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CONTEMPORARY ISSUES

Developing an outline for teleneurology curriculum

AAN Telemedicine Work Group recommendations

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ABSTRACT

The emerging field of teleneurology is delivering quality care to neurologic patients in increasingly numerous technologies and configurations. Teleneurology is well-positioned to address many of the logistical issues neurologists and their patients encounter today. However, formalized medical training has not caught up with this developing field, and there is a lack of formal education concentrating on the specific opportunities and challenges of teleneurology. Considering this, the American Academy of Neurology Telemedicine Work Group identified equivalencies with which any practitioner of teleneurology should be familiar. The purpose of this curriculum is not to define teleneurology or mandate where its use is appropriate, but rather to provide guidance on basic equivalencies that students, residents, and practitioners should know while practicing teleneurology. Comprehensive training in clinical bedside neurology is necessary to safely practice teleneurology and the components of this curriculum are an extension of that training. In this article, we offer a detailed discussion on the rationale for the contents of this curriculum and conclude by providing a model curriculum and an outline for evaluating residents in teleneurology.

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GLOSSARY

AAN = American Academy of Neurology; **ACGME** = Accreditation Council for Graduate Medical Education; **FSMB** = Federation of State Medical Boards.

Telemedicine practice employs a growing variety of technology, applications, services, and devices, including 2-way videoconferencing, data store-and-forward, text and image-based communication, smartphones, personal computing devices, and wireless sensors and tools.[1] In this article, "telemedicine" and "teleneurology" are used interchangeably to refer to neurologic consultation at a distance, typically via videoconferencing. Through various technologies, teleneurology covers inpatient, outpatient, and chronic and acute care services.[2]

Expansion of the Affordable Care Act and a shortage of neurologists (in both rural and urban areas) have compounded the issue of access to care. Projections suggest this will progressively worsen in the coming years with increasing demand for neurologic care due to aging populations. With few exceptions, there will be a continuing shortage of neurologists in the United States.[3]

Teleneurology is poised to address these workforce gaps and has already demonstrated a major role for acute stroke care.[4] Despite these advances, telemedicine training in residency programs is currently absent, or is sporadic and inconsistent. Employers are increasingly asking residency programs to certify training in teleneurology when no such formal training curricula exist (J. Khan, personal communication, January 16, 2016). Neither trainees nor practicing

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neurologists have been adequately prepared for the complex practice of teleneurology, despite the rapidly evolving technology and practice and associated medicolegal and ethical implications.

Teleneurology requires specific knowledge and skills that the most common Accreditation Council for Graduate Medical Education (ACGME) milestones might not address. In response, the American Academy of Neurology (AAN) Telemedicine Work Group formed an education subgroup to develop a framework for a formal teleneurology curriculum in residency programs.

A primer for teleneurology training. Referencing this curriculum, departments can develop training modules to suit the needs of their individual programs. By writing the curriculum to align with ACGME's next accreditation system, we intend for this outline to reflect the knowledge, skills, attitudes, and performance milestones that are needed to produce highly competent providers who can meet the 21st century health care needs of the public.[5]

The Work Group identified equivalencies with which any practitioner of teleneurology should be familiar. The equivalencies described here are not unique to teleneurology, and are applicable to other health professions and disciplines. The use of the word "equivalency" instead of "competency" is to make the teleneurology skills and curriculum applicable to a broad range of health care providers consistent with the recommendation from the American Telemedicine Association and AAN's stated objective of developing a multidisciplinary care within telemedicine. The structure of the training is flexible and could take place continuously over a 4- to 6-week rotation or interspersed over the entire period of residency. The Work Group does not suggest the creation of a core rotation but rather a teleneurology elective. Comprehensive training in clinical bedside neurology is necessary to safely practice teleneurology and the components of this curriculum are an extension of that training.

