Practicing in a Pandemic: A Clinician’s Guide to Remote Neurological Care

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ABSTRACT

Neurologists around the country and the world are rapidly transitioning from traditional in-person visits to remote neurological care because of the COVID-19 pandemic. Given calls and mandates for social distancing, most clinics have shuttered or are only conducting urgent and emergent visits. As a result, many neurologists are turning to teleneurology with real-time remote video-based visits with patients, to provide ongoing care. Although telemedicine utilization and comfort has grown for many acute and ambulatory neurological conditions in the past decade, remote visits and workflows remain foreign to many patients and neurologists. Here, we provide a practical framework for clinicians to orient themselves to the remote neurological assessment, offering suggestions for clinician and patient preparation prior to the visit; recommendations to manage common challenges with remote neurological care; modifications to the neurological exam for remote performance, including subspecialty-specific considerations for a variety of neurological conditions; and a discussion of the key limitations of remote visits. These recommendations are intended to serve as a guide for immediate implementation as neurologists transition to remote care. These will be relevant not only for
practice today, but also for the likely sustained expansion of teleneurology following the pandemic.

INTRODUCTION:

The COVID-19 pandemic has rapidly changed clinical practice. In response to calls for social distancing and home sheltering, clinics have closed, and ambulatory care has gone virtual nearly overnight. The federal government recently relaxed telehealth technology regulations, allowing the use of a wider range of software platforms to extend care. The Center for Medicare & Medicaid Services (CMS) simultaneously expanded telemedicine reimbursements. The U.S. Department of Health and Human Services recently urged state governors to modify telemedicine regulatory barriers, including waiving licensure requirements for out-of-state clinicians. Many private insurance companies followed suit, loosening previous restrictions on telehealth delivery though questions remain surrounding coding, billing, and reimbursements for services delivered remotely. Additionally, while this new environment has fostered telenurology expansion, the move from clinic-based neurology to telemedicine has been an uneasy transition for many clinicians, practices, and hospitals.

As neurologists convert traditional to virtual workflows, the in-person physical exam must be replaced by a virtual version. This is particularly challenging for neurologists who rely on the in-person exam to diagnose and manage patients. In addition to acute conditions like stroke, the feasibility of remote examinations has been demonstrated across many ambulatory neurological conditions including headache disorders, motor neuron disease, dementia, and movement disorders. Additionally, neurological societies like the American Academy of Neurology provide guidance to assist in the transition to telemedicine. Despite challenges in
the transition, we believe this crisis will leave the neurological community better positioned to embrace teleneurology, and while remote assessments are unlikely to fully replace in-person visits, they can supplement current care models and expand access to neurological care.

Here, we aim to provide a practical guide to the remote video-based assessment of patients with neurological disease. We focus on: (1) general principles for conducting a remote ambulatory neurology visit; (2) methods to adapt the neurological examination for remote performance, including disease-specific considerations and the use of available digital technologies to supplement the remote exam; and (3) limitations of the remote examination.

GENERAL PRINCIPLES FOR THE REMOTE ASSESSMENT

Hardware and software

The ability to deliver video-based telemedicine to patients at home relies on the availability of specific hardware and software for both the patient and clinician (Figure 1). Each must have a device capable of transmitting video; this could include a smartphone, tablet, laptop, or desktop computer. If patients have multiple devices available, they should select the device with the best available camera and monitor. The benefits of portability with smartphones and tablets should be balanced against disadvantages, such as smaller screen and button sizes, which may be challenging for older patients. Beyond the device itself, teleneurology delivery requires a high-speed internet connection. Slow connection speeds degrade video quality and limit the neurologist’s ability to assess the patient. Most patients with cable and fiber optic connections (with or without WiFi) have sufficient connection speeds, though those in rural areas may have reduced signal strength. Digital subscriber line (DSL) and cellular (3G, 4G) connections are also likely sufficient, while dial-up connections are not.
Real-time video assessments are performed through several software options. Optimally, visits should be conducted using Health Insurance Portability and Accountability Act (HIPAA)-compliant software. Some electronic medical records (EMRs) have built-in telemedicine capabilities. Versions of Epic (WI, USA), for example, integrate video platforms to allow the patient and clinician to log into the visits using MyChart and hyperspace, respectively. Practices without EMRs with telemedicine capabilities can use popular platforms such as Zoom Enterprise (CA, USA), Updox (OH, USA), and Vidyo (NJ, USA). While relaxed federal regulations have expanded use into HIPAA non-compliant platforms, given the potential for breach of confidentiality, we only suggest these options if no other options exist. Optimal software features include multi-platform (smartphone, tablet, computer) functionality, easy visit access (accessible by hyperlink), and simple program tools (e.g. few clicks to start a visit). Additionally, programs without software download requirements increase the likelihood of a successful connection.

