Current Geriatrics Reports (2020) 9:72–81
https://doi.org/10.1007/s13670-020-00311-z

NEUROLOGY OF AGING (K MARDER, SECTION EDITOR)

Telemedicine: a Valuable Tool in Neurodegenerative Diseases

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Published online: 14 March 2020

Abstract

Purpose of Review The prevalence of neurodegenerative diseases, such as Alzheimer's disease (AD) and Parkinson's disease (PD), is rising as the global population ages. Access to specialist care, which improves outcomes, is insufficient and disease-related disability makes in-person physician visits burdensome. Telehealth is one potential means for improving access to care. The purpose of this manuscript is to review recent publications on telemedicine in AD and PD.

Recent Findings Telemedicine is feasible in AD and PD and acceptable to patients and their caregivers. Compared with in-person visits, telemedicine reduces visit-associated travel and time. Telemedicine can be used for rehabilitative therapies, to administer cognitive tests, and to support caregivers. Access to telemedicine results in changes in patient care including medication adjustments and referrals for therapies and supports.

Summary The use of telemedicine in AD and PD stands to decrease burden on patients and increases access to specialty care. Barriers to the expansion of telemedicine care include lack of widespread broadband access, state licensure requirements, and inconsistent reimbursement. More outcome-based prospective telemedicine studies are needed.

Keywords Telehealth · Parkinson's disease · Alzheimer's dementia · Virtual visits · Healthcare disparities

Introduction

Neurodegenerative diseases represent a growing public health crisis. Two of the most common neurodegenerative diseases, Alzheimer's disease (AD) and Parkinson's disease (PD), affect 35 million [1] and 6 million [2] people worldwide, respectively. The prevalence of these diseases has been increasing rapidly as the global population ages. Current projections indicate that the global prevalence of both diseases will nearly double in the coming years, AD by 2030 [1] and PD by 2040 [3]. Both diseases cause progressive disability and require chronic neurologic care.

We are not meeting the current demand for neurologic care. Specialist care is associated with improved outcomes in PD, including reduced risk of hospitalization, nursing home placement, hip fracture, and death [4, 5]. Despite this, over 40% of US Medicare recipients with incident PD do not see a neurologist within 4 years of their diagnosis [5]. Across the globe, access to neurologic care is limited, with developing countries having the fewest neurologists [6]. In the USA, neurologists are most concentrated in cities [7], making access more difficult for those who live in rural areas. Yet this may be precisely where more care is needed; the prevalence of AD is higher in rural areas [8] and rural-living patients with AD are more likely to undergo preventable hospitalizations [9]. Furthermore, individuals with PD and AD are limited by mobility and cognitive impairments, making travel to physician visits challenging and burdensome. Telehealth, the remote provision of healthcare services, may be a valuable tool for improving access to care for these individuals. We review the evidence for telehealth in the management of neurodegenerative diseases, with a focus on recent publications regarding the use of synchronous videoconferencing, or telemedicine, for the provision of care for AD and PD.

Parkinson's Disease

Several studies have demonstrated that telemedicine for PD care is feasible, even in more severe disease states (Table 1). In

This article is part of the Topical Collection on *Neurology of Aging*

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a 12-month, 195-person randomized controlled study (Connect.Parkinson) comparing usual care for PD with usual care supplemented by in-home telemedicine visits with a specialist, 98% of individuals in the telemedicine group completed at least 1 visit and 91% of 388 planned telemedicine visits were completed during the study [10•]. Smaller studies have had similar results, with in-home telemedicine visit completion rates among individuals with PD ranging from 93 to 97% [11, 12]. The most-readily recognizable features of PD are the motor features, including tremor and bradykinesia, which can be visualized in telemedicine visits without hands-on examination. Conducting standard physical assessments, including a modified version of the Unified Parkinson's Disease Rating Scale, is feasible via telemedicine provided that the video quality is satisfactory [11, 13]. While select hands-on elements, such as testing for rigidity and postural instability, cannot be performed, the majority of the examination, including gait assessment given adequate space, can be completed. This modified version of the Unified Parkinson's Disease Rating Scale demonstrates good reliability and validity in comparison with the standard Unified Parkinson's Disease Rating Scale [14, 15]. Cognitive assessments, including the Montreal Cognitive Assessment (MoCA), can also be administered remotely to individuals with PD [16, 17]. Finally, the diagnosis of PD [18] and atypical parkinsonian syndromes [19] can be confirmed via telemedicine.

