Perspective

Postdischarge Evaluation for Individuals Hospitalized with COVID-19

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A 46-year-old financial analyst with a medical history of obesity, hypertension, and paroxysmal atrial fibrillation presents to her general practitioner for a postdischarge appointment following hospitalization for coronavirus disease 2019 (COVID-19). The patient initially presented to the hospital with a cough after exposure to a coronavirus-infected patient at her church. Her course was complicated by acute respiratory distress syndrome (ARDS), requiring intubation, as well as intermittent episodes of atrial fibrillation with rapid ventricular response. She was successfully extubated after 7 days and ultimately discharged home with plans for close follow-up. The patient lives with her husband and two teenage daughters.

Primary care providers (PCPs) now face a novel clinical scenario: postdischarge care for patients with COVID-19. In a study of 138 patients hospitalized for COVID-19 in Wuhan, China, discharged patients had an average hospital stay of 10 days, with courses that were complicated by ARDS, venous thromboembolism (VTE), arrhythmias, and shock.[1] The World Health Organization estimates an overall recovery time from COVID-19 of 2 weeks for mild infections and 3 to 6 weeks for severe disease.[2] Thus, many discharged patients will need continuing management of pulmonary conditions, surveillance for secondary infections, monitoring for cardiac complications, and screening for depression or posttraumatic stress disorder (PTSD) in the outpatient setting. Clinicians also must address ending home isolation and safe timelines for returning to work. Here, we discuss special considerations in caring for patients with COVID-19 following hospital discharge.

What You Need to Know

- Patients hospitalized for COVID-19 need ongoing and specialized care after discharge that must be managed by their outpatient providers.
- Clinical evaluation, preferably with telemedicine and remote vital sign monitoring where available, should assess for home safety and ongoing or worsening symptoms, particularly pulmonary or cardiac decompensation.
- Providers should be aware of the common complications of severe COVID-19, including ARDS, acute kidney and liver injury, and VTE, as well as the potential psychological effects of critical illness, including PTSD.
- In clinical follow-up, guidelines for safe care at home—including how to effectively self-isolate, when isolation can be stopped, and return to work—should be regularly reviewed.

Approach for the Clinical Evaluation

Severe acute respiratory syndrome-coronavirus-2 infection causes an array of symptoms,[1,3–5] including fever, fatigue, myalgias, headache, loss of smell/taste, cough, sore throat, and shortness of breath. Frequently seen gastrointestinal symptoms[6] include loss of appetite, abdominal pain, and diarrhea. Symptoms may worsen precipitously between days 5 and 12, and in severe disease can result in pneumonia, ARDS, myocardial injury, multiple organ dysfunction, and coagulation derangements. Older age and pre-existing medical conditions are risk factors for hospitalization and more severe disease. Although the in-hospital mortality rate ranges from 9% to 15%,[7,8] the majority of patients will be discharged home.

For posthospital discharge appointments, remote consultations or telemedicine visits are preferred because many patients with COVID-19 will still be under home isolation orders.[9] The use of telemedicine allows for close follow-up to ensure continued symptomatic improvement and is in line with recommended postdischarge steps to improve care quality and patient safety.[10–12] Equally important is that remote consultation allows patients to ask questions and receive education and support.