General considerations and visit setup

While not required, some additional resources optimize teleneurology delivery (Figure 2). First, a troubleshooting team can help clinicians and patients with basic difficulties, such as connecting to the visit. Second, if feasible, a brief pre-visit test between the patient and office staff increases the chance of a smooth visit. Finally, clinicians should familiarize themselves with the software to manage technical difficulties during the visit itself.

Patients should be instructed on how to set up for the visit in their home (Figure 1). Room selection and patient positioning are some of the most important factors. Patients should select a large, private room with good lighting that is near their internet router (if using WiFi) and a seat without windows behind it, to avoid degrading the video because of backlighting.
Camera positioning should allow the neurologist to assess global and spontaneous movements, which requires viewing the entire body. The patient can move their camera or chair during the exam to facilitate this assessment. Optimally, patients should conduct the visit with another person available to hold or move the camera, assist with technology, or assist with the exam.

Clinicians should similarly consider camera positioning, room selection, and “web-side” manner, particularly if conducting the visit from home. A second monitor is useful to facilitate watching the patient while concurrently reviewing and documenting in the EMR. It is also important to be mindful of “virtual empathy.” Strong verbal communication is important to obtain an accurate history and exam. Clinicians should speak loudly and clearly, introduce themselves with their first and last name, and ask the patient and helper how they would like to be addressed. The clinician should also orient the patient to the visit, as video-based visits are likely foreign to most, and at the end of the encounter, should ask the patient to repeat a brief summary of recommendations to ensure understanding. In addition to verbal communication, examiners should be mindful of body language and non-verbal communication. It is important to maintain open body language and good eye contact while interviewing. Clinicians should look at the camera itself while speaking to more closely approximate in-person eye contact.

Basic expectations for an in-office visit, such as professional attire for the clinician and patient, and avoiding interruptions should be upheld during the telemedicine visit. Should there be risk of interruption (e.g. because of concurrent time at home with children), clinicians should alert patients to this possibility at the start of the visit. Most states require clinicians to obtain consent from patients before conducting a telemedicine visit. This should include an overview of the limitations of and alternatives to the telemedicine encounter, including privacy risks, potential financial liability, and an inability to make some diagnostic decisions. Finally, at the
start of a visit, it is imperative to confirm information from the patient in case of an emergency, including patient address and a reliable telephone number.

**THE REMOTE NEUROLOGICAL EXAMINATION**

Many portions of the neurological examination rely on simple observations and can be performed by video without additional modifications beyond appropriate lighting and patient positioning. Other aspects of the exam, like fundoscopy and objective strength assessments require advanced digital tools or the assistance of an experienced onsite examiner. Many of the remaining portions of the exam can be performed remotely, but require modifications for the virtual environment (Table 2). Beyond these modifications, clinicians should consider performance and documentation of disease-specific rating scales (e.g. Movement Disorder Society Unified Parkinson Disease Rating Scale, 8,9 Amyotrophic Lateral Sclerosis Functional Rating Scale-Revised10) to standardize assessments across visits, quantify disease severity, and track disease progression. While some are not validated for remote performance, most can be modified easily for the virtual visit. Here, we describe the approach to the remote neurological exam and provide a remote exam template (optimized for Epic EMR) for clinicians to use, which can help standardize the exam in practice (Supplementary Materials, http://links.lww.com/CPJ/A179).

