

VIEWPOINT

Remote Patient Monitoring During COVID-19 An Unexpected Patient Safety Benefit

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COVID-19 has placed excessive psychological and moral stress and work demands on patients, clinicians, health care organizations, and society. COVID-19 also advanced patient safety in an unexpected way. Before the COVID-19 pandemic, patient monitoring for harm and many approaches to prevent harm were linked to where the patient was treated in the hospital.

A report based on data prior to the COVID-19 pandemic suggested that routinely monitoring hospitalized patients with continuous pulse oximetry and heart rate devices was associated with reduced mortality.¹ In that study, which involved 126 697 patient discharges between 2007 and 2017, early recognition of hypoxemia and respiratory depression were largely responsible for the observed decrease in mortality, from 0 deaths among 111 487 patients in monitored units vs 3 deaths among 15 209 patients in unmonitored units. Yet this surveillance system was not broadly adopted, and monitoring remains linked to location in the hospital. COVID-19 created a need to monitor patients treated in standard medical units, in emergency departments (EDs), and to also monitor some patients at home for clinical deterioration (eg, hypoxemia) to help increase hospital capacity. With the increased volume of patients coupled with high staffing ratios for all types of clinician workload, hospitalized patients are at increased risk for unrecognized clinical deterioration.

Thus, patient risk, rather than physical location, should dictate the degree of monitoring. Many patients treated in general medical and surgical units and patients with COVID-19 treated at home would benefit from continuous pulse oximetry. Some individuals with COVID-19 may have died at home from unrecognized hypoxemia. A 2021 excess mortality modeling analysis estimated an additional 24% of unrecognized COVID-19-attributable deaths.²

The pandemic accelerated the move to monitoring and therapy based on patient risks and needs. A combination of medical urgency, technology advances, and payment policy supported this change. Despite many health systems reporting expanded use of monitoring, there is limited evidence regarding the incidence and prevalence of hospital unit and home monitoring, the safety and efficacy of hospital and home monitoring, and the types of patients who most benefit from which type of therapy.

This Viewpoint reviews the benefits of remote monitoring in the hospital and home settings, explores the technology advances that made it possible, describes the Centers for Medicare & Medicaid Services (CMS) payment policy changes that made home monitoring sustainable, and discusses what health systems could do to launch and publish a home monitoring program.

Continuous remote monitoring of hospitalized patients treated in general medical settings not only improves outcomes,¹ but when integrated into the electronic health record, it increases accuracy and decreases the burden of obtaining and documenting patients' vital signs on overworked and underresourced staff by automating a task that must be performed several times per day for each patient.³ Even though there is limited evidence that monitoring patients with COVID-19 on hospital units improves outcomes, it is plausible that enhanced monitoring of patients treated in non-ICU settings may be helpful.

With the increased demand for hospital beds and the challenge of delivering care with staff shortages, some health care centers have advised individuals with milder symptoms to stay home. Technological advances have made it feasible to monitor some of these patients and other patients remotely (eg, while at home or in skilled nursing facilities). Wireless monitors, cloud-based platforms, and telemedicine have allowed health systems to seamlessly use at-home continuous pulse oximetry to monitor patients and help avoid hospitalizations.

A recent cost-utility analysis estimated that daily assessment and 3-week follow-up of at-home pulse oximetry monitoring was projected to be potentially associated with a mortality rate of 6 per 1000 patients with COVID-19, compared with 26 per 1000 without at-home monitoring.⁴ Based on a hypothetical cohort of 3100 patients, the study projected that remote monitoring could potentially be associated with 87% fewer hospitalizations, 77% fewer deaths, reduced per-patient costs of \$11 472 over standard care, and gains of 0.013 quality-adjusted life-years.⁴ A preliminary analysis of 83 patients enrolled in a program that discharged patients with mild COVID-19 from the ED to home with a pulse oximeter to monitor for worsening of hemoglobin oxygen saturation, found this approach effective in identifying those who required an ED visit for evaluation and possible hospitalization (n = 17 [20%]) and those who could be seen via a telehealth consult (n = 39 [47%]).⁵