Although this curriculum is intended primarily for residency programs, it can also be used to develop a clerkship curriculum for medical students, continuing medical education for practicing neurologists, or education for nurses, nurse practitioners, physician assistants, and other allied health professionals. Furthermore, it can be used to build simulation cases in those programs where residents are not able to get hands-on experience. The Work Group is collaborating with the AAN's Education Committee to build simulation cases (similar to the Objective Structured Clinical Examination) that can be used by residency programs.

The clinical application of teleneurology is diverse and varied. The purpose of this curriculum is not to define teleneurology or mandate where its use is appropriate, but rather to provide guidance on basic equivalencies that students, residents, and practitioners should know while practicing teleneurology. The Telemedicine Work Group is writing another publication to define the standards of care within neurology telemedicine, where many of the questions on the appropriate use of telemedicine will be explored further.

In the next few sections, we offer a detailed discussion on the rationale for the contents of this curriculum and conclude by providing a model curriculum

Table 1 Model curriculum and suggested evaluation of equivalencies

Timeline	Didactics	Type of evaluation
Module 1 (estimated time: 2 hours)	Knowledge	Vignette-based multiple-choice questions and journal club
	Technological aspects of teleneurology, basic implementation, and limitations	
Module 2 (estimated time: 1 hour)	Licensure and medicolegal issues and ethics	Vignette-based multiple-choice questions and journal club
Module 3 (estimated time: 4 hours)	Attitudes	Case-based simulations/OSCE, 360-degree evaluation including telementoring and journal club
	Provider–patient relationship, professionalism, and webside manners	
Module 4 (estimated time: 1 hour)	Informed consent and patient privacy	Case-based simulation/OSCE, 360-degree evaluation, journal club, and vignette-based multiple-choice questions
		Option of self-reflection essay on the future role of teleneurology at the end of the training modules
Module 5 (estimated time: 4 hours)	Skills	360-degree evaluation including telementoring, OSCE, and journal club
	History, examination, and documentation in teleneurology	

Abbreviation: OSCE = objective structured clinical examination.

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(table 1) and an outline for evaluating residents' competencies in teleneurology (table 2).

MODULE 1: KNOWLEDGE: INTRODUCTION TO TECHNOLOGY, BASIC IMPLEMENTATION, AND LIMITATIONS The Work Group recommends a strong didactic component focusing on the technological aspects of teleneurology. A good foundation of technical knowledge is essential for safe and effective practice and is especially vital because it is not part of a standard curriculum. For this section, residents would learn about different delivery models, technological basics, and artifacts in the interpretation of teleneurologic data, and review commonly used terminology.[6] Table 3 lists common delivery models, while table 4 provides an overview of some current limitations. The American Telemedicine Association website has developed useful resources, such as a list of telemedicine nomenclature and core operational guidelines.

MODULE 2: KNOWLEDGE: LICENSURE, MEDICOLEGAL ISSUES, AND ETHICS The licensure and medicolegal considerations associated with the practice of teleneurology vary from state to state and are continuously evolving. A discussion of these issues is beyond the scope of this publication, and trainees should reach out to local personnel that specialize in these areas. However, a basic understanding of these subjects is essential for providing safe and effective care. The Federation of State Medical Boards (FSMB) has initiated the Interstate Medical Licensure Compact. The Compact offers a streamlined licensing process for physicians interested in practicing medicine in multiple states and facilitates new modes of health care delivery such as telemedicine.[7] At the time of this writing, 16 states have enacted the Compact, with legislation introduced in 9 additional states.

Due to variable state laws, medicolegal questions can be particularly challenging regarding teleneurology. For instance, the most common medicolegal issue in telestroke involves the use of thrombolytic therapy and practitioner liability across state lines.[8] We recommend a case-based didactic approach to discuss these issues, ideally with the involvement of legal and regulatory advisors at the academic hospital. More information is available at licenseportability.org/.

