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# Emory university telehealth neuropsychology development and implementation in response to the COVID-19 pandemic

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## ABSTRACT

**Objectives:** Emory University has modified its clinical practices across specialties in response to the 2020 COVID-19 pandemic to provide service delivery while maintaining patient, staff, and faculty safety. This report shares current solutions and workarounds associated with telehealth neuropsychology (teleNP) while also recognizing teleNP opportunities.

**Results:** We modified many measures from our traditional assessment protocols so they could be administered through Zoom. To maximize quality control, formal how-to coversheets and manuals were developed for both training and task administration (i.e. navigating Zoom assessment interfaces, practicing adapted test instructions, and troubleshooting).

**Conclusions:** TeleNP has been successfully used to answer referral questions regarding deep brain stimulation (DBS) candidacy in Parkinson's disease patients and presence of mild neurocognitive impairment in patients with subjective memory decline. Our current protocols will continue to evolve with greater experience and are not considered to be a finished product. Nevertheless, development of robust teleNP protocols should expand availability of neuropsychology in both clinical and research applications while simultaneously decreasing assessment burden associated with traveling - sometimes long distances - for diagnostic neuropsychological evaluation.

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## KEYWORDS

Telepsychology; telehealth; telemedicine; program development; implementation

## Introduction

The 2020 COVID-19 pandemic has forced meaningful change across the clinical service, research, and education missions of Emory University. Although many of the challenges are shared across missions, there are unique features that our Neuropsychology Service within the Department of Neurology at the Emory University Brain Health Center has faced with balancing demands of clinical service delivery while maintaining patient, staff, and faculty safety. This report shares our current solutions and

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workarounds to the limitations imposed by telehealth platforms while also recognizing opportunities that telehealth neuropsychology (teleNP) assessment offers. While many of the features we describe are being continuously modified with experience and external guidance from professional organizations such as the American Psychological Association (APA), National Academy of Neuropsychology (NAN), and Inter Organizational Practice Committee (IOPC), this report describes both the rationale used in our decision-making process and also provides practical guidance for remote assessment implementation which may not generalize to practices that are meaningfully different in structure.

Our Neuropsychology Program at the Emory University Brain Health Center is an academic clinical service that is a division in the Department of Neurology. Patient referrals include epilepsy surgery candidates, movement disorder patients who are being evaluated for deep brain stimulation (DBS), and General Neurology patients with a range of neurologic diagnoses. In addition to providing clinical service, the division collaborates with multiple research initiatives (e.g. Emory Healthy Brain Study; Goetz et al., 2019) and assessment of Georgia residents who are participants within the Georgia Memory Net (Georgia Memory Net, n.d.). Finally, the Neuropsychology Program provides education, clinical supervision, and mentorship to students ranging from undergraduates, graduate students, interns, and postdoctoral fellows as well as full-time psychometrists.

## Background

Emory Healthcare closed clinics beginning March 16, 2020 for non-emergent new patient visits, and also issued guidance that telehealth visits were permissible for follow-up patient visits using Zoom and FaceTime as acceptable platforms. Although Emory University and Emory Healthcare employ a HIPAA compliant Zoom version, the Office of Civil Rights (OCR) issued notification on March 17, 2020 that penalties for non-HIPAA compliant telehealth communication would be waived, when used in good faith, to provide telehealth care during the COVID-19 public health emergency (OCR, 2020).

Like most clinical practices, the rapid expansion of COVID-19 infection required rethinking the standard care models for neuropsychological assessment. Since several physician colleagues in Neurology had established telehealth practices providing care to rural parts of Georgia, the basic infrastructure for remote patient visits was already in place. Prior to the COVID-19 pandemic, a patient eligible for telehealth physician visits had to be an established patient and reside in part of the state that was designated by Centers for Medicare and Medicaid Services (CMS) as a rural area. This restriction to rural telehealth service delivery was waived on March 17, 2020 allowing physicians, nurse practitioners, clinical psychologists, and licensed clinical social workers to provide telehealth services without limitation based upon any rural vs. non-rural designation (Centers for Medicare and Medicaid Services, 2020). Because of this waiver, Emory Brain Health Center leadership requested that all clinical services, including neuropsychology, develop telehealth protocols since the duration of limited face-to-face clinic visits was anticipated to last into Fall 2020 and beyond. With COVID-19,

neurology telehealth visits were initially limited to established patients, but were expanded to new patients realizing that limitations would be present for certain components of the physical examinations (e.g. sensory assessment, visual field examination). Nevertheless, telehealth was considered the preferable treatment method whenever practicable to limit patient exposure risks.

