



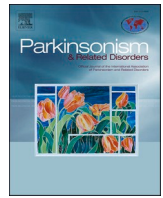
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# Parkinsonism and Related Disorders

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## The global pandemic has permanently changed the state of practice for pre-DBS neuropsychological evaluations

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### ABSTRACT

The evaluation and management of patients with movement disorders has evolved considerably due to the COVID-19 pandemic, including the assessment of candidates for deep brain stimulation (DBS) therapy. Members of the Neuropsychology Focus Group from the Parkinson Study Group Functional Neurosurgical Working Group met virtually to discuss current practices and solutions, build consensus, and to inform the DBS team and community regarding the complexities of performing DBS neuropsychological evaluations during COVID-19. It is our viewpoint that the practice of neuropsychology has adapted successfully to provide tele-neuropsychological pre-DBS evaluations during the global pandemic, thus permanently changing the landscape of neuropsychological services.

### 1. Introduction

The COVID-19 pandemic posed unprecedented challenges to healthcare delivery worldwide. In the US, medical practices and institutions initially faced widespread shutdowns involving suspension or remote delivery of non-emergent medical care, followed by a gradual reopening complicated by regional public health policy measures, institutional variances, and patient preferences. As the pandemic evolved with subsequent waves of infection and exposure risk, healthcare practitioners had to rapidly adapt and shift between care delivery models to accommodate changing risks and regulations related to the pandemic.

Because there were limited guidelines for best practices during a global pandemic, care delivery methods were largely determined on an institutional basis according to patient population risks, care requirements, and availability of personal protective equipment (PPE). Now that COVID-19 vaccinations are available, it is expected that care delivery models will soon begin to shift again. The lessons learned from

the COVID-19 pandemic are invaluable as we prepare for this shift and the likely prospect of future pandemics.

The evaluation and management of patients with movement disorders has evolved considerably due to the COVID-19 pandemic, including the assessment of candidates for deep brain stimulation (DBS) therapy. Such pre-operative evaluations involve a multidisciplinary team of experts, including neurologists, neurosurgeons, and neuropsychologists, amongst other professionals. Goals include identifying diagnostic red flags, assessing likelihood of meaningful improvement, and identifying comorbidities that may increase surgical risk, affect outcomes, or require treatment prior to surgery. Neuropsychologists play an essential role in this multidisciplinary team by evaluating for cognitive or behavioral changes that influence decisions regarding candidacy and site of DBS implantation [1].

The recommendations for DBS device management during pandemics do not specifically address pre-operative evaluations; thus considerable uncertainty remains regarding best practices for

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<https://doi.org/10.1016/j.parkreldis.2021.04.029>

Received 30 December 2020; Received in revised form 5 April 2021; Accepted 29 April 2021

Available online 14 May 2021

1353-8020/© 2021 Published by Elsevier Ltd.

**Table 1**  
Barriers to pre-DBS neuropsychology services during pandemic.

- Institutional priorities
- Consideration of services as elective
- Redeployment of neuropsychologists and/or their testing staff
- Lack of sufficient insurance coverage for tele-neuropsychology
- Access to HIPAA compliant video-based platforms with screen sharing capabilities
- Limited access to stimuli for tele-neuropsychological services
- Lack of camera equipment
- Access to alternate or online delivery modalities for some measures
- Concerns regarding reliability and validity of remote testing methods
- Exposure risk for patients
- Lack of Personal Protective Equipment
- Technology literacy amongst patients
- Reliable high-speed internet access amongst patients and providers
- Lack of appropriate devices for reliable testing amongst patients (e.g., laptop, tablets)
- Access to translators
- Lack of cross-cultural stimuli for tele-neuropsychological services

conducting DBS assessments under these conditions [2]. A retrospective cohort analysis of telemedicine for DBS candidacy pre-COVID-19 focused on remote neurologic assessments, with subsequent in-person neuropsychological and neurosurgical evaluations [3]. However, the COVID-19 pandemic imposed further unexpected challenges on such care models, including redeployment of neuropsychologists during early stages of the pandemic and the increased COVID-19 vulnerability of the patient population necessitating additional care considerations [4].

In a recent survey conducted by the Functional Neurosurgical Working Group (FNSWG) of the Parkinson Study Group (PSG) [5], COVID-19 related closure of clinical activities affected the pre-DBS assessments at 96% of programs (22/23). While the majority of the pre-operative neurologic and neurosurgical evaluations continued through telehealth, 70% of sites reported that pre-operative neuropsychological evaluations were halted and 57% of sites reported that no tele-neuropsychology or in-person neuropsychological visits were possible.