Managing ethical issues in teleneurology: Conflict of interest, physician self-referral, and Stark laws. Learning about the legal considerations in the business of

Table 2 Teleneurology clinical vignettes

Clinical vignette	Encounter type	Setting	Skills demonstrated
Teleneurology history and examination	Initial visit	Outpatient	Interaction with telepresenter
			Limitations of history/examination
			Dos and don'ts of documentation
Technology troubleshooting during teleneurology interview	Initial visit	Outpatient	Technology basics, telemedicine terminologies, teleneurology limitations, artifacts, and errors
Good and bad behavior during teleneurology interview	Initial visit	Outpatient	Informed consent, patient privacy, webside manners, disclosures
Right hemibody weakness (stroke)	Initial visit	Emergency	Telestroke history and examination, NIH scale
	Subsequent follow-up	Outpatient	Documentation in telestroke
			Medicolegal liability
Sudden-onset dizziness (benign paroxysmal positional vertigo)	Initial visit	Emergency	Teleneurology history and examination
Traumatic brain injury (concussion evaluation)	Initial visit	Emergency	Teleneurology history and examination
New-onset headache (migraine)	Initial visit	Outpatient	Teleneurology history and examination including limitations
	Subsequent follow-up		
Progressive cognitive decline (Alzheimer disease)	Initial visit	Outpatient	Teleneurology history and examination including MMSE
	Subsequent follow-up		Discussion of plan with patient and family
			Advanced care planning with the family
Progressive gait difficulties and tremor (Parkinson disease)	Initial visit	Outpatient	Teleneurology history and examination
	Subsequent follow-up		Discussion of plan with patient and family
Episodes of alteration of awareness (epilepsy)	Initial visit	Outpatient	Teleneurology history and examination
	Subsequent follow-up		Discussion of the plan with patient/family

Abbreviations: MMSE = Mini-Mental State Examination.

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Table 3 Teleneurology delivery models

Delivery model	Description	Technological model	Financial model
Teleconsultation	Videoconferencing to provide remote and direct patient care	Two-way, interactive, real-time video sessions at a bandwidth sufficient to allow for synchronous patient care	Supported by Medicare and Medicaid (in most states) and major private third-party payers
Store-and-forward	Services delivered remotely but not requiring the patient to be present during implementation	Data obtained/recorded and stored for review at a later date	Supported by Medicare and major private third-party payers; not supported by Medicaid in most states
Mobile health	Applications on personal computing devices designed to collect health information, provide personal health guidance, and facilitate interactions with remote providers	Personal smartphone connected to application server, with information available through authenticated web portal access or exported to an electronic or personal health record	Wide variability in terms of coverage; most third-party payers do not cover
Multisite comanagement	Videoconferencing systems are used to connect a live, multisite meeting between specialists and providers to discuss complex patients but patients may not necessarily be seen	Group of specialists at university medical center connect with primary care providers in rural or underserved area or correctional facilities to discuss care	Grant-funded
Remote patient monitoring	The remote management of chronic conditions using serial or continuous data collection	Data collected through various sensors or self-entry and data trends are monitored in real time	Some Medicaid and third-party coverage; not currently covered by Medicare

medicine is only peripheral to medical school and neurology residency curricula, but it assumes greater significance in teleneurology. To prevent financial or perceived conflicts, providers cannot provide "equipment or services solely to induce referrals or services reimbursable by Medicare." In addition, the US Department of Health and Human Services Office of the Inspector General Guidelines mandate that telemedicine equipment may not also be used for personal communication unrelated to medical care.[9]

We recommend a review of these laws in addition to providing real-life examples of violations as a part of instruction. As before, local human resources and legal departments can provide beneficial context.

MODULE 3: ATTITUDES: DEVELOPING A CARING ATTITUDE

Provider–patient relationship. Developing a provider–patient relationship is the key to a successful therapeutic alliance and forms the basis of the art of healing. The rapid advancements in technology, increasing patient volume brought by financial demands, ubiquitous electronic medical records, and administrative responsibilities make this difficult even in traditional face-to-face encounters.[10] These pressures may be greater in a teleneurology setting, where the technological component and lack of physical presence make it even more difficult to establish this relationship.