## Development and considerations

Neuropsychological test administration using videoconferencing has been successfully employed and reported in a variety of research and clinical settings (Cullum et al., 2006; Cullum et al., 2014; Grosch et al., 2015; Galusha-Glasscock et al., 2016; Harrell et al., 2014; Turner et al., 2012; Wadsworth et al., 2018). It is beyond the scope of the paper to review this literature, although a 2017 systematic review and meta-analysis reported good concordance between in-person and videoconference evaluations (Brearly et al., 2017). However, findings were less consistent with subjects older than 75 and for studies that had slower internet connections. Greater empirical support is also described for verbally mediated tasks although support for visual tasks is present (Brearly et al., 2017). In general, these reports used videoconferencing in controlled environments (i.e. both sender and receiver were in rooms designed for remote transmission and assessment) rather than in less controlled conditions (i.e. patient and provider residences).

The development and implementation of remote cognitive testing was initially in response to assessment needs of the Emory Cognitive Neurology Clinic, and subsequently, for Georgia Memory Net (GMN) patients (Georgia Memory Net, n.d.). As part of new patient visits in the Cognitive Neurology Clinic, all patients receive a brief neuropsychological evaluation including a 15-item Boston Naming Test (BNT; Mack et al., 1992), Trail Making Test (TMT; Army, 1944), Consortium to Establish a Registry for Alzheimer's Disease Word List task (CERAD-WL; Morris et al., 1988), Digit Span (Wechsler, 2008), Benson Complex Figure (Possin et al., 2011), Animal Fluency (Rosen, 1980), Controlled Oral Word Association (COWA/FAS; Spreen & Benton, 1977), and Montreal Cognitive Assessment (MoCA; Nasreddine et al., 2005). The impetus for rapid transition to remote testing was in response to the Centers for Disease Control and Prevention (CDC) identification of most vulnerable populations (i.e. people 65 years and older and people of all ages with poorly controlled underlying medical conditions). After development of a telehealth protocol for brief neuropsychological testing in the Cognitive Neurology Clinic, the lessons learned were applied to GMN. The GMN is a statewide program supported by the Georgia Department of Human Services to evaluate Georgia residents with memory loss and cognitive decline referred by their Primary Care Physicians during patient Annual Wellness Visit to a regional Georgia Memory Net Memory Assessment Clinic for diagnosis and care planning. Both the Cognitive Neurology Clinic and the GMN provided the opportunity to explore remote teleNP feasibility with a limited number of cognitive measures.

The primary GMN cognitive measures identified for telehealth include the MoCA, Rey Auditory Verbal Learning Test (Rey AVLT; Rey, 1941; Rey, 1958; Schmidt, 1996), Animal Fluency, and COWA/FAS. Working with the Cognitive Neurology Clinic

personnel, minor changes in test structure and instructions necessary for remote testing were identified. For example, MoCA visual stimuli are presented individually in order to guide patient's attention to specific task performance; Necker cube copy and clock drawing are held up by the patient to the computer camera so that a screen capture can be taken; hand raising rather than tapping is used for the attention task; the patients are asked to close their eyes prior to being asked orientation items to eliminate any temptation to search the computer screen for time and date information. Although the publisher of the MoCA has issued guidance for videoconference MoCA administration (<https://www.mocatest.org/remote-moca-testing/>), we believe our modifications are simpler for the patient to perform (e.g. closing eyes rather than looking straight into the camera when performing orientation) and for scoring (e.g. holding up a hand for each presentation of the letter A rather than tapping the side of the phone with a pen or pencil when performing vigilance).