Since pre-operative neuropsychological evaluations are of paramount importance to the assessment of DBS candidacy [6], we sought to understand the factors contributing to the discrepancy between the ability of DBS programs to offer remote neuropsychology visits compared to neurology or neurosurgery visits. Members of the Neuropsychology Focus Group from the PSG FNSWG met virtually to discuss current practices and solutions, build consensus, and to inform the DBS team and community regarding the complexities of performing DBS neuropsychological evaluations during COVID-19. It is our viewpoint that the practice of neuropsychology has adapted successfully to provide tele-neuropsychological pre-DBS evaluations during the global pandemic, thus permanently changing the landscape of neuropsychological services.

### 1.1. Approaches to neuropsychological evaluation during COVID-19

Neuropsychologists have used tele-neuropsychology to varying degrees to ensure continuity of care for surgical candidates during the COVID-19 pandemic. This discussion focuses on in-home tele-neuropsychology and considers additional methodologies, which are not mutually exclusive and can be selected based on the needs of the patient, institutional priorities, and federal and state regulations, including: video interview with in-clinic testing, in-clinic testing using web cameras (hybrid approach), and face-to-face testing using PPE as potential alternatives to a fully remote approach.

International procedures for pre-DBS evaluations during COVID-19 vary based on access to medical care and neuropsychological services, access to technology and high-speed internet, governmental regulations, and privacy rules. An informal discussion with international colleagues throughout Canada, Europe, Asia, and Africa revealed that pre-DBS evaluations followed similar protocols as the US, with variations in

timelines for returning to practice. For countries where access to technology is limited, providers returned to in clinic testing with PPE at a faster rate than those who have high-speed reliable internet and appropriate hardware for telehealth. Most international providers reported a combination of in clinic with PPE or hybrid model procedures in addition to offering tele-neuropsychology for interviews and/or assessment. International colleagues in areas with unreliable, limited or no access to technology or neuropsychology services reported limited use of telehealth, with neurology colleagues performing cognitive assessments when indicated.

Barriers to continuation of in-person neuropsychology care or conversion to tele-neuropsychology are described in Table 1. At the beginning of the pandemic, federal and state governments implemented changes to healthcare systems to maximize provider flexibility including in-home telehealth to mitigate transmission risk. Likewise, test publishers gradually approved use of previously restricted tests or stimuli for telehealth. While policy changes have allowed for more widespread implementation of tele-neuropsychology, insurance reimbursement for services continues to vary widely by state.

### 1.2. Practice changes required during pandemic conditions

COVID-19 related restrictions necessitated numerous changes in the implementation of pre-DBS neuropsychological evaluations including adaptations of cognitive tests through cameras and computerized assessments, oral adaptations of written tasks, and conversion from paper to web-based questionnaires. In addition to providing information regarding candidacy for surgery, pre-DBS evaluations also provide baseline data to monitor for potential changes following surgery, necessitating a comprehensive evaluation. Our experience indicates that most individuals can complete a tele-neuropsychological assessment in a single session, with breaks as needed. Access to high-speed internet is necessary; if connection is insufficient, a follow-up appointment can be scheduled at an alternate location with better internet access. During the consent process, limits of confidentiality, including disclosure that the exams are not recorded and there are no observers present off camera, and the importance of maintaining test security with patient agreement to not copy, record, or save any test materials must be reviewed. For emergency purposes and state licensure requirements, the patient's location at the time of the evaluation is confirmed.

### 1.3. Reliability and validity of tele-neuropsychology

Professional guidelines for tele-neuropsychology were recently established as the result of the COVID-19 pandemic [7]. Studies regarding equivalence of face-to-face assessments and tele-neuropsychology are emergent and validation studies are limited, particularly for DBS patients. However, research efforts have documented the reliability and validity of bi-directional audio/video-conferenced tele-neuropsychological assessment in older patients [8,9]. Up to 70% of older patients expressed comfort with video-based neuropsychological assessment [10] and up to 80% of patients who received tele-neuropsychological assessments expressed interest in future tele-neuropsychological visits [11].

Objective neuropsychological measures designed for telehealth use, as well as those available via open access, can be administered to patients with screen-share features. For tasks involving writing or drawing, 'screen capture' can be used to obtain an electronic record of the patient's response. A second electronic device (e.g., laptop or tablet) can be used as a camera to allow the examiner to see what the patient is drawing/writing. Inventories related to mood, anxiety, behavioral changes (e.g., impulse control, apathy) and quality of life can be administered via screen-share or built into electronic medical records. Implementing electronic questionnaires can continue beyond the pandemic to reduce length of the time in clinic.

#### 1.4. Benefits of tele-neuropsychology

Participating in tele-neuropsychology offers multiple benefits. First, the logistics of an in-clinic evaluation are alleviated, including the potential for a lengthy commute, overnight stay, or disrupted routine. Second, tele-neuropsychology evaluations can occur on separate days from other pre-surgical evaluations, reducing fatigue that can affect cognitive testing. Third, patients receiving video-based DBS evaluations at home may experience less anxiety, which can worsen motor symptoms (e.g., tremor, dyskinesia). Without these complicating factors, patients are better able to attend to the cognitive testing.