**General Examination**

Essential components of the general examination vary based on the chief complaint. Simple inspection can be performed as it would be in the office by adjusting patient or camera position. For example, dystrophic skin changes, Raynaud’s phenomena, or loss of hair may suggest small fiber neuropathy or other underlying diseases. The remote examination
Additionally allows assessment of the patient’s home, facilitating evaluation for fall risks in those with imbalance, or the sleep environment in those with sleep disorders. Vital signs may be useful in some patients, and many have digital thermometers and portable blood pressure cuffs; assessment of orthostatic vital signs is feasible with instruction. Among those without this equipment, the neurologist or onsite helpers can assess respiratory rate, and savvy patients or family members could be instructed to take a radial pulse. The clinician can also demonstrate provocative orthopedic maneuvers (e.g. Slump test, Finkelstein test) prior to performance by the patient to assess the musculoskeletal system.

**Mental status**

Assessment of the patient’s level of alertness, orientation, language, and memory can be completed as it would in the office. Formal mental status testing can also be performed remotely with a number of measures validated for remote performance. The Montreal Cognitive Assessment (MoCA) can be modified in several ways, depending on needs and preference (https://www.mocatest.org/remote-moca-testing/). The trail-making test can be performed verbally, and instructions can be given to draw a figure and clock. A blind version of the MoCA is also available and is helpful for telephone visits, when a patient has vision loss, or when there are other limitations like poor video quality.

**Cranial nerves**

The cranial nerve examination requires some of the most modifications for remote performance. Visual field testing and eye movements, for example, traditionally rely on confrontational maneuvers in front of the patient. However, through creative modifications and patient or family member instruction, many components of the cranial nerve exam can still be performed (Table 2). In addition, a basic pupillary examination can be performed depending on
the camera quality and zoom-in capabilities in the software used. Gross assessment of facial sensation can also be performed, including evaluation of temperature (using a cold utensil) or pinprick (if a toothpick or pin is available) sensation. Cranial nerves IX and X can be assessed by listening to speech, and patients can be asked to take a small sip of water during the visit to assess swallowing.16

Motor examination

Patient positioning, camera quality, and room lighting are particularly important for the motor examination. Careful observation allows adequate assessment of muscle bulk and overall movement when viewing patient from a distance; close-up assessment for fasciculations or other low amplitude movements is possible among those with high-quality cameras. During a remote encounter, strength testing relies on inference using functional strength assessment. Patients can be asked to perform actions that utilize specific muscle groups (pronator drift, finger taps, rising from chair, heel or toe walking).

Sensory Examination

The sensory examination generally requires a reliable helper to administer the remote exam, compare right and left sides, and assess response to dual simultaneous stimulation. As above, assessment of temperature and pinprick sensation is possible with tools available in most homes. Patients can be instructed how to perform the Romberg test (with a family member nearby if concerns for safety/falls) or to touch their nose with eyes closed to assess proprioceptive function. Patients can also perform provocative sensory testing (e.g. Phalen’s or Tinel’s test) with instruction.

Coordination
Coordination testing can be performed with minimal modifications during the remote examination. Finger-to-nose testing, for example, can be done between the patient and a helper, or between the patient and a stationary object visible on the screen. Similarly, the finger chase test can be approximated by observing rapid arm movements between two targets. Rapid alternating movements, finger tapping, and heel-to-shin testing are performed without modification, assuming appropriate camera positioning.

Reflexes

Reflexes are challenging without a reliable onsite helper. However, family members could be instructed in performance of the plantar response or patellar reflex using the blunt side of a heavy utensil (e.g. serving spoon, large spatula) given a general familiarity with the maneuver. Other reflex assessments are not feasible remotely.