We next moved forward to explore what neuropsychological measures could be reasonably modified for remote assessment to provide a more comprehensive cognitive. Test consideration was not limited to measures successfully adapted for use in GMN or our Cognitive Neurology Clinic, and different tests of similar cognitive constructs were ultimately selected for teleNP. As neuropsychologists, we are currently tasked to balance ethical principles (i.e. Principle A with Principle D) and we face a dilemma as waiting to provide services until in-person testing is feasible means that patients who need timely care will not receive it, yet moving forward with teleNP testing could be harmful if the telehealth format changes interpretation (Hewitt et al., 2020). Furthermore, we are required to apply existing ethical standards when they do not specifically address an area of practice (e.g. use of remote, electronically delivered services) (Grosch et al., 2011). Considerations for our transition to teleNP included scope and limitations of the telehealth modality, informed consent for telehealth services, patient privacy and confidentiality, test security, and validity of telehealth assessment where these considerations were balanced against the uncertainty of the university's timeline for a limited face-to-face clinic (Hewitt et al., 2020; Inter Organizational Practice Committee, 2020). For best-practice guidelines, test-level validity data as well as factors that may affect teleNP validity (e.g. diagnosis, disease severity, technology) were considered for older adults (Marra et al., 2020). The major assessment factors considered with teleNP included stimulus presentation and recording of responses. Concerns included reproduction of proprietary test material for remote stimulus presentation as well as issues of stimulus size based upon screen size or device. Guiding our thought processes was a desire that there would be no test materials needing to be downloaded by the patient, and also not requiring materials to be sent back by the patient through the mail.

### Test modifications

Given that our staff and faculty were conducting assessment from home, the initial test selection focused on measures that were not the product of major test publishers (i.e. Pearson Assessments and Psychological Assessment Resources) and were in the public domain. This decision was to avoid infringement of copyrighted materials in

which use of test stimuli at home is poorly controlled compared to face-to-face clinic assessments. Additionally, we realized that these materials are already easily found with common web search engines, further decreasing overall test security concerns. Tests selected include the Rey AVLT, Rey-Osterrieth Complex Figure (ROCF; Fastenau, 1996; Loring et al., 1990; Osterrieth, 1944), TMT, Animal Fluency, and COWA/FAS. Strategies were piloted for successful administration of the ROCF copy and memory trials resulting in an approach in which patients are instructed to have a folder available next to their computer. After patients copy the ROCF on a blank piece of paper - preferably unlined paper - from the image projected on their computer screen, a screen shot is taken. Patients are instructed to hold their copy up to the screen and the examiner takes a screen shot of only the ROCF copy making sure not to capture the patient's face. Patients are then instructed to fold their ROCF copy paper in half and place in their folder so it is not visible for the subsequent recall tasks. Patients are instructed to discard ROCF reproductions at the end of the evaluation.

While the translation of generative verbal fluency tasks to teleNP is straightforward, it was necessary to adapt Trail Making for oral responding similar to previously described modifications (Mrazik et al., 2010). Differentiating from oral bedside administration of the TMT, we opted to have the visual stimuli traditionally presented in face-to-face administration available to the patient while responses are said aloud. We scanned the material to be used through Zoom screen sharing. Since the psychometrist will be unable to easily correct an error and demonstrate correction, additional slides were created to use a stepwise approach when correcting an error (i.e. if a patient makes an error on Part A or B samples, pages are presented with arrows detailing the correct sequence to ensure the patient visually understands the task before proceeding). Should a patient make an error or lose their place on Part A or B trials, a prompt is given and the psychometrist shows where to start with their cursor.

The next step in task modification involved the Wechsler Adult Intelligence Scale—Fourth Edition (WAIS-IV; Wechsler, 2008). While the transition to telehealth assessment for most verbal tests (i.e. Digit Span, Similarities) was straightforward, there were concerns regarding performance measures given the proprietary nature in which scanning of materials was necessary for stimulus presentation via telehealth (i.e. Matrix Reasoning, Vocabulary). Prior remote teleNP testing used cameras to transmit images from the originating site to the tester, but image scanning provides greater consistency of visual display without the need to position a camera for each stimulus presentation. While this practice understandably is not encouraged by test publishers, we proceeded with a good faith assumption that during the period of rapid transition of service delivery that some practice modification would be tolerated. Test publishers have been actively modifying their materials for remote assessment and making these materials available through their preferred assessment software. These options will ultimately provide more satisfactory solutions to visual stimulus presentation.