Older patients have a higher risk of complications related to COVID-19 compared to younger patients [12] and Parkinson's disease patients with COVID-19 have longer hospitalizations than their peers [13]. Tele-neuropsychology or a hybrid-approach can reduce exposure risk during a clinic visit. Finally, tele-neuropsychology may also improve access to collateral informants, facilitating communication regarding the patient's support system and family concerns, important factors in pre-DBS assessments.

#### 1.5. Limitations of tele-neuropsychology

Certain limitations are inherent to tele-neuropsychology. The breadth of behavioral observations is limited, as motor symptoms may be inadequately captured by video angle. Tele-neuropsychology may limit observation of non-verbal communication cues from family members, particularly regarding sensitive content (e.g., driving, impulse control). Like standard evaluations, collateral sources are requested to be on-camera with the patient during the clinical interview, and private virtual discussions can be arranged with patient permission. Moreover, for DBS candidates with speech disturbances (e.g., hypophonia), even mild connectivity problems can hamper communication. Headphones with a microphone often mitigate this issue, but as speech problems may worsen following surgery, sound quality requires consideration when performing remote assessment.

Evaluation of psychomotor processing speed and executive functioning are important components of the neuropsychological evaluation of PD patients [14], which can be challenging in a virtual visit. Non-motor, or verbal, timed tasks may be used as a proxy for psychomotor processing speed. Fortunately, many measures assessing problem-solving, mental flexibility, and working memory can be administered without physical manipulation of test stimuli or through computerized administration, which are ideal for tele-neuropsychology.

Importantly, patients may not have video technology available in their home, which can lead to disparities in telehealth access. A hybrid approach is a good solution to providing equitable care. If technical issues occur during tele-neuropsychology visits, it is important to discern whether these struggles reflect cognitive impairments. Options for in-person re-assessment when technical or other administration issues preclude definitive conclusions regarding correspondence of test performance to underlying neurocognitive ability may help provide clarity to these issues for pre and post-DBS evaluations. Some pre-surgical DBS patients may be too cognitively impaired to comprehend testing via telehealth; however, this too provides useful clinical information regarding DBS candidacy. Lastly, for patients whose primary language is not English, conducting a tele-neuropsychology evaluation with the assistance of an interpreter remains a challenge [15].

## 2. Discussion

A variety of issues must be considered when adapting to a tele-neuropsychological approach for pre-surgical DBS assessments, including technical, regulatory, test administration, and administrative issues, all of which contributed to the delay in resumption of neuropsychology care for DBS candidates during initial stages of the COVID-19 pandemic. Our experience demonstrates that provided an

**Table 2**

Permanent changes to neuropsychological practice.

- Electronic questionnaires to shorten in person evaluations
- Hybrid approaches
- Scales/assessments that are now able to be used for administration under dual circumstances
- Video interviews with patients and informants
- Video feedback sessions

appropriate device and adequate internet connection, tele-neuropsychology with the DBS candidate in their home is feasible, convenient, can reduce fatigue and anxiety, and is often preferred by patients and families. For patients without access to technology or reliable internet, the hybrid-approach or in-person evaluations with PPE minimize exposure for patients and staff, while collecting critical clinical data. Future studies are being designed to investigate the impact of tele-neuropsychology on pre-DBS evaluations within the US through a multi-site quality improvement data repository with the aim of expansion to international sites.

Institutions can support tele-neuropsychology approaches through the provision of webcams and access to HIPAA compliant video-based platforms with screen sharing capabilities and with telehealth scheduling and patient interface. Neurologists and neurosurgeons can support neuropsychologists by providing specific referral information including limitations with hearing, vision, or lack of access to technology, along with information regarding the priority of the evaluation and preferences for remote assessment.

Lessons learned during COVID-19 can be adapted to provide care and reduce barriers for pre-DBS evaluations beyond the pandemic. If regulatory agencies and insurance companies establish permanent policies regarding tele-neuropsychological services, the practice of neuropsychology is positioned to provide continuity of care through tele-neuropsychological services for pre-DBS evaluations permanently. If these policies are not enduring, numerous strategies implemented during the pandemic will nonetheless prove permanently useful to neuropsychological practice (Table 2). Regardless, additional work is needed to ensure equitable access to tele-neuropsychological services for those with technology-related limitations hearing/vision impairment, and non-English speakers.

Despite many challenges, the COVID-19 global pandemic has provided neuropsychologists with an opportunity to evolve and expand services. Adapted practice models for providing essential pre-DBS evaluations within the multi-disciplinary team for the current and potential future pandemics will enhance future neuropsychological care.

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