



# Telemedicine and Multiple Sclerosis

Telemedicine is acceptable to patients and clinicians in the continuum of clinic-to-in-home care and reduces barriers to care.

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Telemedicine represents a powerful tool in the clinic-to-in-home care continuum, allowing patients with neurologic conditions to access specialists despite geographic, disability-, and life-related hurdles. Most simply, teleneurology is an episode of neurologic care (eg, consultation, evaluation, or education) performed at a distance using technology (eg, telephone, computers, tablets, or internet.) In recent years, teleneurology has expanded to improve access to clinical care and research not just for patients with acute strokes, but also for patients with more chronic neurologic conditions including Parkinson's disease, headaches, epilepsy, and others. Teleneurology is also making inroads in the care of patients with multiple sclerosis (MS).

## Technology Use Is Widespread for Patients

It is increasingly clear that patients with MS access technology routinely. For MS-related care, patients use technology to communicate with clinicians, access educational materials, and seek information and social support from others living with MS. Beyond these MS-focused goals, patients also use technology for the broad spectrum of consumer consumption: social media for connectedness, activity trackers for fitness, video games and movies for fun, and teleconferencing for work.

## Teleneurology Acceptance

Patients with MS and clinicians caring for them both report overall high acceptability of teleneurology for clinical care. This may include conducting video-enabled neurologic follow up visits in patient homes,<sup>1,2</sup> conducting cognitive testing<sup>3</sup> and telehealth interventions, both telephone-based<sup>4</sup> and televideo-based for health promotion<sup>5</sup> and home-based management.<sup>6</sup>

## Teleneurology Expands Access to Care

An important advantage of teleneurology is provision of specialized MS care with fewer real and opportunity costs. In a study comparing in-clinic and teleneurology-enabled visits, telemedicine reduced travel burden, including a mean

( $\pm$ SD) travel distance of 160 ( $\pm$  196) miles, travel cost of \$69.30 ( $\pm$  \$123.60, range \$0-\$600), overnight lodging (17% of patients), and air travel. Telemedicine also reduced indirect costs, including time off work (65% of employed patients) and caregiver burden (30% avoided caregiver time off from work/obligations).<sup>2</sup> Another study reported that remote delivery of cognitive evaluations for patients with MS saved more than \$144 in travel costs and lost wages relative to in-clinic evaluations.<sup>3</sup> Beyond the actual encounter, however, larger costs (eg, medications, tests avoided, or relapses prevented) saved via the televideo visit with the MS specialist were not evaluated.

## Comprehensive Care

The Veterans Administration (VA) system has pioneered use of teleneurology for patients living with MS. Through the highly innovative VA Home Automated Telemangement (HAT) system for patients with MS, investigators developed a system to enable 4 main components: interactive patient education and counseling, telerehabilitation, remote neurological examination, and patient home-care management.

Online questionnaires determine specific symptom complaints. Self-testing modules relayed remotely to the health care team help personalize exercise plans, provided by a physical therapist.<sup>7</sup> The system is designed to adapt to the individual's changing activity level. Importantly, safety tips are included at each stage, along with sections on MS education.<sup>7</sup>

## Diagnostic Accuracy

The diagnostic accuracy of teleneurology-enabled disability examinations appears fairly reasonable, especially when expected biases are accounted for. In 2 separate studies ( $n=20$  for both), VA investigators showed that, with an in-person examiner available to guide the patient, a televideo-enabled disability examination showed reasonable similarity to a criterion-standard in-person Expanded Disability Status Scale (EDSS) examination.<sup>1,8</sup> Outside the VA, a separate study ( $n=25$ ) compared an in-person EDSS evaluation to a multimodal remote examination that included a video of previously trained participants' self-administered neurologic evaluation, as well as



patient-reported questionnaires and other components.<sup>9</sup> A further study, capturing patients with mild or moderate disability (n = 41, EDSS range 0-7, median 2), compared in-person EDSS evaluation with a televideo-enabled EDSS evaluation that did not require an in-person examiner; there was agreement within 1 EDSS point for 88% of the visits compared. Together, these studies suggest that although imperfect, telemedicine permits reasonable assessment of patients' overall neurologic function and could be used to categorize patients into low, medium, or high disability levels. It could also be used as an interim assessment tool for determining the need to escalate to a clinic visit and for tracking clinical status changes more frequently if combined with more sophisticated diagnostic tools.