We also decided at this time to transition from the Mattis Dementia Rating Scale—Second Edition (DRS-2) to the MoCA as our primary global cognitive summary score for patients undergoing DBS evaluation. There was general dissatisfaction with DRS-2 across multiple Brain Health Center Movement Disorders faculty because DRS-2 scores would often deviate from clinical expectations. We had successfully established

modifications of the MoCA for remote telehealth administration, and we thus took this opportunity to switch from the DRS-2 to the MoCA as the main cognitive summary score in patient evaluations. The MoCA summary score reportedly is a more sensitive marker of cognitive impairment than the DRS-2 (Hendershott et al., 2019).

## Implementation

It was necessary to consider which patients might be inappropriate for assessment. Although this is an adult service that performs few forensic evaluations, any patient with the potential for medico-legal use of test results was considered an inappropriate candidate for telehealth assessment since forensic evaluations require comprehensive, widely-validated face-to-face examination procedures. Consequently, any deviations from this approach such as teleNP would likely be unable to survive a Daubert challenge. Our service does not accept referrals outside the Emory Healthcare System. Most clinical patients suffering from traumatic brain injuries are evaluated and managed by the Department of Physical Medicine and Rehabilitation (PM&R) with neuropsychological evaluations being performed by a separate Neuropsychology Service in the PM&R department. In addition, epilepsy surgery candidate evaluations were considered to be of sufficient complexity that remote assessment was considered inappropriate, a position recently formally adopted by the Neuropsychology Task Force of the International League Against Epilepsy (Inter Organizational Practice Committee, 2020; International League Against Epilepsy, 2020).

All other patients are considered potential candidates for teleNP and are contacted by one of the full-time psychometrists to first determine whether they are interested in a telehealth service. If interested, the next step is to schedule a pre-assessment training session to establish if a patient has sufficient computer/internet infrastructure to support remote testing. In 2018, 79% of households reported having high-speed internet subscriptions with large variability across location ranging from 26% to 93% across Georgia counties (U.S. Census Bureau, 2018) precluding teleNP in many patients. In fact, outside of the major metropolitan regions of Augusta and Atlanta, telehealth cognitive screening has been limited. Emory uses a HIPAA compliant version of Zoom requiring a Business Associate Agreement. This system is not integrated with our Cerner electronic medical record, and thus a Zoom invitation is sent to the patient's primary email. All test materials and patient responses are stored on a HIPAA compliant server that uses Duo, which is a two-factor authorization system needed for server access. During the pre-assessment training session our psychometrist helps the patient navigate the Zoom platform and practices drawing tasks to ease anxiety (e.g. taking screen shots). Most pre-assessment training sessions average 30 minutes or less, but if the required training goes much beyond that, this is a sign of decreased likelihood of a successful teleNP evaluation (i.e. the clinical referral question can be confidently answered by the neuropsychology provider). In these cases, we simply note in the medical record that the patient is not considered to be an appropriate candidate for teleNP; there is no clinical report written, no diagnostic inference made, and the patient/family is assured that we will make appropriate arrangements for face-to-face assessments as soon as our clinic resumes in person testing for general clinic referrals.

At the Emory University Brain Health Center, new patients sign a general consent that allows for referrals to other Brain Health Center services, including neuropsychology, without the need for additional formal informed consent for additional invasive procedures or tests. Prior to conducting the diagnostic interview on the day of the telehealth assessment, verbal consent to teleNP testing is obtained that also establishes patient identity by asking birthdate, verifying patient location, and explicitly requiring the patient to agree to not record any portion of the assessment. Patients are told that teleNP methods and procedures are not identical to those that would be administered in a face-to-face setting and that if there are either clinical or assessment concerns identified, these will be noted in the report and arrangements made for in-person follow-up.

As part of the clinical diagnostic interview (CPT code 96116), patients are administered a MoCA which is used to further determine if they are likely to undergo valid assessment with more comprehensive testing based upon the clinical judgment of the provider. If it is determined patients are better suited for face-to-face testing, a brief report is written based upon the clinical interview and MoCA results.