Before the visit, providers should review any available chart information regarding the patient's predominant symptoms, date of onset, and course of disease. Special attention should be paid to hospital course and any complications. In addition, chart review should be conducted to determine whether patients have received any specific therapies during their hospitalization, including antivirals (eg, remdesivir), convalescent plasma, dexamethasone, and/or targeted immune modulators (eg, tocilizumab, baricitinib[13,14]; note that bamlanivumab is given to patients for mild to moderate COVID who are at high risk of hospitalization, but who have not yet been hospitalized). Patients will generally require VTE prophylaxis only while hospitalized with COVID-19. In certain cases, however, extended VTE prophylaxis for 2 to 4 weeks may be considered,[15] especially in cases of active malignancy, poor mobility, prior VTE, thrombophilia, or a D-dimer >1.0 mg/L Finally, providers should review hospital laboratory and radiologic data that may inform the posthospital course (Fig.).
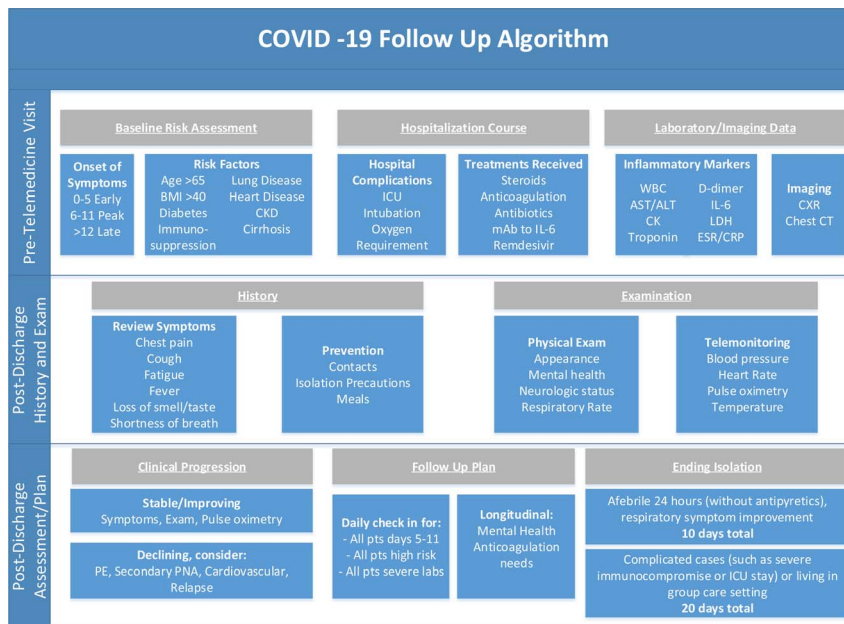
Fig. COVID-19 follow-up algorithm. AST/ALT, aspartate transaminase/alanine transaminase; BMI, body mass index; CK, creatine kinase; CKD, chronic kidney disease; COVID-19, coronavirus disease 2019; CT, computed tomography; CXR, chest X-ray; ESR/CRP, erythrocyte sedimentation rate/C-reactive protein; ICU, intensive care unit; IL-6, interleukin-6; LDH, lactate dehydrogenase; mAb, monoclonal antibody; PE, pulmonary embolism; PNA, peptide nucleic acid; pt, patient; WBC, white blood cell count.

Evaluation of Symptoms

In an early case series from China, 40% of patients were still symptomatic at discharge,[16] and patients in the United States and Europe often are discharged home earlier. The predominant symptom at discharge was cough, followed by fatigue, chest tightness, and dyspnea. When evaluating a patient posthospitalization, it is important to elicit his or her history, again noting the date symptom of onset, the peak intensity, and any residual symptoms. Many patients had symptoms for longer than 1 month. Providers should obtain a clear picture of the degree of dyspnea at the time of discharge and try to determine their trajectory. Providers should ask whether the patient is short of breath at rest, with speaking, or with activities.[9] In addition, they should determine whether there are other pulmonary symptoms such as orthopnea, paroxysmal nocturnal dyspnea, platypnea, or pleurisy that may suggest other sources of dyspnea.

Appraising Safe Transition to Home

Another important objective is to assess a patient's ability to safely care for him- or herself in the home environment (Table 1). Any difficulties in the transition to the home environment, including ability to get food and medications, should be evaluated. Many patients experience profound fatigue and may have difficulty performing instrumental activities of daily living, such as preparing food, housekeeping, and shopping. People with loss of smell/taste or loss of appetite may not be able to easily consume enough calories or fluid. It is important to know who is living in the home with them, the health status of housemates, and patients' ability to comply with self-isolation guidelines.[17,18]

Screening for Secondary Complications

Providers should be alert to any symptoms of worsening dyspnea, fever, chest pain, or dizziness that may suggest complications such as secondary pneumonia or pulmonary VTE. Both bacterial and fungal pneumonias have been seen among hospitalized COVID-19 patients. Among patients hospitalized with COVID-19, rates of VTE have been reported from 3% to up to 30% in critically ill intensive care unit (ICU) patients.[19] Although routine postdischarge VTE prophylaxis is not currently recommended,[20] many patients still have a significantly elevated D-dimer at the time of discharge. Some guidelines recommend extended VTE prophylaxis for up to 4 weeks in those at high risk, including underlying coagulopathy, prolonged immobility, prior VTE, active malignancy, or D-dimer >1.0 mg/dL.[19,21] Agents of choice include enoxaparin 40 mg daily, rivaroxaban 10 mg daily, or apixaban 2.5 mg twice daily for 2 to 4 weeks.