Gait

The gait examination should be performed with the assistance of a helper with the patient, both for safety and to assist with repositioning the camera. Additionally, clinicians should screen for baseline postural instability and modify the gait exam to reduce the risk for falling during the remote visit. Pointing the camera into a hallway or large room cleared of obstacles allows observation of the patient’s entire body. Pull testing for postural stability should be deferred because of safety concerns.

Additional Considerations by Subspecialty

Cognitive and Geriatric Assessment

Additional special consideration should be given to patients with cognitive impairment, visual impairment, and hearing loss. When assessing elderly patients, longer visit times may be required, and technology may prove overwhelming. A plain background behind the clinician can
limit visual distraction during the visit. While useful for any telemedicine encounter, the presence of a family member or knowledgeable informant is particularly important here to help with technology and corroborate the history. It is important to have the patient in full view to observe spontaneous movements and interactions with the environment and family (e.g., need for cues from a family member, difficulty focusing on camera/screen). Likewise, it is helpful to observe for signs that family members are reluctant to discuss information in the presence of the patient (e.g. shaking their head, remaining quiet for fear of angering the patient); if identified, clinicians can suggest a private follow up call with family members. Patients with hearing aids may experience acoustic feedback or rely on a helper to repeat information. Still, despite some limitations, home teleneurology visits offer a unique insight into a person’s daily life and may facilitate assessment of home safety.

Movement Disorders Assessment

Evaluation of patients with hypo- and hyperkinetic movement disorders largely relies on simple observation. Again, full body view during the entire exam allows the examiner to monitor for subtle movements that are only intermittently present or not visible with a narrow view. Adequate internet connection speed is particularly important for assessment of patients with Parkinson disease, to ensure observed bradykinesia is disease-related rather than technology-related. As in the office, assessment of tremor should include evaluation for postural, kinetic, rest, and vocal tremor. Having a pen and paper on hand allows Archimedes spiral drawing. Tech-savvy patients using a tablet with digital stylus can screen share a digital spiral.

Neuromuscular Assessment

The diagnosis of many neuromuscular disorders relies on a detailed neurological exam and electrophysiological studies not yet possible with remote assessments. Still, despite some
limitations, teleneurology can establish gross localization for most patients. History taking and functional strength and sensory testing allow evaluation for proximal, distal, and asymmetric abnormalities. Additionally, neurologists can document “at least” grade 3 (anti-gravity) or grade 4- (able to provide some resistance) strength during the functional strength assessment. Some diagnoses may be easily identifiable during the visit in those with typical history and exam features (e.g. myasthenia gravis, myotonic dystrophy, dermatomyositis).

The remote assessment is also useful to triage patients requiring urgent in-person evaluation, such as those with bulbar or respiratory weakness. A simple swallow assessment, observing for forceful cough, or having patients count as high as they can in a single breath allows assessment of pharyngeal and respiratory muscle function. Patients can also be asked to lie down in view of the camera to assess breathing comfort in a supine position, observing for abdominal lift and chest expansion. Quantifying functional strength assessments (e.g. time required to stand from a seated position over five trials) could also be repeated in serial remote visits to trend strength in specific muscle groups.  

**Novel Digital Tools**

A wide range of new technologies, from wearables and biosensors to machine learning-powered augmented reality systems, are expanding the capabilities of teleneurology today. While the majority of these are not widely available, many patients already own commercially available technologies that can supplement the remote neurological exam. For example, as described, patients with a digital stylus can screen share a writing sample during the visit. Smartphone applications or smart watches monitoring daily step counts, heart rate, sleep, or other disease specific features can provide objective information to neurologists about overall function at home. Additionally, ambulatory monitoring tools such as home sleep apnea testing, nocturnal
pulse oximetry, and snoring recordings can still be deployed to the home for objective assessments. While many other disease-specific technologies are not yet validated in the clinical realm, we expect expanded use during the current crisis followed by a more sustained boon when it ends, facilitating further expansion of teleneurology.

