London, UK
jo.best@journalist.com
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Wearable technology: covid-19 and the rise of remote clinical monitoring

Interest is growing in the use of wearable devices to monitor patients with covid-19 and chronic illness, writes Jo Best

Jo Best *freelance writer*

In the age of covid-19, digital devices worn by patients are increasingly being piloted to monitor those who might need hospital admission or who have recently been discharged.

In a scheme in north west London, "wearables" collected the vital signs of people quarantining before or after travelling abroad and healthcare staff who couldn't isolate at home. Round-the-clock data were monitored by a trained team. If the team spotted signs of deterioration, people could be transferred to hospital when necessary.[1] Reducing direct contact between people in quarantine and health workers could reduce transmission of SARS-CoV-2 and reduce the use of personal protective equipment.

In Northampton, wearables have been used to track patients with chronic illness or who are recovering from covid-19, with clinicians reviewing vital signs data regularly in virtual ward rounds and through remote consultations. By enabling clinicians to monitor patients from afar, it is hoped that fewer vulnerable patients will need to be admitted, freeing up beds and staff time.[2]

In the context of covid-19 and more broadly, using wearables to monitor patients before or after admission "can give a level of reassurance when people are being treated remotely that they're not in danger," says Pritesh Mistry, digital fellow at the think tank the King's Fund.

What are wearables?

Medical grade wearables can be as simple as a sensor that measures a single variable, such as a photoplethysmograph. Others are more complex pieces of hardware worn around the arm or as a patch on the chest, that gather a selection of vital signs, with information typically relayed to clinicians for monitoring or analysis. Wearables can measure data 24/7, and algorithms can alert clinicians if a threshold is breached, for example, if vital signs go too far outside the normal range.

Clinicians may get a better picture of a patient's health over a longer period, instead of an occasional snapshot during periodic hospital appointments, and they can observe patients' progress without having to call them into the clinic. Automatic data gathering may also free staff time by sparing them having to make manual observations.

Wearables are a way of "providing resources to the healthcare system and reducing clinical risk," said Mistry.

Consumer grade wearables, such as the Apple Watch and Fitbit bands, can also gather health data that can be shared with doctors. These devices are commonly used by the wearer to monitor trends in, for example, their exercise or sleep (box 1). Models of Apple Watch[5] and Fitbit[6] come with a single lead electrocardiograph that might identify some people at increased risk of atrial fibrillation.[7]

Box 1: Consumer wearables find clinical use

The most common way patients encounter wearables in a medical context is through consumer fitness tracking devices. Clinicians are already finding them useful too. In one of the biggest health related deployments of wearables, thousands of people at risk of developing diabetes have been given fitness trackers to encourage them to increase their physical activity.[3] The project, part of the digital diabetes prevention programme run by NHS England, Public Health England, and the charity Diabetes UK, includes peer support groups and apps with access to health coaches.

Wearable fitness trackers won't appeal to everyone, but they can help encourage exercise in the right context, says Neil Gibson, senior physical activity adviser at Diabetes UK. People "need appropriate follow-up support from healthcare professionals so that people know why they're being given wearable tech," he said. Such devices have been found to increase activity levels, particularly when additional support is provided.[4]

Wearables are no more likely to present challenges for data privacy than other hospital systems or electronic health records. For medical grade devices, whether a nurse or a machine collects periodic data makes little difference to confidentiality. For consumer grade devices, it's up to consumers which data they agree to share with others, including companies or their doctor.

Fledgling use in the NHS

The NHS Long Term Plan,[8] published in 2019, envisioned a health service in which digital devices worn by patients played a useful role. Wearable technology could ultimately be used to help predict and prevent events leading to hospital admissions and monitor patients' physiology to help care for them at home. And use of wearables in medicine is growing.

Currently, most wearables deployed in the NHS are in small-scale research or pilot projects for just a handful of uses: helping patients self-manage their condition, monitoring chronic illnesses, or tracking vital signs to spot deterioration in patients in hospital or at risk of admission.