Table 1. Review of systems for patients with COVID-19

General survey: weight changes, fever, fatigue

HEENT: headache, changes in smell or taste, sore throat, nosebleeds

Respiratory: cough, dyspnea, exercise/exertional tolerance, platypnea

Cardiovascular: chest pain, palpitations, orthopnea, paroxysmal nocturnal dyspnea, edema

Gastrointestinal: dysphagia, diarrhea, change in appetite

Peripheral vascular: leg pain, swelling, change in color

Musculoskeletal: pain

Psychiatric: anxiety, depression, change in mood or sleep

COVID-19, coronavirus disease 2019; HEENT, head, eyes, ears, nose, and throat.

Symptoms suggesting cardiovascular complications, including chest pain, palpitations, orthopnea, paroxysmal nocturnal dyspnea, and edema, also should be assessed. Multiple studies have reported heart failure (range 8.3%–23.0%) and acute myocardial infarction/injury (range 7.2%–19.7%) in patients hospitalized with COVID-19.[22] Myocarditis has been the presenting feature in some patients, whereas others experience an elevation in troponin, mirroring the increase in inflammatory markers. To date, there have not been any reports of postdischarge outcomes for patients with cardiovascular complications. Despite concerns early in the pandemic about the deleterious effects of angiotensin-converting enzyme inhibitors/angiotensin receptor blockers and nonsteroidal anti-inflammatory drugs on disease course, there is no current evidence for their cessation during acute illness or recovery.[23,24] If a patient's angiotensin-converting enzyme 1, angiotensin receptor blocker, or aspirin was stopped in the acute setting, the provider should consider restarting it.

Finally, mental health evaluation is a key part of postdischarge care, given the potential effects of critical illness, isolation, stigmatization, and, in some individuals, survivors' guilt. Among survivors in Wuhan, China, 30% experienced sleep disturbance, 12% reported anxiety, and 10% reported depression.[25] In previous studies of those who have received ICU care for any condition, approximately 1 in 4 manifest symptoms of PTSD,[26] a rate that is comparable to that of combat soldiers, and this frequency could be increased in COVID-19 given the extreme isolation.

Examination

Although physical examination is limited in telemedicine, providers should perform an assessment of general appearance and respiratory status (Table 2). A provider should determine whether breathing is labored and assess a patient's ability to speak in full sentences, use accessory muscle, and the patient's cough frequency.[27] Provocative maneuvers such as having the patient walk around the home can be used to assess for dyspnea on exertion. Providers also should evaluate mental status and mood and affect.

Telemonitoring, if available, affords the ability to follow home-based vital signs and weight. Pulse oximetry has been especially instrumental in monitoring COVID-19 patients outside

Table 2. Telemedicine physical examination for patients with COVID-19

General survey: general status, appearance (well kempt vs disheveled) distressed
Vital signs[a]: blood pressure, temperature, weight, respirations, pulse oximetry
HEENT: conjunctiva, nasal discharge, lips (eg, perioral cyanosis)
Thorax/lungs: chest excursions, work of breathing
Extremities: swelling, skin discoloration
Neurological: mental status, mood/affect, cranial nerves (II–XII), motor system symmetry

COVID-19, coronavirus disease 2019; HEENT, head, eyes, ears, nose, and throat.
[a]If the patient possesses the equipment to measure.

the hospital setting. Increasingly, patients have access to devices such as smartphones or smart watches that can monitor vital signs. Although some of these devices have been approved to measure heart rate and monitor for arrhythmia, it is important to note that they have not yet been shown to accurately measure pulse oximetry or temperature.[28]

What You Should Do

The practice at our institution is for patients to follow up with their PCP 2 to 5 days after hospital discharge, depending on their level of risk and the severity of their illness.[29] The primary goal of the first postdischarge appointment is to assess pulmonary status and safety at home. For discharged patients with ongoing disease, PCPs should determine follow-up intervals based on their trajectory and ability to self-report worsening symptoms. More frequent outreach may be needed during days 5 to 11 of the disease course. Subsequently, outreach can be spaced to every 3 days until symptoms resolve and/or the patient can end self-isolation.[29] Longitudinal follow-up may be needed for patients without return to their respiratory baseline or with cardiac, neurologic, or psychiatric sequelae.