Telemedicine is well-received by patients, and satisfaction rates are generally high. In a case series that offered a one-time consultation to individuals with PD or related disorders, 100% of the 33 individuals who completed a post-visit survey were likely or very likely to recommend telemedicine to others [20]. Also, in this case series, participants were satisfied or very satisfied with the specialist's ability to improve quality of life (100%), the ability to convey feelings and symptoms to the specialist (100%), and the quality of the connection (90%). In the aforementioned Connect.Parkinson study, satisfaction rates were similarly high, with 97% of patients and 86% of physicians either satisfied or very satisfied with telemedicine visits [10•]. A dual-arm randomized controlled trial of telemedicine versus usual care for veterans with Parkinson's disease found no differences in overall satisfaction between the groups, with higher satisfaction in the telemedicine group regarding convenience and travel time [21]. The chief complaint among patients and providers in these studies was the quality of the video connection [12, 21]. A poor home Internet connection can be a barrier to a complete evaluation, although video quality of videoconferencing platforms has improved over time. In a recent national online survey of 781 individuals with PD, 76% indicated a high interest in telemedicine with 29% reporting prior telemedicine experience. The most commonly cited concern was the lack of hands-on care (69%), whereas access to specialists (62%), convenience (60%), and time savings (59%) were perceived as the top advantages [22•].

Telemedicine for individuals with PD has been shown to save time, money, and travel distance. In a survey of 34 individuals with Parkinson's disease with telemedicine experience, they reported saving an average of 209 min in travel time, 160-km travel distance, and $200 (CAN) due to telemedicine [23]. A study comparing in-home telemedicine with usual care in 20 participants found a significant difference in total visit time (travel time plus visit time) with the telemedicine group on average spending 53 min and the usual care group spending 255 min for visits [12].

Studies suggest that outcomes are similar between telemedicine and usual in-person care [10•, 21, 24]. The Connect.Parkinson study reported no worsening of clinical outcomes, including number of emergency room visits, number of hospitalizations, or level of caregiver burden in the telemedicine group, compared with the usual care group [10•]. A small 10-person randomized, crossover pilot study compared telemedicine via an iPad mini with regular in-person visits every 2 months and found no significant differences in quality of life measures (Parkinson's Disease Questionnaire-39, UPDRS parts I and II), motor scores (UPDRS parts III and IV, Modified Hoehn and Yahr stage), mental health measures (Beck Depression Inventory), number of phone calls, or number of hospital visits [24]. Furthermore, telemedicine may facilitate advanced therapy management. Follow-up after deep brain stimulation (DBS) and levodopa intestinal gel infusion procedures, which often require frequent clinical visits for adjustments, can cause a significant burden on patients and caregivers, especially in remote locations. A retrospective chart review study evaluated virtual care of 41 individuals with Parkinson's disease and DBS in the Ontario Telemedicine Network and found that telemedicine in this population is both feasible and useful, particularly in reducing travel burden and costs [25]. A study in China tested a remote DBS monitoring and adjustment system in 3 patients with Parkinson's disease and found it to be feasible and effective [26]. In a study of 15 Swedish patients treated with carbidopa-levodopa intestinal gel infusions followed by home titration via telemedicine, 86% of patients were satisfied with the titration method, which ultimately saved time and costs compared to in-person hospital titration [27].

