIC to custom-build a COVID-19 care plan using MyChart Care Companion. Patients are monitored daily for 7 days after discharge from the hospital. Ambulatory patients are monitored for 14 days from symptom onset. A list of enrolled patients is organized in a registry within the EMR, which may be filtered by patient demographics, comorbid medical conditions, date of onset, and reported symptoms.

Daily monitoring of patients consists of telephonic outreach from a registered nurse or allied health professional and a self-monitoring app (MyCare Companion) that allows for patient-entered data of COVID-19 symptoms. Using either or both methods, patients are asked whether any of a list of symptoms are present, and whether those symptoms are getting better, getting worse, or the same. These symptoms include cough, dyspnea (*Have you been able to perform your usual activities without shortness of breath?*), weakness, vomiting (*Have you been able to keep down fluids?*), diarrhea, and appetite, as well as pulse oximetry and temperature, if available. Patients reporting new or worsening symptoms via the app will see a message stating that their symptoms are going to be forwarded to a clinician. A pool of nurses and clinicians monitor the EMR registry and flag symptoms that are worsening. After a nursing assessment, a patient may then be escalated for additional care with 2 options: (1) an urgent virtual evaluation with the patient's primary care provider (PCP) or a "virtualist" physician on call, or (2) referral to the emergency department with direct handoff communication. The PCP or virtualist may order additional medications (cough medications, bronchodilator), arrange for additional diagnostic testing (laboratory, radiography) in a designated facility that can manage COVID-19-positive patients, or order mobile testing by a visiting paramedic or allied health professional. For patients who do not desire escalation of care and who instead choose to focus on comfort care, palliative care is activated through a virtual-visit assessment and urgent initiation of services if they report worsening symptoms. Palliative care measures are consistent with Cleveland Clinic's ethical framework and those reported in other countries.⁵ Throughout the process, the patient's PCP or primary specialty consultant is apprised of all outreach via the EMR.

Additional content planned includes screening for advance directives (day 2), anxiety and stress (day 5), depression and coping (day 10), and expressing gratitude (day 14). These may be delivered via the app or during telephonic outreach.

During the period of laboratory testing from March 11 to April 5, 2020, Cleveland Clinic identified 1,168 people with confirmed COVID-19. Patients who test positive for COVID-19 who present with a new oxygen requirement (or an acute change from baseline), significantly abnormal vital signs, or significant dehydration or are unable to take oral fluids are candidates for hospital admission. Of the total laboratory-confirmed COVID-19 patients, individuals over age 60

were more likely to be admitted (25%), compared with those under age 60 (7.9%). Of 132 patients admitted with an established date of symptom onset, the median days from onset of symptoms to admission is 8 days. Additional analysis is forthcoming on patient characteristics, care received at home, and type and severity of symptoms leading to admission. Characteristics of patients currently enrolled in the program are listed in **Table 1**.

As of May 25, 2020, 1,924 patients have been enrolled in the program, with 483 (25%) older than 60 years and 67 (3.5%) younger than 18 years. Most (85%) patients are enrolled after day 5 from symptom onset. Current engagement with the MyCare Companion app is at 32%. As many as 25% continue under monitoring for longer than 14 days due to persistent symptoms.

About 10% of patients in active monitoring present with symptoms (eg, shortness of breath) requiring escalation to a virtualist provider. Median time to escalation 7 to 8 days. Patients with a pulse oximeter at home present with escalation a few days earlier due to declining oxygen saturation readings, prior to subjective complaint of shortness of breath. Two percent of patients in active monitoring are eventually admitted; 3% have been readmitted for persistent COVID symptoms or due to complications of other underlying illness. Nine patients under home monitoring have died, either due to COVID-related complications or complications of other underlying disease.

Any conclusions thus far are limited by the small sample size, the short duration of the project relative to the disease course, sample bias related to COVID-19 testing prioritization of patients with high-risk conditions, and geographic limitation to Northeast Ohio.

Future applications and iterations of this home monitoring program are substantial. Patient engagement and activation demonstrate a wide variety of benefits in clinical outcomes, patient satisfaction, readmissions, and cost.^{6,7} Mobile engagement platforms potentially decrease the need for caregiver communication with patients whose symptoms are mild or stable, freeing the workforce to focus on patients who need the human touch most. With a potential surge of inpatient activity due to COVID-19, efficient utilization of human capital will be pivotal. We are also evaluating the efficacy of this program using nonclinically trained personnel. Maximizing patient engagement with the tool is key to extending care beyond hospital walls.

COVID-19 also presents a unique mental health

TABLE 1
Population characteristics of patients enrolled in the Cleveland Clinic home monitoring program

	Number of patients	Percent of total
Total patients enrolled	878	—
Patients over age 60	302	34%
Patients under age 18	8	1%
Male-to-female ratio	1:1	—
Adult smokers	51	6%
Patients with > 1 risk factor	487	55%
Patients with active MyChart status	347	52%
Patients with active MyChart status reporting symptoms via the Care Companion app		
Patients escalated for hospital admission	9	1%
Patients with hospice dispositions	3	< 1%

challenge, with several studies detailing the short- and possible long-term effects of quarantine and social isolation on sleep, depression, and anxiety.^{8,9,10} These may be exacerbated in those who are already socially isolated or have a chronic illness.¹¹ Integration of psychiatry, behavioral health, social work, and community partners in the Cleveland Clinic home monitoring program will be key. Additional criteria (such as obesity, dementia, newborns of COVID-19-positive mothers) may need to be considered as clinical understanding of COVID-19 in different populations evolves.^{12,13} Strong primary care and subspecialty collaboration is essential. As the weeks turn into months and longer, the home monitoring program may serve as the infrastructure in building our understanding of the long-term outcomes of COVID-19 disease.

Lastly, this intervention has immediate implications on the organizational response to COVID-19, providing answer to important questions: Which signals merit aggressive care to prevent future ICU admission and ventilator support? How can those signals be amplified by increased self-reporting? Are there time-based predictions we can make relative to inpatient demand? How can we have more meaningful end-of-life discussions upstream, so that patient choice and treatment availability are not conflicting narratives?

In conclusion, we present this novel, team-based approach to caring for patients with COVID-19,

which incorporates a self-monitoring app for patient engagement, monitors symptoms for early intervention, and promotes a holistic view of care. In the months ahead, we hope to learn how effective our program will be in increasing the efficiency of health-care providers, mitigating the crisis, and alleviating suffering. We look forward to learning from other groups deploying similar interventions.

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