LIMITATIONS OF THE REMOTE NEUROLOGICAL EXAMINATION

There are portions of the neurological examination that cannot be performed via telemedicine, even under the best circumstances. Additionally, many practices have limited the performance of tests viewed as extensions of the neurological examination, including electromyography (EMG) and electroencephalography (EEG), in the setting of the COVID-19 pandemic. The absence of these data can limit the neurologist’s ability to make a diagnosis or to facilitate medical decision making, particularly for patients being seen for initial assessment or for those with a substantial change compared to a prior in-person visit. Still, as described for the neuromuscular examination above, given uncertainty about the timing of return to normal clinical practice, remote assessment of new patients is likely necessary across all specialties. We suggest that clinicians inform patients about the limitations of the remote exam as well as the potential need for in-person follow up at the start of each encounter. In practice settings where informed consent is required to initiate a telemedicine visit, this language can be incorporated into the consent script or documentation.

While increased medico-legal risk may exist, the American Medical Association has lobbied for expanded liability coverage for physicians providing services via telehealth during the COVID-19 pandemic. Some states have limited malpractice litigation against care delivered during the crisis. Still, clinicians should confirm their medical liability coverage includes
care provided via telemedicine. Clinicians should also document any limitations of the visit that may affect their medical decision-making and share these concerns with the patient; this should include limitations in the reliability of any exam portions performed by patients or family members at home.

Beyond the limitations in exam and diagnostic capabilities, real and perceived social and societal limitations of telemedicine exist. First, the technological requirements for conducting a telemedicine visit limit access. Reassuringly, around 90% of American households have access to high-speed internet at home (73% with a broadband connection and 17% with a smartphone with cellular data without other home internet). Still, this suggests at least 1 in 10 Americans lack such access with over-representation among older patients, those in rural locations, under-represented minority groups, and those of low socioeconomic status. Patients with neurological disease may be over-represented in this group given the older age of many in the population. Additionally, the majority of patients without access to this technology are from vulnerable populations. In a time when a substantial proportion of visits are being converted to telemedicine, this has the potential to exacerbate existing disparities in care.

Despite rising use of telemedicine, patients and neurologists may worry that visits will be impersonal. Reassuringly, assessment of remote encounters across multiple neurological conditions demonstrates that patients and neurologists establish similar comfort as compared to routine in-person visits. Again, older patients with neurological disease or those with advanced disability may feel less comfortable with the use of technology. While prior studies have demonstrated the feasibility of remote visits among those with advanced neurodegenerative conditions, patients or families with greater baseline comfort with visits may self-select for participation in these studies, limiting generalizability.
CONCLUSIONS:

The rapid conversion to video-based teleneurology may be daunting for clinicians. However, neurologists should rest assured that most components of the in-person visit, including a substantial proportion of the neurological exam, are directly translatable to the virtual environment with the modifications described here. Additionally, while some patients may have initial reservations about teleneurology, many view remote visits as a convenient alternative to seeing a clinician in the office. In fact, teleneurology has the potential to expand access to care for patients with impaired mobility, limited transportation options, or limited healthcare provider availability in their area, assuming they have access to the appropriate technology. This can address important gaps in care by better incorporating teleneurology into post-pandemic care models.

