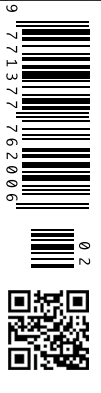




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Remote Patient Monitoring for Safe and Effective Management of COVID-19 Patients

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Remote patient monitoring (RPM) and the role it can play in the early detection of COVID-19 complications, increasing patient safety, and reducing the risk of spreading infection.

The spread of the COVID-19 pandemic has posed immense challenges to medical professionals around the world. As personal interactions between medical professionals and patients have suddenly become fraught with danger, interest in digital technology has increased.

Much has been written about the benefits of telemedicine and its steep increase in usage during the COVID-19 pandemic. In this article, the focus will be on remote patient monitoring (RPM), which has been much less covered in media and healthcare publications so far.

RPM allows patients to measure and share their vital signs with physicians, often using apps coupled with medical devices such as pulse oximeters or thermometers. At the physician practice, data from multiple patients can be aggregated and displayed on an electronic dashboard, which can then be monitored by a medical professional. Based on medical rules, the electronic dashboard typically ranks patients by severity of symptoms. This allows to rapidly identify those patients in need of attention. When remote patient monitoring and telemedicine are combined in one application, the medical professional can directly interact with patients in a physically distanced and secure way via video call. In addition, some RPM applications can be supplemented with algorithms that – for example – could predict which patients are likely to experience complications. Given that an estimated 40% of COVID-19 patients are asymptomatic,¹ and 23-36% of all hospitalised patients end up requiring intensive care,² such algorithms can be especially important during the COVID-19 pandemic.

While RPM could be performed using strictly analogue methods such as telephone checkups, the use of smartphone apps to automate the process of quantitative data collection reduces the effort to manage an RPM programme. And the use of video calls as an integral part of an RPM programme adds a “personal” dimension to the monitoring process.

In the context of COVID-19, the integrated use of RPM and

telemedicine can help to achieve five objectives (Table 1).

Given that RPM plus telemedicine move the interaction between doctor and patient into the virtual realm, the provision of medical care via RPM and telemedicine can provide medical care in remote areas with few physicians. In a pandemic setting, RPM and telemedicine can provide value through its application in two models:

RPM-Hubs with RPM-focused medical personnel (could be part-time or full-time RPM activity depending on patient numbers), with the capacity to monitor large numbers of patients. Such hubs can help shoulder the burden when COVID-19 patient numbers spike in infection hotspots or when broad national increases in infected COVID-19 patients threaten to overwhelm the established health system infrastructure. Such RPM hubs could be established at:

- Hospitals/academic medical centres
- Centralised care hubs

Regular ambulatory care facilities with medical personnel trained to use RPM. In this setting, RPM is typically used for monitoring local COVID-19 patients – either by GPs or local “COVID-19 focus practices” in a certain municipality. If applied broadly across a country (by training large numbers of GPs, for example), a country could add an effective tool in its arsenal against COVID-19, which could include:

- Primary care practices (e.g., GPs)
- Other outpatient medical practices or designated “COVID-19 focus practices”
- Local health authorities employing medical professionals
- Local clinics or local hospitals

Each of the two models has its own benefits, and the choice of which model to deploy will depend on the legal framework and pre-existing characteristics of national and local health systems.

RPM hubs can deliver benefits of scale – with few RPM specialists being able to monitor large numbers of patients. From an implementation perspective, it is relatively simple to set up a few RPM hubs at major hospitals (compared with

training thousands of ambulatory care practices how to use RPM). Hubs can be set up to provide a “backbone” for a large-scale pandemic response, allowing them to be quickly deployed to provide remote patient monitoring for patients in pandemic hotspots where localised outbreaks have occurred. Lastly, RPM practitioners within RPM hubs will gain experience and expertise in the use of RPM and telemedicine for COVID-19 patients – and how to interpret vital parameters of COVID-19 patients to decide when medical interventions or hospitalisation is needed. They will be more likely to have institutional connections into academia so as to share and disseminate this expertise, and in fact remote patient monitoring teams may plausibly be located at university hospitals.