Moreover, tele-rehabilitation has been shown to be feasible and valuable for individuals with PD (Table 1). Multiple studies have demonstrated the feasibility and effectiveness of various physical therapy methods delivered remotely. A randomized controlled trial compared virtual tele-rehabilitation and in-clinic sensory integration balance training for postural instability in 76 individuals with PD; while the in-clinic group had greater gains on the Berg Balance Scale, both groups improved, and the study demonstrated that tele-rehabilitation is a feasible alternative to in-clinic physical therapy [28•]. Another small randomized controlled trial evaluated group tango instruction virtually versus in-person in 26 individuals

Table 1 Selection of telemedicine and tele-rehabilitation studies in Parkinson's disease and related disorders from 2015 to 2019

	Author	Year	Study Design	Sample Size	Sample Population	Disease Severity	Authors' Conclusions
Telemedicine	Beck et al. [10]	2017	Randomized controlled trial	195	Individuals with Parkinson's disease in the USA	Mean disease duration 8.3 years; mean modified UPDRS part III 29.5; mean MoCA 26.1 (virtual care group, $n = 97$)	Remote care is feasible, convenient, and neither more or less efficacious than in-person care
	Tarolli et al. [19]	2019	Observational study	45	Individuals with atypical parkinsonian syndromes identified via Fox Trial Finder	Mean disease duration 4.2 years; mean UPDRS part III 40.4; mean MoCA 22.8; 55.6% requiring assistance with ADLs	Virtual diagnosis of atypical parkinsonian syndromes is both feasible and reliable
	Spear et al. [22]	2019	Survey	781	Individuals with Parkinson's disease in the USA	No disease severity data provided	Interest in telemedicine is high; people consider access to specialty care the top advantage and lack of hands-on care the greatest disadvantage
	Qiang et al. [23]	2015	Survey	137	Patients with Parkinson's disease at Toronto Western Hospital who were both users and non-users of telehealth	Mean disease duration 14.5 years, 29% with Hoehn and Yahr stage greater than or equal to 3; mean UPDRS part III 24.2 (users of telemedicine group, $n = 34$)	Telemedicine spares patients commute time and money; training of telehealth nurses is a key factor to consider
	Sekimoto et al. [24]	2019	Randomized crossover trial	10	Patients with Parkinson's disease at Juntendo University Hospital in Tokyo	Mean disease duration 7.3 years; mean Hoehn and Yahr stage 2.0; median UPDRS part III 22.0	Telemedicine delivered via tablet is successful, leading to comparable outcomes (e.g., PDQ-39, Hoehn and Yahr stage) as regular in-person visits
Tele-rehabilitation	Gandolfi et al. [28]	2017	Randomized controlled trial	76	Outpatients with Parkinson's disease at neurorehabilitation centers in Italy	Mean disease duration 6.2 years; median modified Hoehn and Yahr stage 2.5; mean UPDRS 44.1; mean MMSE 26.8 (home-based group, $n = 38$)	Home-based virtual reality balance training is a feasible alternative to in-person exercises for reducing postural instability
	Seidler et al. [29]	2016	Randomized controlled trial	26	Individuals with mild-to-moderate Parkinson's disease	Mean time since diagnosis 4 years; mean Hoehn and Yahr stage 2.5; mean MMSE 28.5	Virtual instruction of a tango class is feasible and has comparable effects on motor function with in-person instruction
	Griffin et al. [30]	2017	Non-randomized trial	29	Individuals with idiopathic Parkinson's disease and moderate hypokinetic dysarthria	No quantitative disease severity data provided	Lee Silverman Voice Treatment is non-inferior when delivered via iPad compared to in-person
	Theodoros et al. [31]	2016	Randomized controlled trial	52	Individuals with Parkinson's disease and dysarthria from a metropolitan area	Mean time since diagnosis 4.7 years; mean Hoehn and Yahr stage 2 (online group, $n = 36$)	Online, home-based speech treatment leads to similar acoustic, perceptual, and quality of life outcomes as in-person treatment
	Quinn et al. [33]	2019	Observational study	8	Individuals with Parkinson's disease who had previously received LSVT LOUD® treatment	Mean time since diagnosis 4.5 years; mean Hoehn and Yahr stage 1.94; mean MoCA 24.9	Improvements in voice sound pressure level result from group speech therapy delivered via tele-rehabilitation
	Seritan et al. [39]	2019	Observational study	33	Patients with a neurological disease seen by telepsychiatry at an academic center	61% with DBS; 39% with "mild or major" neurocognitive disorder	Telepsychiatry is feasible and leads to high patient satisfaction and greater access to mental health care