### Clinical Outcomes

Investigations of telemedicine effectiveness for overall MS-related care are limited, possibly because of the pilot nature of most studies, performed with low numbers over short durations. For example, the study comparing visit-associated features between 100 in-clinic visits and 50 telemedicine-enabled visits reported televideo visits were for follow up, were shorter, and were often more focused on specific topics. Visits occurred in patients' homes or workplaces using a range of devices (ie, computers, smartphone, desktops, tablets).<sup>2</sup> The clinical outcome most frequently assessed was adherence to disease modifying therapies (DMTs) for MS, including a series of analyses of the VA MS HAT system. Improvement in DMT adherence, monitoring, and outcomes was noted when using principles of motivational interviewing and telehealth home monitoring.<sup>10-12</sup> Telemedicine also increased adherence to 20 people with MS who had remotely delivered direct current stimulation (tDCS) to improve mood, more than treatment administered in clinic.<sup>13</sup> A pilot study of 206 persons with MS, randomly assigned to internet-based, self-management systems (including communication about upcoming clinic visits, self-management of MS symptoms and secure messaging, and self-monitoring) was not able to demonstrate increased MS Center care. The authors of this study postulated that this was due to insufficient differences within the intervention groups.<sup>14</sup>

### Rehabilitation

Telemedicine has exciting and wide potential for rehabilitation. Systematic reviews show feasibility of remote monitoring of physical activity in MS.<sup>15,16</sup> Measuring daily step count in people with MS over a range of ambulatory impairment is reliable and correlates well with in-clinic measures of ambulatory function.<sup>17</sup> In a group of 20 participants, comparisons of in-office and psychologist-supervised remote-in-office or remote-in-home cognitive testing showed similar results from all settings on the automated neuropsychological assessment metrics (ANAMS) test, although this was not seen on the symbol digit modalities test (SDMT).<sup>3</sup>

### Functional Improvements

Most research on telemedicine has focused on improving functional domains including mood, fatigue, physical activity, and overall quality of life. Studies have been mostly exploratory and small with widely assorted outcomes and goals, making conclusions difficult to generalize.<sup>18-20</sup>

### Physical Activity

Increasing physical activity can be challenging for people with MS, prompting use of telemedicine interventions. More robust trials include an 12-week randomized controlled trial examining efficacy of an internet-delivered and social-cognitive theory-based behavior intervention. This intervention was supplemented by video coaching and aimed at increasing adherence and supporting physical activity over time. Physical activity improved after the 12-week trial for a 3-month follow up period.<sup>21</sup> Further studies in people with MS (n = 82) with 6-months follow up, reported multiple symptom improvements (eg, fatigue and mood) and increased physical activity and improved balance after intervention.<sup>22,23</sup>

### Conclusion

Telemedicine is becoming more common in the provision of specialized care for patients with MS. The burgeoning literature to date suggests that this form of medical care is acceptable to patients and clinicians when used within the continuum of clinic-to-in-home care, and that it reduces barriers of access to care. In many cases the neurologic examination performed through a televideo system is suitable to the clinical scenario. A number of promising studies in the area of rehabilitation have shown that through teletechnologies it is feasible to monitor patients in their home environments, and that telerehabilitation interventions could improve both cerebral (eg, mood, cognition, fatigue) and physical function. As telemedicine for MS expands, it will be important to determine whether it yields similar, or even improved, clinical outcomes relative to in-clinic care in terms of relapse prevention, medication safety, and stabilization of MS progression. ■

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