

# Technology and Parkinson's Disease: New Solutions for Old Problems

From digital innovations to practical solutions, technology can offer the possibility of improved quality of life for individuals with Parkinson's disease.

By Sanaz Attaripour Isfahani, MD and Jill Giordano Farmer, DO, MPH

In the Parkinson's disease (PD) management spectrum, medications that replace, recycle, or mimic dopamine effect, as well as deep brain stimulators and various rehabilitation strategies have been shown to be effective. Nevertheless, the effect of these interventions is not sufficient to grant a normal or near normal quality of life (QOL) to patients. As with any neurodegenerative condition, patients find their daily activities and caring for themselves more challenging as the disease worsens. Motor manifestations of PD play a major role in the challenges with daily activities and QOL scores, including bradykinesia, rigidity, tremor, and postural instability.<sup>1</sup> Less well-defined motor abnormalities like decreased dexterity, stooped forward body position, difficulties with swallowing, and many more movement abnormalities also affect patients' daily activities and cause disability.<sup>2</sup>

Often, the challenges with movement span decades of a lifetime. In a study on QOL in patients with PD and degree of independence in daily life, assistance was often necessary in bathing, dressing and undressing, toileting, and walking. Additionally, QOL was lowest in areas of social activities, hobbies, and leisure activities.<sup>3</sup>

As we await further therapeutic options to assist in the management of various aspects of PD, physicians and patients should consider additional strategies for improving QOL. Specifically, various technological tools can aide patients and caregivers in dealing with the disabilities patients experience. However, rates of acceptance and use of technological solutions by elderly individuals is lower than those of younger adults.

Physicians can play a role in discussing potential options in the technological realm for assisting with the day-to-day management of PD symptoms.

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## Telemedicine, Sensors, and Mobile Apps

Given the difficulties some patients with PD have when it comes to traveling and planning office visits, the increasingly accepted field of telemedicine may offer a solution. Many patients have reported preferring telemedicine because they feel more at ease in the comfort of their own home. Remote medical communications in many forms can be especially valuable to patients with PD. However, remote communication requires tools in order to evaluate the patient who is not physically present at the office.

Some sensor modalities (which can be applied in remote visits) are biopotential-specific sensor units, such as electrocardiography (ECG) and electromyography (EMG), motion sensor units, such as accelerometers and gyroscopes; and environmental sensor units such as video cameras. Technology solutions to PD remote medical visits include remote tracking of medication use and assistive technologies that directly compensate for disease-related challenges. The same sensors will quantify the effectiveness of medication and rehabilitation therapies.

Smartphone apps designed for PD patients are now available to address different aspects of patients' needs. These

apps are mainly designed to record and track the data gathered by the sensors already available on most smartphones, such as memory games, finger tapping, speaking, and walking. Ahead is a short list of apps designed for those with Parkinson's disease:

- Released by the University of Rochester, the **Parkinson mPower** app uses the iPhone's sensors to measure patients' tremor, balance, and gait to track and store this information via specially designed activities. To download, visit [Parkinsonmpower.org](http://Parkinsonmpower.org).
- **Parkinson Home Exercises** was released by the European Foundation for Health and Exercise and is available for iOS and Android. This video app demonstrates Parkinson's-friendly exercises and covers a wide range of movement topics like walking, posture, balance, and flexibility. It is available for download at the Apple store and Google Play.
- **DAF Professional** for iOS and Android is a speech therapy app that helps PD patients slow their rate of speech so that it sounds clearer to others.
- Making phone calls has become easier for people with dexterity issues who use **Parkinson's EasyCall** for Android, introduced by Parkinson's UK. With a simple interface, contact buttons on speed dial can be created.
- **Lift Pulse** for iOS and Android was initially designed as a useful research tool, but it can also be used by patients and caregivers. It identifies, records, and calculates the magnitude of a person's hand tremor using the phone's built-in sensors and algorithms.

### Challenges, Opportunities, and New Directions

A major challenge regarding wider adoption of these tools may be the phones themselves, since many have been designed and manufactured for users with unimpaired dexterity and steady fine movements of the fingers. Individuals with PD face the same limitations while using a computer keyboard. Such challenges have been eased by the emergence of intelligent personal assistant (IPA) software. IPA is a software agent that can perform tasks or services for an individual. These tasks or services are based on user input, location awareness, and the ability to access information from a variety of online sources. IPAs have made life easier in general but can be much more beneficial for people who are experiencing impaired motor abilities, such as those with PD.