with Parkinson's disease and found no significant differences in retention, attendance, or outcomes, with both groups showing improvements in balance and motor function [29]. Similarly, voice tele-rehabilitation has been assessed and implemented in multiple studies and found to be feasible, effective, and well-received [30–34]. A randomized controlled trial compared online versus in-person Lee Silverman Voice Treatment in 34 individuals with PD and found that online therapy was successfully delivered online and was non-inferior to in-person therapy (based on pre- and post-treatment acoustic and perceptual measures of voice) with high participant satisfaction [34].

Finally, anxiety and depression are common in Parkinson's disease and reduce quality of life [35, 36]. Unfortunately, access to mental health care is limited. Telephone- and/or video-based cognitive behavioral therapy (CBT) may help address this barrier. A small pilot study showed that telephone-based CBT was feasible, with 20 of 21 individuals completing the study treatment and effective with improvement in depression (mean Hamilton Depression Rating Scale change from baseline to week 10 was 7.91 points) [37]. Another study that looked at telephone-administered cognitive behavioral therapy noted that reading emotion in the voices of participants was challenging given the "flat" speech of some individuals with PD and proposed intermittent in-person sessions to help improve the therapist-client connection [38]. Video-based telepsychiatry used in a recent study to augment typical in-person care by a geriatric psychiatrist at a large academic center was feasible, with a 96% visit completion rate; patient satisfaction was high, with 95% reporting that they were very satisfied with the care, comfort, and overall visits and 100% reporting that they were very satisfied with the convenience of the visits, which were conducted in their homes [39•].

Alzheimer's Dementia

In many ways, AD care lends itself well to telemedicine. The clinical interview is of primary importance in AD care, and videoconferencing is well suited to this element of a traditional patient encounter. In addition, telemedicine visits grant providers a better understanding of the patient's home environment and reduce disruptions to the patient's routine. Early research has demonstrated that telemedicine is accepted among AD patients and caregivers, is feasible [40, 41], enables remote administration of neuropsychological tests [42], and provides diagnostic accuracy comparable with in-person visits [43, 44]. Recent publications have built upon the existing evidence base.

Video-based administration of cognitive tests is feasible [42, 45]; however, more work is needed to determine the validity of this novel method of administration for specific tests. With video-based test administration, patients face the added challenge of navigating technology, may have difficulty hearing the instructions or seeing test stimuli, and cannot physically interact with test materials. In addition, delays or interruptions in video connection, if and when they occur, pose challenges. As a result, AD patients may be expected to perform more poorly on cognitive tests administered via video. A recently published meta-analysis examined 12 studies that used a test-retest design to compare in-person with video-based administration of cognitive tests [46•]. Scores on cognitive tests that were untimed and/or allowed for repetition, by either the examiner or patient, were only 1/10th of a standard deviation lower with video-based administration than with in-person administration. Among timed tests and tests that forbade repetition, those that required a verbal response (e.g., digit span and phonemic fluency) were also robust to video-based administration. However, there was such variability across studies in effect sizes on tests that required a motor response (e.g., the Clock Drawing Test and Mini Mental State Examination) that the effect of video-based administration on these tests could not be determined. Some of the examined studies included cognitively intact younger individuals and, in many cases, individuals completed video-based testing in the clinic, limiting the generalizability of these results to in-home administration of cognitive testing in older adults with AD. In addition, this meta-analysis did not include any studies that examined video-based administration of the Montreal Cognitive Assessment (MoCA) [47], a commonly used dementia screening assessment.