### *Practical considerations*

We are presently performing assessments with patients at their residences, and with technicians and faculty also at their homes rather than conducting the remote assessments from the clinical site. This approach was adopted to maximize patient safety in which many patients are in their 60s and older, while simultaneously minimizing exposure of faculty and staff. With the CDC announcement that people 65 years and older and people of all ages with poorly controlled underlying medical conditions are the most vulnerable to COVID-19, this approach is considered the best current model of care while acknowledging the limitations associated with testing in a less-well controlled environment.

Telehealth practices are based on state practice laws, and in Georgia, patients must be physically within the state at the time care is rendered by a Georgia healthcare provider (e.g. physicians, nurses, psychologists; <https://www.healthit.gov/faq/are-there-state-licensing-issues-related-telehealth>). During record review prior to the clinical interview, the patient's residence in the state of Georgia is confirmed and again on the day of testing to ensure identify and location verification. Emory may eventually establish dedicated clinic space for teleNP assessment, which would facilitate record management, although this would increase exposure risks for persons providing teleNP. Also, under very early consideration is potential development of remote assessment sites that would allow patients to visit with greater control over the testing environment, but which would require a high level of sanitation control before and after each test session as well as exposure risks associated with travel.

Considering limitations with remote testing and loss of control over the testing environment, it is to be expected that the home testing environment requires some degree of flexibility. For instance, interruption risks may include pets or family members particularly parents with school-aged children. Often times, particularly with patients with existing dementia diagnoses, assistance from a care partner is needed to



navigate the technological interface of a telehealth platform which, at times, may necessitate their presence during the assessment. Performing assessments in the patient's residence nevertheless introduces less control into the testing environment. Although we have not experienced any formal "Zoombombing" due to our use of Zoom waiting rooms, there are increased risks of intrusions and distractions during telehealth testing.

We also recognize the need for test security, which is why an explicit agreement to not make any recording of the assessment is obtained prior to teleNP testing. The ability to record Zoom sessions lies with the Emory personnel establishing the Zoom connection rather than with the patient. However, we are also practicing in a clinical environment in which most patients and caregivers are seeking diagnostic assistance through the neuropsychological evaluation and have low motivation for subverting the validity of testing. We note that the ROCF, Rey AVLT, TMT, and MoCA are a simple Google search away, yet remain valid tools for establishing cognitive impairment and decline.

There are also technological issues that need to be evaluated prior to assessment. In some instances, there is variable internet connectivity in which Zoom crashes or in which the audio cuts out. We discuss these possibilities with each patient prior to assessment and tell them that should our connection be lost and if the Zoom connection does not automatically reconnect, they will be called by phone. With pre-assessment training, connectivity issues are typically identified and possible technological issues or distractions (e.g. pets or others in the home) are surveyed. Should technological issues such as freezing or delayed feedback occur repeatedly, phone rather than Zoom audio is used for critical verbal tasks such as digit span, auditory verbal learning, and prose passage memory while still maintaining video monitoring to the extent possible. We try to eliminate the tendency to write down information with testing prompts (e.g. "You do not need anything for this next task. I want you to listen carefully," or "You will need your pen, blank piece of paper, and folder for this next task").

### ***Training and quality control***

A critical component of implementation is the development of formal coversheets and administration manuals since our service did not conduct teleNP prior to the pandemic. These manuals include navigating Zoom assessment interfaces, practicing adapted test instructions, and troubleshooting. [Supplementary materials](#) are available by contacting the corresponding author.

Step-by-step protocols were instrumental in first training our psychometrists. We have also sought guidance from prior APA officers regarding supervision expectations for students performing teleNP, although no official APA position is presently available, and we have moved forward with teleNP training for both interns and practicum students. With experience of the Zoom platform, the process to achieve a standardized process with remote testing was an attainable goal. TeleNP training is a multi-step process beginning with individual practice of modified assessment protocols and ending with two mock patient administrations, at minimum, one of which is necessary to

complete with a neuropsychologist. Mock patient administrations are completed in Zoom with three people participating. We deemed three people were necessary so that the person portraying the mock patient could focus on what it felt like to be a patient seeing the materials for the first time while another observer could focus on aspects that might be missed by the examiner or patient.

Feedback from initial training and mock patient administrations led to the creation of a troubleshooting manual. Troubleshooting encompasses technological difficulties to administration corrections. Again, with teleNP a certain level of trust is necessary with our patients. If patients voice audio concerns and say they did not hear a number or word, then we must trust them. To create a standardized approach to our modified teleNP protocols, we limit testing to patients who have computers (i.e. desktop or laptop) or tablets with a stand (i.e. iPad).