Examples of such an agent are Apple's Siri, Google Home, Google Now, Samsung's S Voice, LG G3's Voice Mate, and BlackBerry's Assistant. Some IPAs adapt to the user's individual language and search preferences with continuing use, allowing for individualized results.

Desktop computers with keyboard and mouse are adjustable according to patients' needs by using a voice control

system. Other adaptive software is available that automatically smoothes the mouse cursor motion to reduce the effects of unsteady or tremulous hands. Additionally, desktop keyboards with oversized keys (four times larger than regular keys) make typing easier for individuals with Parkinson's disease.

To make routine tasks less challenging, assistive devices and products have been developed using new and updated technologies embedded in routinely used devices. Utensils with sensors in the handles detect tremor and steady the utensil. The stabilizer handle can be attached to a regular spoon, fork, or soup spoon. Another type of the handle is designed to assist with limited hand and arm mobility.

Grooming can become a source of dependence on a caregiver. Dress shirts with magnetically infused buttons assist anyone with tremor or impaired dexterity to dress and undress independently. Dressing sticks, one-handed belts, sock aids, and one-handed nail clippers for PD patients have been invented, marketed, and successfully used by patients, as well.

A question very commonly asked by the caregivers of PD patients regards the safety of driving. Among 12 Class II studies, 11 demonstrated significantly worse driving performance in PD patients compared to healthy controls.<sup>4</sup> Self-driving vehicles are under consideration as a potential solution, although their safety has not yet been sufficiently proven.

Exercise can help improve the common motor and non-motor symptoms of PD, in addition to enhancing overall health. With the exception of tremors, other motor manifestations of PD have shown improvements.<sup>5</sup> However, some risks are worth considering when prescribing exercise for PD patients. The use of stationary equipment is safer and provides the option of exercise at home. In general, an increase in physical activity results in a higher incidence of sports-related injuries. Hence, personalized rehabilitation therapies based on data derived from wearable sensors seem necessary. Using home-based equipment (i.e., wearable sensors, step counters, and pedometers), physical therapy and rehabilitation can be done at home while remotely monitored by a provider. Patients with abnormal movements can confound the data recorded by most commercial pedom-

### PRACTICAL POINTER

Be mindful of the growing base of technological tools—digital and practical—and their utility in patients with Parkinson's disease. Although many of these tools will not impact the course of the disease, if harnessed appropriately they may assist patients with daily struggles and potentially improve QOL.

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eters, but most of these do not have data sharing ability. Pedometers adjusted for movements seen in PD patients record more accurate data, which can be shared with the physical therapist and other providers.

Falls are more common in PD patients and are probably related to postural instability,<sup>6</sup> low muscle strength,<sup>7</sup> daytime sleepiness,<sup>8</sup> and orthostatic change in vital signs.<sup>9</sup> Falls in PD patients more commonly result in injury, with the incidence of hip fracture reported as four times that of older people of the same age without PD. Exercise and balance training help prevent falls in people with Parkinson’s disease by targeting select fall risk factors, e.g., poor postural stability, reduced leg muscle strength, and freezing of gait.<sup>10</sup> However, when a patient falls down or has an emergency, devices could be used to ensure an alert is transmitted wirelessly to the local clinic or hospital. Sensors have been attached to patients’ clothing, shoes, slippers, necklaces, and even floor carpets to detect sudden movements of the body and report the fall via an emergency notification system.

### Smart Tools for Improved Quality of Life

Smart devices are embedded with electronic software, sensors and network connectivity that enable these objects to collect and exchange data. Interconnected automation will make life easier for everybody, but it may be especially valuable for people with motor limitations and Parkinson’s disease.

Currently, the volume of information, how to handle collected data, making sense of it, and keeping it constantly secure is challenging bioinformatics engineers. From a health services provider point of view, the cost of delivering telehealth care is not sufficiently covered by insurance systems. As needs and services are rapidly growing, new strategies in the field of health economics should be provisioned.

Research efforts should focus on determining and assessing the struggles of the challenged population and inventing technologies to address their very specific needs.

The technology offered to the elderly, particularly those with a neurodegenerative condition like PD (considering

the cognitive impairment the disease may cause), should be much more user-friendly than average technological tools. Introducing such technologies to patients with PD will enhance their autonomy and self-sufficiency and improve their quality of life. ■

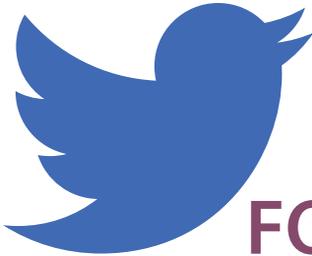
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