Overdependence on the technology must not compromise the patient–provider relationship, particularly in cases where the provider is meeting the patient for the first time. Recognizing this concern, certain medical societies have recommended that telemedicine only be used with established patients.[11] The idea of limiting telemedicine only to established patients is not pragmatic in neurology given the immobility of our patients and access of care issues.

It is imperative that we teach our residents the art and science of developing provider–patient relationships, especially in the context of teleneurology. The Work Group has identified 4 key components that could be included in this part of the curriculum. These include the following:

1. Understanding the technique behind developing a provider–patient relationship
2. Identifying challenges to developing a provider–patient relationship in teleneurology
3. Reviewing FSMB recommendations for developing provider–patient relationships in telemedicine
4. Discussion of value proposition with patients for use of telemedicine in enhancing care, wherein the telemedicine provider explains the reason for using telemedicine (for instance, quick access in case of telestroke, or additional expertise for neurology consultation in areas of poor access and neurologist resources)

A provider–patient relationship occurs when a provider renders health services for a patient's benefit, either with express or implied consent.[9] The components involved in establishing this partnership have been discussed thoroughly elsewhere.[12]

While neurologists may display appropriate nonverbal gestures in a face-to-face encounter, this interaction may not be the same when the patient and provider appear on a computer screen. Patients could interpret the provider's body language or preoccupation with technology setup as lack of empathy, negatively affecting the entire encounter. Thus, it is important that the provider be comfortable with the technology and have access to technical assistance when needed. The Work Group suggests mindfully developing and displaying these nonverbal cues while providing periodic feedback to residents about their interactions. See specifics in table 4.[13,14]

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Table 4 Limitations of teleneurology consultation

Limitations	Examples
Technological limitations	
Connectivity and speed	Poor connectivity can make assessment of movement disorders difficult
	Many aspects of the encounter become difficult if audio/video quality is poor
Peripherals	Fundus cannot be examined if a panoptic device or funduscopic camera is not available
	Poor quality video camera with limited or no ability to pan, tilt, or zoom can lead to a frustrating and incomplete encounter
	Poor audio speakers or microphones can make it difficult to hear or understand a patient, particularly with other ambient noise present
Encryption and security	All devices need a secure socket layer or other forms of encryption to comply with Health Insurance Portability and Accountability Act
Maintenance	Webcam breaks in the middle of urgent consultation
	Teleneurology setup needs 24 × 7 × 365 backup
Cost	A panoptic device costs anywhere between $500 and $1,000
	A funduscopic camera is on average $7,000
Examination limitations	
Fundus	Need peripherals, which can be expensive, relies on telepresenter for patient positioning, lack of stereopsis
Motor examination	Relies on telepresenter for formal strength testing
Reflexes	Relies on telepresenter for proper technique of elicitation
Vestibular examination	Technology currently not widely available for reliable head impulse testing or Dix-Hallpike maneuvers
Regulatory limitations	
Licensure	Need multistate licensing, which can be very labor- and cost-intensive
Credentialing	Need credentialing in different hospitals for different services
Limitations to relationship-building	
Depersonalization of the provider–patient relationship	Lack of physical touch that is common to the neurologic examination
	Sensory and nonverbal limitations
Technological barriers	Presence of a computer screen and other electronic devices can be intrusive
	The remote neurologist's lack of familiarity with the equipment can interfere with the encounter
Third-party participation	Presence of colocated health care providers can result in perceived loss of patient's privacy
Underdeveloped norms and standards	Telemedicine clinical encounter standards are still evolving and are subject to frequent changes

Trainees could learn the FSMB-recommended 4-step process to establish a provider–patient relationship in a telemedicine setting. The FSMB recommends that every clinical encounter should involve verifying the location and identity of the requesting patient, disclosing the provider's identity and credentials, providing disclosures regarding delivery models and treatment methods, and obtaining appropriate consent from patients (see reference 15 for more detail).

Displaying professionalism. Professionalism in teleneurology includes mannerisms displayed by the clinician and the environment in which the encounter takes place (background, attire, lighting). Our focus here is on clinician mannerisms.