We created a telehealth appointment log and a technology survey to capture our patient's familiarity and frequency of use with electronic tools. The appointment log characterizes the patient's telehealth and communication responses (i.e. how many phone call/email attempts per patient). When reviewing responses for willingness to participate in a remote teleNP service in place of their in-person appointment, the most common barrier has been lack of confidence with technology.

### **Documentation**

Language guided by Emory Healthcare is included in all reports documenting that the assessment was performed using remote telehealth assessment.

*NOTE: This is a telehealth visit that was performed with the originating site at the patient's Georgia residence and distant sites the included the provider's residence and psychometrist's residence.*

- *Verbal consent to participate in a video telehealth visit was obtained after positive identification from the patient's birthdate.*
- *This particular visit occurred during the 2020 COVID-19 outbreak.*
- *I discussed with the patient the nature of our telehealth visits, that:*
  - *I would evaluate and write a formal neuropsychological evaluation report based on telehealth testing.*
  - *Methods and procedures are not identical to those that would be administered in a face-to-face setting.*
  - *Our sessions are not being recorded and that personal health information is protected.*
  - *Our team will make arrangements for in person follow-up if deemed appropriate at any time during the evaluation.*

### **Discussion and future directions**

We acknowledge teleNP test implementation will differ in certain ways from the original procedures and that this may have an effect on normative performance values. However, the constructs that we target in our assessments are hopefully robust to minor protocol deviations. Psychologists who perform assessments in acute care

settings have long recognized the need for assessment modification as dictated by clinical circumstances, and some neuropsychologists, particularly those who began their careers in the 1980s or earlier, faced similar challenges due to tests with less robust normative data available. This is similar to what clinicians face when performing evaluations of patients from ethnic backgrounds in which appropriate normative standards do not exist (e.g. person whose native tongue is not English). Necessary assessment modification for teleNP implementation in response to COVID-19 is a reminder that experience and understanding of clinically related brain-behavior relationships are critical in clinical case formulation. Many factors influence test scores that are not typically formally acknowledged such as tester characteristics of gender, age, and assessment experience. Even when patient characteristics are acknowledged and demographic correction is available, there remain practice differences in implementation (e.g. wrongful assumption GED certificate is equivalent to a high school diploma; Hewitt et al., 2019). For many of our patients, neuropsychological results are not interpreted in isolation but rather as part of a comprehensive Epilepsy Surgery conference or DBS conference with multidisciplinary team input to establish surgical candidacy. For others, results are discussed in case conference with our cognitive neurology partners. These interdisciplinary settings provide the opportunity for appropriate interpretative caveats and concerns to be identified and discussed with input from multiple sources.

There will be concerns regarding non-standard test administration with respect to normative interpretation. It is important to remember that many neuropsychological measures used in clinical assessment were developed as procedures rather than formal psychological tests with systematic normative studies. Even though systematic normative sampling is an important part of neuropsychological testing, the nature of the test itself may ultimately be more important for clinical diagnosis and characterization than the presence of systematic norms. For example, the formal California Verbal Learning Test (CVLT) has a more robust and systematic normative characterization compared to the Rey AVLT, yet it appears superior to the CVLT, at least with respect to its sensitivity of lateralized cognitive impairment associated with unilateral temporal lobe epilepsy (Loring et al., 2008). Similarly, the Selective Reminding Test (Buschke & Fuld, 1974) is superior to Logical Memory from Wechsler Memory Scale in predicting seizure onset laterality in temporal lobe epilepsy patients (Umfleet et al., 2015). We have previously argued that norms alone, without appropriate validation in clinical samples, are insufficient justification for test selection and clinical application (Loring & Bauer, 2010). It is also possible that diagnostic sensitivity and psychometric characteristics of test modifications necessitated by teleNP administration may be more rapidly established than before through collaborative mechanisms such as the National Neuropsychology Network (National Institutes of Mental Health 1 R01 MH118514, Principal Investigator: Robert M. Bilder, <https://www.sistat.ucla.edu/NNNWeb/index.html>).