Teleneurology is well suited for follow up of most neurological conditions, particularly during a crisis when the alternative is often no care. Assessing treatment response, identifying treatable symptoms, and finding ways to preserve independence, are based primarily on the neurological history. Additionally, quantification of portions of the exam generates objective or pseudo-objective measures that can be followed over time. Even multidisciplinary care can be delivered remotely with physical therapists, speech pathologists, counselors, or social workers jointly attending a tele-visit. Remote visits can also be used to diagnose some patients with neurological chief complaints, though we continue to consider an in-person examination preferable to a remote exam for new patients. However, given uncertainty surrounding the duration of the current crisis, the ability to triage potentially vulnerable patients for the need for in-person assessment, exploits the benefits of teleneurology while mitigating risk for the patient.
Neurologists should work to incorporate remote video visits into practice today to improve their comfort with technology and the remote examination. Additionally, clinicians should consider the use of novel digital tools to supplement the remote exam, including potential validation for use in clinical practice. This potentially chaotic transition to remote visits provides an opportunity to develop organized, efficient, and scalable workflows to facilitate long-term telenurology implementation and improve traditional care models. This rapid conversion will undoubtedly set the stage for a wider adoption of telenurology moving forward. Additional advocacy to extend the removal of barriers to telemedicine, expand physician liability protections, ensure adequate reimbursement for telehealth, and standardize the telenurology exam and workflow can ensure more patients with neurological disease have ready access to care. Neurologists should act now to prepare themselves for the future of our field.

TABLE AND FIGURE LEGENDS:

TABLE 1: Select studies of remote assessments in neurological conditions

TABLE 2: Neurological exam adaptations for the remote assessment

FIGURE 1: Patient and clinician considerations during virtual visit setup. (HIPAA = Health Insurance Portability and Accountability Act; EMR = electronic medical record)

FIGURE 2: Visit workflow and timeline for the remote neurological assessment
TABLE 1: Select studies of remote assessments in neurological conditions

<table>
<thead>
<tr>
<th>Author</th>
<th>Condition</th>
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<th>Findings</th>
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<tr>
<td>Tarolli</td>
<td>Atypical parkinsonism</td>
<td>45</td>
<td>Video visits feasible and reliable to assess and validate the diagnosis of patients with atypical parkinsonism</td>
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<tr>
<td>Friedman</td>
<td>Migraine</td>
<td>45</td>
<td>Telemedicine assessments were feasible and effective for follow-up migraine care</td>
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<td>Selkirk</td>
<td>Motor neuron disease</td>
<td>68</td>
<td>Video-based telemedicine is effective for delivering reliable multidisciplinary care to individuals with amyotrophic lateral sclerosis</td>
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<tr>
<td>Dorsey</td>
<td>Parkinson disease</td>
<td>166</td>
<td>Video visits feasible to characterize and validate diagnosis of Parkinson disease in a national cohort</td>
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<tr>
<td>Davis</td>
<td>Multi-disease</td>
<td>308</td>
<td>Follow-up telemedicine care feasible and valuable among patients in rural settings with chronic neurological conditions</td>
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<tr>
<td>Bull</td>
<td>Huntington disease</td>
<td>11</td>
<td>Video-based visits feasible and reliable for assessing motor function in those with Huntington disease</td>
</tr>
<tr>
<td>Turner</td>
<td>Multiple sclerosis</td>
<td>41</td>
<td>Satisfaction high with telemedicine, and patients had improvements in outcomes over 6 months</td>
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<tr>
<td>Martin-Khan</td>
<td>Dementia</td>
<td>205</td>
<td>Identified high concordance between video-based vs in-person dementia diagnosis accuracy</td>
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<td>Cialone et al</td>
<td>Batten disease</td>
<td>13</td>
<td>Remote administration of standardized Batten disease measure feasible and reliable by video-based visit</td>
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### TABLE 2: Neurological exam adaptations for the remote assessment