Pulse oximeters used in hospitals can now be deployed at home with patient data relayed to smartphones, secure cloud servers, and web-based dashboards where physicians and hospitals can monitor the patient's status in near real time. A separate team focused on remote monitoring would likely have to be created to perform this type of monitoring. One study used such a telemonitoring application for 33 patients with severe COVID-19 who were discharged home with less than 3 L/min of oxygen and were showing clinical improvement and reported that this approach was

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safe, user friendly, cost-effective, and reduced length of hospitalization by a mean (SD) of 6.5 (3.4) days for patients (n = 20) who required home oxygen and by 1.3 (0.4) days for those (n = 13) who did not require oxygen.⁶ In a pilot study of a COVID-19 rapid follow-up service with pulse oximetry monitoring for 9 higher-risk patients, unplanned return visits to the ED were decreased compared with a retrospective comparator group of 32 patients (4.7% vs 22.6%).⁷ The combined use of telehealth, home health, and remote monitoring could bring some hospital-level-monitoring services to patients in their home.⁸

Payment reform also accelerated the move to risk-based monitoring. In December 2020, stimulated by the COVID-19 pandemic, the CMS reduced the duration of monitoring needed to bill for reimbursement from 18 to 2 days for all patients for remote physiological monitoring.⁹ Before this change, most home monitoring covered was for chronic disorders rather than acute diseases. Also, CMS launched the Acute Hospital Care at Home program in which hospitals meeting criteria to provide hospital-level care at home are paid the full in-hospital diagnosis-related group payment.⁸

Despite these advances, broad hospital and home monitoring services are not widely used by health systems. Before health systems can take advantage of these services, they must overcome several barriers.

1. Consider implementing continuous pulse oximetry and heart rate monitoring for all hospitalized patients and ED patients. With the increased census, acuity, and decreased staffing for most clinical roles, patients are at heightened risk for unrecognized deterioration. Continuous monitoring could improve safety and reduce workload on clinicians. This approach should be coupled with better algorithms to use the monitoring and clinical data to diagnose the causes of clinical deterioration and recommend therapy.
2. Create a service line to coordinate this work. Generally, a group of clinicians, such as emergency medicine or hospitalists, could operate the home monitoring program, develop protocols, enroll and monitor patients, and manage quality of care. This service line should also have a research focus to better understand whether, how, why, and in whom these therapies improve quality and value.

3. Ensure a mechanism to bill for these patients. CMS allows billing for these services, but to bill for the monitoring, the same clinicians who initiate at-home monitoring (eg, pulse oximetry in the ED) must also monitor the patients. This poses challenges as the monitoring team may be separate from the clinicians who prescribed the monitoring. Given existing clinical workloads, it is usually unfeasible for a prescribing physician to also monitor additional home patients.
4. Maximize value whereby health systems will likely need to combine and integrate several technologies such as monitoring, telehealth, chat bots, triage, and scheduling. This will require collaboration among vendors. According to the cost-utility analysis,⁴ this therapy should receive consideration for greater uptake.
5. Create protocols for selection and enrollment that match the patient's risks and needs with a menu of types and duration of monitoring, required oversight, and response to a patient's deteriorating condition or abnormal values. Protocols need to match a patient's needs with therapies such as home health services, pharmacy services, physical therapy, laboratory and imaging tests, and in-person and telehealth physician or advanced-practice clinician services.

The menu of home monitoring could include blood pressure, heart rate, electrocardiogram, pulse oximeter, and temperature, among other parameters, and may involve intermittent or continuous monitoring. Monitor oversight could involve the patient, who could be responsible for sending data, or a technology platform that automatically transfers data to a care team, such as a nurse with physician oversight. The platform data could be reviewed in real time or intermittently, based on the patient's risk for deterioration.⁷

Patients can now be monitored based on risks and needs rather than location in the hospital. While enhanced monitoring at home could potentially improve safety and value, empirical evidence of the benefits of this approach are limited. Home monitoring and hospital at-home models offer the potential to transform care and potentially allow a substantial proportion of hospitalized patients to receive care from home. Yet, health systems will need to collaborate with technology companies to accelerate learning and produce greater value for patients, clinicians, and health care organizations.

ARTICLE INFORMATION

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