Two recent publications have examined the video-based administration of the MoCA. One study assigned 17 individuals with cognitive complaints to undergo the MoCA under one of three test conditions in the clinic: (1) in-person administration and in-person scoring, (2) in-person administration and video-based scoring, (3) video-based administration and in-person scoring [48]. The mean (SD) MoCA score as assessed by the test administrator was 23.18 (3.80) and inter-rater reliability across the three test conditions was high. Lindauer et al. examined the in-home video-based administration of the MoCA with several modifications to facilitate in-home remote administration, such as mailing participants a paper copy of the visuospatial/executive function items prior to the visit, in 28 individuals with mild-to-severe AD [49]. This version of the MoCA had excellent test-retest reliability with an intraclass correlation of 0.93. As of September 1, 2020, access to the MoCA test will be restricted to those who have completed a paid training and certification program [50]. The privatization of the MoCA brings new barriers to screening for cognitive impairment and may hinder the use of the test via telemedicine [51].

Few studies examining the reliability of neuropsychological assessments have been longitudinal. However, one recent study compared in-person to in-clinic video-based administration of the Mini Mental State Examination (MMSE) and the

Alzheimer's Disease Assessment Scale cognitive subscale (ADAS-cog) in 28 individuals with AD over a 24-month period [52]. Across the whole group, no significant differences were found between performance on the MMSE or the ADAS-cog under the different test conditions at any time point. However, subgroup analyses suggested that those with more severe cognitive impairment performed significantly worse on both tests at some time points with video-based administration.

AD patients and caregivers are highly satisfied with telemedicine visits. In recent publications on VA telemedicine dementia clinics, overall satisfaction ranged from 88 to 98% for patients and 91–98% for caregivers [53–55]. One study reported no differences in satisfaction between in-person and telemedicine visits [56], while another demonstrated a preference for telemedicine visits over in-person visits [54]. Telemedicine visits have also been shown to reduce distance traveled [53, 56, 57] and time spent traveling [57]. However, uniformly low response rates (37–46%) on post-visit satisfaction surveys [54–57] raise the concern that we may be overestimating satisfaction.

The US Department of Veterans Affairs (VA) has an established telehealth program that includes Clinical Video Telehealth, which enables patients to receive telemedicine care at a community clinic or in their home. Underscoring the need for this program, approximately 3 million US veterans enrolled in VA healthcare live in rural areas and more than 50% of them are elderly [58]. The VA conducted over 1 million telemedicine visits for 393,000 patients in the fiscal year 2018 alone [59]. Several recent reports on four VA telemedicine dementia clinics highlight the variability in the structure and components of telemedicine dementia clinics. Three of the four programs provided telemedicine visits to AD patients at a community clinic; only one provided in-home telemedicine visits (Table 2) [56]. Among those programs that provided in-clinic telemedicine visits, two programs included in-person obtainment of vital signs [54, 57, 60], two provided in-person technical assistance [54, 57, 60], and one conducted extensive phone-based assessments prior to the visit and in-person neuropsychological testing [54]. Two programs were primarily used by individuals with mild cognitive impairment (mean Functional Assessment Staging Test score 2.9) or mild dementia (mean Functional Assessment Staging Test score 4.23) [54, 57] although one primarily serviced patients with mid-late stage disease [53]. Some were for initial consultation [53, 54] but others drew from an established patient base [56] and the volume of visits varied considerably between programs. None of these publications examined the accuracy of diagnoses made through telemedicine.