<table>
<thead>
<tr>
<th>Exam Portion</th>
<th>Maneuver</th>
<th>Adaptation</th>
</tr>
</thead>
<tbody>
<tr>
<td>General</td>
<td>Vital signs</td>
<td>Use patient’s home thermometer and/or blood pressure cuff if available</td>
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<tr>
<td></td>
<td></td>
<td>Instruct patient or helper on assessing respiratory rate and taking radial pulse</td>
</tr>
<tr>
<td></td>
<td>Orthopedic testing</td>
<td>Clinician demonstrates provocative maneuver and has patient repeat</td>
</tr>
<tr>
<td>Mental Status</td>
<td>Formal cognitive testing</td>
<td>Clinician transmits hand-written and visual test materials to patient (email or patient portal preferred), and patient prints materials for completion during the visit</td>
</tr>
<tr>
<td>Cranial Nerves</td>
<td>Visual fields</td>
<td>Helper instructed in confrontation testing</td>
</tr>
<tr>
<td></td>
<td></td>
<td>If using a large monitor, position device at fixed distance from patient, and instruct patient to focus on center of screen with investigator performing finger flicks at edge of camera view</td>
</tr>
<tr>
<td></td>
<td>Eye movements/ VOR</td>
<td>Ductions/versions: Patient tracks their own finger or finger of helper</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Saccades: patient looks between camera and a fixed object in home in each direction</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Patient instructed in sustained up-gaze to assess for fatigable ptosis</td>
</tr>
<tr>
<td></td>
<td></td>
<td>For a detailed assessment, the patient moves close to the camera so only a single eye is in view followed by movements in all directions</td>
</tr>
<tr>
<td></td>
<td></td>
<td>VOR: patient fixates on camera or examiner’s face and turn head up/down or side to side</td>
</tr>
<tr>
<td>Facial sensation</td>
<td>Patient or helper touches or places utensil (toothpick, metal spoon) on each side of face and compares sensation</td>
<td></td>
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<tr>
<td>------------------</td>
<td>-------------------------------------------------------------------------------------------------------------</td>
<td></td>
</tr>
<tr>
<td>Facial and tongue motor function</td>
<td>Patient squeezes eye lids closed tightly, smiles, puff up cheeks with air, purse lips, whistle, clench jaw tightly, and rapidly move tongue from side to side. Patient can move closer to the camera for careful inspection for fasciculations or atrophy.</td>
<td></td>
</tr>
<tr>
<td>Hearing</td>
<td>Patient or helper performs finger rub bilaterally and compares sides</td>
<td></td>
</tr>
<tr>
<td>Swallowing/ pharyngeal function</td>
<td>Patient is asked to drink small sip of water. Patient is asked to demonstrate strong cough</td>
<td></td>
</tr>
</tbody>
</table>
| **Motor** | **Strength** Use functional strength maneuvers to assess specific muscle groups  
*Arms:* raising arms (≥ grade 3 strength), pronator drift, finger taps, lifting object  
*Legs:* rising from chair, squat to stand, heel and toe walking, jumping |
<p>| Hypo- and hyperkinetic movements | Ensure camera allows visualization of entire body. Helper can move camera/zoom in for assessment of low amplitude movements (e.g. fasciculations) |
| <strong>Sensory</strong> | Pinprick Use toothpick, safety pin, or other sharp object |
| Temperature | Use metal utensil or key to assess cold sensation |</p>
<table>
<thead>
<tr>
<th>Proprioception</th>
<th>Patient instructed in Romberg test (with helper present) or touches nose from outstretched arm with eyes closed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dual simultaneous stimulation</td>
<td>Skilled helper is instructed in performance</td>
</tr>
<tr>
<td>Reflexes</td>
<td>Patellar reflex</td>
</tr>
<tr>
<td></td>
<td>Plantar response</td>
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<tr>
<td>Coordination</td>
<td>Finger-to-nose test</td>
</tr>
<tr>
<td></td>
<td>Finger chase</td>
</tr>
<tr>
<td>Gait and Station</td>
<td>Posture</td>
</tr>
<tr>
<td></td>
<td>Casual/stressed gait</td>
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</table>

VOR = vestibulo-ocular reflex
### APPENDIX 1: Authors

<table>
<thead>
<tr>
<th>Name</th>
<th>Location</th>
<th>Contribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Christopher G. Tarolli, MD</td>
<td>University of Rochester, Rochester, NY</td>
<td>Drafted and revised the manuscript for intellectual content</td>
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<td>E. Ray Dorsey, MD</td>
<td>University of Rochester, Rochester, NY</td>
<td>Revised the manuscript for intellectual content</td>
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<td>Adam Cohen, MD</td>
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REFERENCES