We are presently living in a transformative era where there are also a number of opportunities for broadening the reach of neuropsychology. The Veteran's Administration Office of Rural Health has reported success in increasing telehealth access by providing tablets to high-need patients with barriers to in-person medical

care (Zulman et al., 2019). As COVID-19 effects linger, other potential assessment strategies to facilitate remote assessment may include sending a tablet to patients for testing that is returned after assessment—this approach has precedent such as with ambulatory EEG and may provide opportunity for cognitive evaluation in areas in which neuropsychology services are not readily available.

One of the motivations for developing the NIH Cognitive Toolbox was to provide the opportunity to obtain cognitive performance data in environments where specialized neuropsychological testing might not be available. Unfortunately, results for NIH Toolbox may correspond poorly to more clinically validated measures (e.g. Loring et al., 2019). Transition to remote assessment with a trained examiner will allow the assessment of important cognitive domains with measures more fully established for clinical validation without the necessity to have on-site psychometrist expertise. Development of reliable teleNP also has implementation for clinical research application, both for multi-center clinical trials and more broadly for population based studies.

Although there are risks of increased anxiety with the general telehealth concept in certain patients, there is also the potential benefit of increased testing comfort when conducted in a familiar environment (e.g. avoiding “white coat hypertension”). TeleNP may also be preferable in cases in which there is a significant travel burden, avoiding direct travel costs and indirect travel costs such as lodging or time off from work. As patients become more comfortable with telehealth visits with their physicians, which some have affectionately referred to as the resumption of making “house calls,” patients are likely to become increasingly more comfortable with teleNP.

Although we have now resumed face-to-face testing of epilepsy surgery candidates, we anticipate offering telehealth options for the foreseeable future. Consequently, we are exploring options for test versions that have already been adapted for computer presentation that are in the public domain. Tests such as the Wisconsin Card Sorting Test (WCST) were developed as procedures rather than the formal clinical cognitive measures (Grant & Berg, 1948) such that computerized versions in the public domain may be appropriate for telehealth use. It is important to remember that even for widely used normative interpretation standards such as Heaton (Heaton et al., 2004), normative tables were derived primarily from National Institutes of Health (NIH) funded studies with healthy volunteers serving as controls in research rather than reflecting systematic normative sampling as is done with test standardization, with criticisms including small cell sizes and different test versions than currently used (Fastenau, 1998; Fastenau & Adams, 1996). A comparison of the 2 different normative approaches on largely the same subject cohort reported slightly less than 50% of participants obtaining Boston Naming Test (BNT) scores within  $1/2$  standard deviation with both approaches (Table 9, Heaton et al., 2004).

We recognize that we have advantages associated with the clinical setting in which we practice. In contrast to pediatric neuropsychology practices that often require discrepancy scores of specified magnitude using tests with well-established normative characteristics, or medico-legal evaluations in which deviation from established validated protocols can be highlighted to diminish the interoperative neuropsychological assertion in an adversarial environment, our results are typically interpreted in

multidisciplinary contexts that include careful review of diagnostic test findings of protocol specific functional and structural imaging, subspecialty neurology input, and extended integration of all diagnostic findings.

## Summary

The 2020 COVID-19 pandemic has forced reconceptualization of neuropsychological service delivery models, and remote assessment using teleNP has provided an approach for continuing care and evaluation of selected clinical patients and research subjects. This transition to offer teleNP has been rapid, and consequently there will continue to be refinement of methods and procedures with increasing experience. In addition, teleNP procedures will undoubtedly differ across practices based upon the characteristics of patient referrals in addition to institutional expectations and requirements.

Even when the threat of COVID-19 contagion recedes or is eliminated and traditional in-person clinic visits resume, telehealth assessments including both telemedicine and teleNP will likely remain as care options for many patients. It is incumbent upon the field of neuropsychology that we embrace teleNP as a viable service option and continue to be the innovators and developers of sound methods to characterize neurocognitive impairment across a variety of clinical conditions. Continuing experience and research will undoubtedly lead to a better understanding of the strengths and limitations of teleNP while expanding opportunities for comprehensive neuropsychological assessment in situations where cognitive testing was previously difficult to obtain.

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## Disclosure statement

No potential conflict of interest was reported by the authors.

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