One recent pilot involving more than 400 patients is investigating wearables for patients in the community with chronic obstructive pulmonary disease. Doctors use patient reported and physiological data, including from wearables, to identify deterioration and intervene earlier to reduce hospital admission.[9]

Wearable technology has been piloted to identify problems early among patients with dementia[10] and epilepsy.[11] Wearables are also being tested in orthopaedic settings to analyse patients' gait after surgery and to offer them tailored exercises to prevent future joint problems.[12]

What patients and clinicians think

Research into the use of wearables in hospitals is scant, but several projects have been undertaken, including an as yet unpublished clinical study by NHS Lothian in Edinburgh involving 250 patients. It aimed to shorten attendances by predicting deteriorations in emergency patients and intervening earlier using data gathered from wearables, such as temperature, blood oxygen saturation, and respiratory and heart rates.[13]

A 2019 study on the use of wearables for gathering vital signs in hospital found that "continuous monitoring in the ward was not only well received by most patients and their relatives but also by their healthcare professionals."[14]

Clinicians reported detecting deterioration earlier and intervening quicker. Nurses said that automatic gathering of vital signs freed time for patient care; they believed patients were disturbed less than with manual collection. Some patients reported feeling more secure knowing they were being continuously monitored. Others had concerns about information overload (box 2).

Box 2: Drowning in data

Information overload is a concern acknowledged not only by staff: some patients in a 2019 study of using wearables to collect vital signs in hospital thought they could be overwhelmed by seeing their markers in real time.

As wearables are used more widely, standards will need to specify which data are shared with patients and how. Show too much, and patients may become anxious or self-medicate without clinical support. Show too little, and patients may miss potentially useful information or feel shut out from their own health data.

"As a doctor, you never share all the information you have unless it's helpful and relevant to the patient, and that varies from case to case," said Matt Wilkes, a former NHS Lothian anaesthetics registrar and now a covid-19 fellow in critical care and chief safety officer at Current Health, a remote monitoring wearable technology company. "Giving physicians, in the clinical context, some control over which [wearables] data are shared is just a pragmatic and helpful way for that doctor-patient interaction to proceed."

Negative consequences included false alarms, which increase instead of reduce clinicians' workload, and risk of "alarm fatigue," when staff become desensitised to frequent automated alerts.

Such problems show that successful clinical use depends on more than just deploying wearable technology. "Information flow is crucial: who does the alarm go to, and how are they going to act on it?" asked Matt Wilkes, former NHS Lothian anaesthetics registrar. Wilkes is now a covid-19 fellow in critical care and chief safety officer at Current Health, a company whose remote monitoring wearable technology is used in several NHS trusts, including in the NHS Lothian pilot.

"You have to close the loop of action—something has to happen when the monitor is triggered," he said.

Data as patient-reported information

The rise of consumer wearables is likely to be accompanied by a rise in patients asking for help interpreting the results. A 2019 review for the NHS by the US cardiologist Eric Topol[15] predicted that by 2021 people would be able to consent to data uploaded from their consumer wearables and lifestyle apps being linked with health records (via the NHS app), enabling review by clinicians.

"This kind of data, which is probably not as accurate as from a clinical grade device, is very useful to show particular trends," said Theodoros Arvanitis, professor of digital health innovation and director of the Institute of Digital Healthcare at the University of Warwick.

"It can be viewed as patient-reported information to create a holistic picture of a patient, and especially in chronic disease management this could be useful," he added.

However, getting to the stage where physicians could review those data will require huge investment in infrastructure and skills, and device manufacturers will need to ensure compatibility with NHS software.

The King's Fund's Mistry said, "At a minimum, for wearables to be used within a healthcare system, you need to have the ability to interpret the data, the data need to be accessible, the devices need to be able to plug in and talk to each other—you need interoperability."

Questions remain about how to make sure data are presented in a way that clinicians can easily interrogate and interpret. "You've got so much information: for example, in a 10 minute GP consultation, there will be a lot of wearables information from the patient alongside everything else that needs to be considered," he said.

NHSX, which sets policy for technology, digital, and data in the NHS, didn't respond to *The BMJ*'s requests to confirm plans to connect wearables data to electronic health records through the NHS app. Nonetheless, wearables will almost certainly figure higher on all doctors' agendas in future, as consumer devices become more popular and manufacturers increasingly add medical-type features.

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