The experiences of dementia telemedicine programs have also demonstrated that interdisciplinary telemedicine

Table 2 Selection of telemedicine studies in Alzheimer's disease and related disorders from 2016 to 2019

Author	Study design	Telemedicine sample size	Sample population	Location of patient	Mean age	% Male	Authors' conclusions
Dang et al. [52]	Retrospective observational study	94	Veterans with memory complaints	Clinic	74.7 (range 36–95)	Not reported	Telemedicine care is acceptable to patients and caregivers and may improve access to care
Kim et al. [59]	Retrospective observational study	98	Korean patients with dementia	Clinic	78.2 (range 66–93)	30.3	Dementia care through telemedicine is equally effective as in-person care
Chang et al. [58]	Retrospective observational study	130	Rural veterans with dementia	Clinic	Not reported (geriatric)	100.0	Telemedicine can aid in medication management for rural dementia patients
Moo et al. [54]	Retrospective program evaluation	38	Veterans with neurodegenerative or vascular dementia	Home	79.0 (SD 8.1)	97.4	Caregivers find telemedicine an acceptable alternative to in-person dementia care
Powers and Buckner [51]	Retrospective program evaluation	45	Rural veterans with dementia	Clinic	77.0 (range 63–100)	Not reported	Dementia care through telemedicine is well-received by rural patients
Powers et al. [55]	Retrospective program evaluation	95	Rural veterans with dementia or MCI	Clinic	77.8 (SD 10.0)	100.0	Telemedicine saved travel time and increased access to specialists for rural dementia patients

dementia care is feasible. A Tennessee-based program provides telemedicine visits with a geriatrician and social worker [53]. A Pittsburgh-based program provides interdisciplinary telemedicine dementia care with a team comprising a geriatrician, geriatric psychologist, geriatric psychiatrist, nurse manager, and social worker [57]. During 1 year of the Pittsburgh-based program, 222 telemedicine visits were offered, 210 (95%) were accepted, and 156 (70%) were completed for 95 unique patients. A care model employed in California combines in-person assessment by a geriatrician and neuropsychologist with in-clinic video-based visits with a behavioral neurologist facilitated by a nurse [55]. The switch from in-person to telemedicine visits improved access to care by a behavioral neurologist.

Telemedicine visits for AD result in changes in care. Within the Pittsburgh VA Healthcare System's dementia telemedicine clinic, 199 visits (130 initial consultations, 69 follow-up visits) occurred with a geriatric specialist over a 12-month period [60]. On average, 1.8 medication changes were made during initial consultations and 1.1 medication changes were made during follow-up visits. In another report on the same program, telemedicine providers identified inappropriate medications that could be contributing to cognitive impairment in nearly half of the visits [57]. In a Tennessee-based program, long-term care services and supports were recommended in 64% of the 46 conducted telemedicine visits and medication changes were recommended in 36% [53]. Telemedicine visits also frequently generate referrals to social work and recommendations for further testing [54]. In addition, several programs have demonstrated that new diagnoses can be provided or confirmed in telemedicine visits [53, 54, 57].

A long-standing dementia telehealth program in South Korea connects rural clinics in Gangwon province to the Kangwon National University Hospital. Kim et al. recently compared long-term outcomes between 98 individuals who received their dementia care through video-based visits conducted at a rural clinic in South Korea and 90 who received their dementia care at the university hospital [61•]. They found no significant difference in mean annualized change in MMSE score between the two groups over a mean follow-up period of approximately 2 years. While this was not a randomized study, the results suggest that video-based dementia follow-up care is as efficacious as in-person care. Among patients with dementia who reside in independent and assisted senior living communities, access to a program that provided telemedicine visits enhanced by in-home evaluation by trained personnel who can obtain vital signs, collect samples for testing, and perform electrocardiograms is associated with decreased use of the emergency department [62]. These results suggest that telemedicine care provides at least comparable outcomes and may improve some outcomes.