During each outreach, clinicians should assess whether the patient's trajectory is improving, stable, or worsening. If worsening, then PCPs must assess for signs of severe disease, defined as fever or suspected respiratory infection plus one of the following: tachypnea >30 breaths per minute, severe respiratory distress, or $SpO_2 < 93\%$ on room air.[30] Other signs of severe illness include new confusion, persistent pain or pressure in the chest, or bluish lips or face. PCPs also must consider secondary complications associated with COVID-19. Reassessment in an emergency department or clinic able to serve COVID-19-positive patients may be needed.

There is no evidence to support routine imaging or measurement of laboratory values in clinically stable patients at their postdischarge visit. Certain laboratory values associated with disease severity, including a complete blood count to monitor lymphopenia, D-dimer, ferritin, and lactate dehydrogenase, may be trended during hospitalization. These have unclear prognostic value, however, and are not routinely collected following discharge.[31] Measurement of laboratory values should only be ordered as necessitated by patient-specific complications, such as following an acute kidney or liver injury. An electrocardiogram at the time of the in-person follow-up should be considered in patients whose hospital course was complicated by cardiac disease, but this is not indicated for all postdischarge COVID-19 patients.

Duration of Self-Isolation after Discharge

One of the first questions on the minds of many discharged patients and their caregivers is how long self-isolation must continue. Depending on the length of their hospitalization, some patients may meet criteria to end isolation during their admission. When a patient is still under self-isolation orders upon discharge, however, a strategy for ending isolation must be selected by the postdischarge provider. For patients with mild to moderate disease who are not severely immunocompromised, the

Centers for Disease Control and Prevention (CDC) recommends that self-isolation can be ended when at least 10 days have passed since symptoms first appeared and at least 24 hours have passed since the last fever without antipyretics and other COVID-19 symptoms have improved. Complicated patients are considered those who need ICU care, are severely immunocompromised, or are either pregnant or < 2 weeks postpartum. Group care settings include inpatient rehabilitation, psychiatry facilities, or dialysis centers.

Different criteria apply to patients who were severely or critically ill with COVID-19 and/or are severely immunocompromised. For these patients, self-isolation may be continued for between 10 and 20 days after symptoms first appear and the other criteria are also met (afebrile for at least 24 hours and symptoms improved). If a clinician is unclear on when isolation can be safely stopped for the patient, then CDC guidance recommends consulting with infection control experts.[27]

These recommendations are based on the different patterns of replication-competent virus recovery from patients with less and more severe COVID-19. In patients with mild to moderate disease, with the exception of one case report, no study to date that has tested convalescent patients has recovered replication-competent virus >9 days after symptom onset.[32] One study of patients with severe or critical disease found that the duration of recovery of replication-competent virus was >10 days in a minority of patients, however. In this cohort, 88% of subjects cleared by 10 days and 95% cleared by 15 days; the longest period of viral shedding was 20 days.[33]

Of note, the current protocol does not recommend retesting for cure as standard practice in any patients. Despite the fact that the limits of recovering replication-competent virus are between 10 and 20 days, some patients can continue to have noninfectious severe acute respiratory syndrome-coronavirus-2 RNA recovery from their upper respiratory tracts up to 12 weeks after initial symptoms. This makes time since symptom onset a much more reliable strategy for clearing a patient from isolation. If a patient does require testing for an elective procedure, then the CDC advises that the patient wait 90 days before obtaining the preprocedural COVID-19 test. Retesting also may be considered for new symptoms that are highly concerning for COVID-19.[27]

Care Inside the Home

Until a patient meets the criteria to end self-isolation,[34] precautions should be taken when caring for him or her in the home. These are detailed by the CDC on its Web site, and summarized here.[18,35] If possible, patients should stay in their own room, including taking meals there, and use their own bathroom. Their primary caretaker should not be someone who is at high risk of severe COVID-19, and other residents of the home who are at high risk should consider staying elsewhere if possible. The patient should not leave the home, except to attend medical appointments as necessary. While in isolation, they should wear a face covering whenever around other household members. All of the household members should follow standard precautions, including practicing frequent handwashing and avoiding touching their faces, and high-touch surfaces should be cleaned and disinfected daily.