On the other hand, establishing RPM in ambulatory settings comes with its own set of advantages. Ambulatory care facilities, with their local focus, can leverage pre-existing doctor-patient connections. Patients might feel more comfortable from being treated by “their” doctor, especially in a remote setting, as opposed to having to become accustomed to interacting with a stranger. Moreover, doctors who know their patients can leverage their knowledge of those patients’ dispositions and pre-existing conditions. Should the patient’s condition warrant a personal visit or hospitalisation, then the corresponding logistics would be easier to organise (compared with RPM in a long distance setting).

Of course, both models could be set up in complementary fashion as well – with ambulatory practices practicing RPM as a “first line of defence” plus RPM hubs (e.g., at major hospitals) ready to step in when local health system resources get close to capacity when COVID-19 infections rise.

During the COVID-19 pandemic, pilot projects of remote patient monitoring plus telemedicine have shown promising early results. As part of a pilot project conducted in the United Kingdom, it was reported that among 244 patients monitored remotely in “virtual wards,” zero fatalities occurred (the RPM platform “Medopad” from the company Huma was used during the pilot project).³ Furthermore, compliance of patients with the RPM solution was high, also among the 40% of patients who were between 60-80 years old. In a particularly effective use of medical resources, at-risk medical personnel were deployed to conduct remote monitoring activities, thus protecting this group’s health without reducing medical resources or medical expertise.

One concerning effect of the COVID-19 pandemic has been its detrimental impact on patients suffering from pre-existing medical conditions such as cancer, heart conditions, kidney disease, pulmonary diseases, or chronic immune or

RPM plus telemedicine can help to achieve 5 objectives during the COVID-19 pandemic:

- 1 **Detect COVID-19 complications early** Detect medical complications of COVID-19 patients as early as possible, allowing early medical intervention to prevent severe disease or save a patient’s life
- 2 **Use health system capacity prudently** Preserve precious hospital/ICU capacity for those who need it most, and reduce the amount of “prophylactic” hospitalisations of Covid-19 infected patients (i.e., who are hospitalised “to be on the safe side”)
- 3 **Increase safety for vulnerable patients** Establish a safe path of interaction for vulnerable patients (e.g., patients with chronic diseases, cancer, rare diseases)
- 4 **Expand monitoring capacity** Empower ambulatory practitioners to monitor multiple patients simultaneously, and to triage the most serious cases
- 5 **Reduce personal contacts** Interrupt infection chains by significantly reducing the number of in-person contacts between doctors and patients

respiratory diseases. For such patients, the sudden reduction of in-person medical visits (or interrupted clinical trials) has posed a grave health risk. Using RPM plus telemedicine for these patients can be a high-impact measure to maintain medical support and to protect these vulnerable populations from COVID-19 infection.

Recent research has also indicated that COVID-19 caused a reduction in the number of patients diagnosed with serious diseases, with an effect shown on cancer diagnoses in the United States.⁴ For cancer and other serious diseases, a patient’s chance of survival depends in large part on diagnosing the disease at an early stage. While remote patient monitoring and telemedicine are not designed to enable sophisticated diagnostic procedures (such as imaging), they could be used as a tool to conduct an initial consultation.

The COVID-19 pandemic has led to renewed and increased interest in remote patient monitoring as a means of providing safe and effective medical care. The technology can aid in early detection of COVID-19 complications, help preserve hospital capacity, increase patient monitoring capacity, increase practitioners’ and patients’ feeling of safety, and help reduce the risk of spreading COVID-19 infection.

In light of the upcoming autumn/winter period in the northern hemisphere, RPM could be an effective tool to help save lives of COVID-19 patients and other vulnerable patient populations. ■

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