Telemedicine care in AD need not be limited to physician-patient encounters. Recent pilot studies have built upon the existing literature base suggesting that tele-rehabilitation is feasible in AD [63, 64]. Telemedicine can be used to accurately assess aphasia [65] and to provide speech therapy for primary progressive aphasia [66] and phonologic alexia [67]. In addition, home safety evaluations can be done through telemedicine [68]. Other studies have focused on the needs of caregivers of individuals with dementia and have demonstrated the feasibility of conducting video-based support groups [69], providing video-based caregiver education [70] and providing video-based training on the management of behavioral symptoms [71].

Conclusions

Telemedicine is a valuable tool in the management of neurodegenerative diseases in the elderly. Telemedicine in PD and AD is feasible, is acceptable to patients and caregivers, reduces time and travel for visits, and can improve access to specialist care. Telemedicine care is impactful; it results in medication changes and referrals for additional therapies and supports and can be used to administer cognitive tests and manage advanced therapies like deep brain stimulation. Finally, tele-rehabilitation is feasible and can help improve access to rehabilitative therapies.

Still, barriers to accessing telemedicine services, particularly in-home services, remain. First, only 73% of US adults have home broadband access [72]. Older adults and rural residents are less likely to have home broadband access [72] and 20% of veterans lack any access to the Internet [73]. Highlighting technology-related barriers, only 17% of invited memory care clinic patients agreed to participate in a Massachusetts-based VA program [56]. Among those who did not decline due to upcoming admission to a long-term care facility, 30% reported not having a home computer and 11% reported either not being comfortable with their home computer or not having the right technology for telemedicine visits. Second, in the USA, licensure requirements limit the ability to provide care across state lines. However, this may be changing. Recent legislation allows VA providers to provide telemedicine to patients located out-of-state without obtaining a medical license in that state [74]. In addition, the Interstate Medical Licensure Compact expedites the process for obtaining licensure in multiple states [75]. Third, in the USA, reimbursement is inconsistent. Medicare does not reimburse for home-based telemedicine visits for neurodegenerative diseases [76]. Medicaid telehealth reimbursement policies vary across the states and only 19 states reimburse for home-based telemedicine visits [77].

As telehealth becomes more prevalent, new programs that span the technology, legal, and clinical realms are needed to train physicians. Authors JLA and RBS received telemedicine training as part of their fellowships in movement disorders. The American Academy of Neurology has published a framework for the creation of telehealth training programs for neurology residents [78], and one of the authors (JLA) is participating in the development of such a training program for the University of Rochester neurology residents. As we expand telehealth practices, we should be mindful of physician satisfaction, particularly considering some data showing that physicians are less satisfied than patients with telemedicine [10•]. We must also consider how best to integrate telemedicine into clinical programs and how to ensure that it is financially sustainable. At the University of Rochester, we provide telemedicine care to patients with PD or suspected PD through a grant-funded program, Parkinson Disease Care New York, which is not currently integrated into our electronic health record, although there are plans to document notes in the electronic health record in the near future. The program has administrative assistants to help with scheduling and a nurse to help with patient calls and medication refills. University of Rochester specialists have also provided contract-based care to patients with PD residing in area nursing homes, a population where access to specialist care can be limited [79].

Future research should move beyond examining the feasibility and acceptability of telemedicine care in neurodegenerative disease. Prospective studies examining short- and long-term outcomes are needed to determine whether telemedicine care results in improved or comparable outcomes compared with usual in-person care. Moreover, research examining the validity of in-home video-based cognitive testing across different stages of disease is needed. Additional studies are also warranted to examine management of advanced therapies via telemedicine. Still, telemedicine has proven time and again to be a feasible and satisfactory form of care and is a promising tool to increase access to care, particularly in older adults with neurodegenerative disease.

Compliance with Ethical Standards

All reported studies/experiments with human or animal subjects performed by the authors have been previously published and complied with all applicable ethical standards (including the Helsinki declaration and its amendments, institutional/national research committee standards, and international/national/institutional guidelines).

Conflict of Interest The authors each declare no conflicts of interest.

Human and Animal Rights and Informed Consent This article does not contain any studies with human or animal subjects performed by any of the authors.

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