Returning to Work

The CDC has offered specific return-to-work guidelines for healthcare workers.[36] In addition to meeting the criteria to end self-isolation above, they should wear a medical-grade mask at all times until all symptoms are completely resolved. There are no return-to-work guidelines for essential workers outside health care, such as first responders, transportation workers, or grocery store employees, but it is reasonable to extrapolate from healthcare worker guidelines and recommend masking until all symptoms have resolved. Ultimately, workers should seek guidance from their employers on returning to work once they are cleared from self-isolation.

References

1. Wang D, Hu B, Hu C, et al. Clinical characteristics of 138 hospitalized patients with 2019 novel coronavirus–infected pneumonia in Wuhan, China. *JAMA* 2020;323:1061–1069.
2. World Health Organization. WHO Director-General's opening remarks at the media briefing on COVID-19 - 24 February 2020. https://www.who.int/dg/speeches/detail/who-director-general-s-opening-remarks-at-the-media-briefing-on-covid-19—24-february-2020. Published 2020. Accessed March 21, 2020.
3. Guan W-J, Ni Z-Y, Hu Y, et al. Clinical characteristics of coronavirus disease 2019 in China. *N Engl J Med* 2020;382:1708–1720.
4. Wu Z, McGoogan JM. Characteristics of and important lessons from the coronavirus disease 2019 (COVID-19) outbreak in China: summary of a report of 72 314 cases from the Chinese Center for Disease Control and Prevention. *JAMA* 2020;323:1239–1242.
5. Huang C, Wang Y, Li X, et al. Clinical features of patients infected with 2019 novel coronavirus in Wuhan, China. *Lancet* 2020;395:497–506.
6. Pan L, Mu M, Yang P, et al. Clinical characteristics of COVID-19 patients with digestive symptoms in Hubei, China: a descriptive, cross-sectional, multicenter study. *Am J Gastroenterol* 2020;115:766–773.
7. Richardson S, Hirsch JS, Narasimhan M, et al. Presenting characteristics, comorbidities, and outcomes among 5700 patients hospitalized with COVID-19 in the New York City area. *JAMA* 2020;323:2052–2059.
8. Karrasch C, Gallo RA. The acutely injured knee. *Med Clin North Am* 2014;98:719–736.
9. Greenhalgh T, Koh GCH, Car J. Covid-19: a remote assessment in primary care. *Br Med J* 2020;368:m1182.
10. Moore C, Wisnivesky J, Williams S, et al. Medical errors related to discontinuity of care from an inpatient to an outpatient setting. *J Gen Intern Med* 2003;18:646–651.
11. Agency for Healthcare Research and Quality. Re-Engineered Discharge (RED) toolkit. https://www.ahrq.gov/patient-safety/settings/hospital/red/toolkit/index.html. Published 2020. Accessed April 26, 2020.
12. Misky GJ, Wald HL, Coleman EA. Post-hospitalization transitions: examining the effects of timing of primary care provider follow-up. *J Hosp Med* 2010;5:392–397.
13. Salama C, Han J, Yau L, et al. Tocilizumab in patients hospitalized with Covid-19 pneumonia. *N Engl J Med* 2021;384:20–30.
14. Kalil AC, Patterson TF, Mehta AK, et al. Baricitinib plus remdesivir for hospitalized adults with Covid-19. *N Engl J Med* 2021;384:795–807.
15. Bikdeli B, Madhavan MV, Jimenez D, et al. COVID-19 and Thrombotic or Thromboembolic Disease: Implications for Prevention, Antithrombotic Therapy, and Follow-up. *J Am Coll Cardiol* 2020;75:2950–2973.

16. Wang X, Xu H, Jiang H, et al. Follow-up study of 131 COVID-19 discharged patients: is the current Chinese discharge criteria reliable? https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3551342. Published 2020. Accessed November 8, 2021.

17. Zhou B, She J, Wang Y, et al. The duration of viral shedding of discharged patients with severe COVID-19. *Clin Infect Dis* 2020;71:2240–2242.

18. Stay at home: guidance for households with possible coronavirus (COVID-19) infection. 2020; https://www.gov.uk/government/publications/covid-19-stay-at-home-guidance.

19. Bikdeli B, Madhavan MV, Jimenez D, et al. COVID-19 and thrombotic or thromboembolic disease: implications for prevention, antithrombotic therapy, and follow-up: JACC state-of-the-art review. *J Am Coll Cardiol* 2020;75: 2950–2973.

20. Moores LK, Tritschler T, Brosnahan S, et al. Prevention, diagnosis, and treatment of VTE in patients with coronavirus disease 2019. *Chest* 2020; 158:1143–1163.

21. American Society of Hematology. COVID-19 and VTE/anticoagulation: frequently asked questions. https://www.hematology.org/covid-19/covid-19-and-vte-anticoagulation. Published 2020. Accessed February 9, 2021.

22. Sreenivasan J, Khan MS, Anker SD, et al. Cardiovascular risk factors and complications in patients infected with COVID-19: a systematic review. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3569855. Published 2020. Accessed November 8, 2021.

23. Gupta AK, Jneid H, Addison D, et al. Current perspectives on coronavirus 2019 (COVID-19) and cardiovascular disease: a white paper by the *JAHA* editors. *J Am Heart Assoc.* 2020;9:e017013.

24. European Society of Cardiology. ESC Guidance for the Diagnosis and Management of CV Disease during the COVID-19 Pandemic. https://www.escardio.org/Education/COVID-19-and-Cardiology/ESC-COVID-19-Guidance. Published 2020. Accessed May 13, 2020.

25. Wu C, Hu X, Song J, et al. Mental health status of survivors following COVID-19 in Wuhan, China: a descriptive study. https://papers.ssrn.com/sol3/papers.cfm?abstract_id=3559616. Published 2020. Accessed November 8, 2021.

26. Parker A, Sricharoenchai T, Raparla S, et al. Posttraumatic stress disorder in critical illness survivors: a metaanalysis. *Crit Care Med* 2015;43:1121–1129.

27. Portnoy J, Waller M, Elliott T. Telemedicine in the Era of COVID-19. *J Allergy Clin Immunol Pract* 2020;8:1489–1491.

28. Jordan TB, Meyers CL, Schrading WA, et al. The utility of iPhone oximetry apps: a comparison with standard pulse oximetry measurement in the emergency department. *Am J Emerg Med* 2020;38:925–928.

29. Johns Hopkins COVID Ambulatory Response Team. COVID Ambulatory Response Team Triage Management Protocol. Internal report. Baltimore, MD: Johns Hopkins Hospital; 2020.

30. World Health Organization. Clinical management: living guidance. https://www.who.int/publications/i/item/WHO-2019-nCoV-clinical-2021-1. Published 2021. Accessed November 8, 2021.

31. Zhou F, Yu T, Du R, et al. Clinical course and risk factors for mortality of adult inpatients with COVID-19 in Wuhan, China: a retrospective cohort study. *Lancet* 2020;395:1054–1062.

32. Owusu D, Pomeroy MA, Lewis NM, et al. Persistent SARS-CoV-2 RNA Shedding Without Evidence of Infectiousness: a Cohort Study of Individuals With COVID-19. *J Infect Dis.* 2021. doi:10.1093/infdis/jiab107external icon.

33. van Kampen JJ, van de Vijver DA, Fraaij PL, et al. Duration and key determinants of infectious virus shedding in hospitalized patients with coronavirus disease-2019 (COVID-19). *Nat Commun* 2021;12:1–6.

34. Centers for Disease Control and Prevention. Discontinuation of Isolation for Persons with COVID-19 Not in Healthcare Settings (Interim Guidance). 2020; https://www.cdc.gov/coronavirus/2019-ncov/hcp/disposition-in-home-patients.html. Accessed February 9, 2021.

35. Centers for Disease Control and Prevention. Caring for someone sick at home. https://www.cdc.gov/coronavirus/2019-ncov/if-you-are-sick/care-for-someone.html. Published 2020. Accessed November 8, 2021.

36. Centers for Disease Control and Prevention. Return to work criteria for healthcare personnel with SARS-CoV-2 infection. https://www.cdc.gov/coronavirus/2019-ncov/hcp/guidance-risk-assesment-hcp.html?CDC_AA_refVal=https%3A%2F%2Fwww.cdc.gov%2Fcoronavirus%2F2019-ncov%2Fhcp%2Freturn-to-work.html. Published 2020. Accessed November 8, 2021.