Webside manners. Webside manners refers to the verbal and nonverbal soft skills used while interacting with patients via telemedicine.[16] Appropriate bedside manner is one of the cornerstones of medical school and residency training and evaluation. Although teleneurology removes the in-person encounter, displaying appropriate webside manners is of the utmost importance. While there are many commercially available teaching modules,[17] direct physician mentoring with constant feedback on improving webside manners is the most dynamic teaching method. Future training programs could also develop their own objective structured clinical examination–type modules to train and evaluate residents in webside manners.

MODULE 4: ATTITUDES: INFORMED CONSENT, PATIENT PRIVACY, AND DISCLOSURE While our residents are familiar with these terms, they assume particular importance in the practice of teleneurology. The Work Group recommends a refresher course as a part of any didactic teleneurology training program. Neurologists must inform their patients of the security of personal data, including details on what information is being accessed and by whom.[18] A thorough understanding of Health Insurance Portability and Accountability Act and the Health Information Technology for Economic and Clinical Health Act should be observed and followed.[19]

Physicians also have an obligation to disclose information (financial, professional, or personal) that could potentially bias their choices and influence a patient's understanding or use of the information, products, or services offered on teleneurology websites.[20]

The FSMB model policy mandates informed consent prior to performing a telemedicine consultation.[15] Residents should learn to obtain and document informed consent to perform the consultation. Some families may also have an initial hesitation with a telemedicine consultation. Residents should be taught how to address families' concerns by using statements that suggest value for a specialty consultation that would otherwise not be available without telemedicine.

MODULE 5: SKILLS: TEACHING TELENEUROLOGY-SPECIFIC CLINICAL SKILLS **The neurologic history and examination.** The neurologic history and examination need to begin with the expectation from the provider that the patient will receive the same standard of

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care as with any other encounter. Prior studies have demonstrated that neurologists felt that teleneurology was equivalent to in-person care 63% of the time, inferior 31% of the time, and superior 3% of the time. Ratings of equivalence to in-person care differed depending upon specific diseases.[21]

Prior to beginning an encounter, it is important for the provider and telepresenter (health care professional colocated with the patient) to discuss expectations. This telepresenter can be a registered nurse, physician assistant, nurse practitioner, telehealth technician, or referring physician. In some cases, as when telemedicine visits occur in the home, there may be no telepresenter. To help ensure diagnostic accuracy for the encounter, the provider should inquire about the telepresenter's level of training and experience with the neurologic examination. Because the telepresenter provides critical portions of the examination, communication and trust between the remote neurologist and the telepresenter is often necessary to give confidence to the examination. Ideally, the telepresenter would be trained by the remote neurologist, but in many cases this is not possible. There is no evidence to date as to what level of training and experience an ideal telepresenter should have. Most importantly, both the provider and telepresenter should be comfortable with the telemedicine format and have discussed their expectations prior to the patient encounter.[22]

The initial conversations should discuss the importance of the neurologic examination, necessary equipment, and performance of specific testing. This discussion can take place via telemedicine with a simulated patient or on-site prior to beginning an actual patient encounter. Residents should be comfortable with this unique aspect of practice.

Telemedicine is effective for obtaining a complete neurologic history if the provider has clear communication and effective interpersonal skills. It is vital to demonstrate these skills with both the patient and the telepresenter. The telepresenter performs a major role in the examination and residents must know how to build rapport and demonstrate clear communication to get accurate physical examination findings. The providers should follow a structured format equivalent to an in-person visit.

Technological competence is a key component of the successful teleneurology encounter. The provider must be comfortable with using technology to review the patient's medical records, move cameras, and perform other functions. Practicing with simulated patients will help improve the teleneurologic experience for both patients and providers.

The providers should review grading systems together prior to the encounter so that the telepresenter may communicate any asymmetry. Certain standardized examinations, such as the Mini-Mental State Examination, NIH Stroke Scale, Expanded Disability Status Scale, and Full Outline of Unresponsiveness score, have been proven to be reliable when performed via telemedicine and should be reviewed before beginning the encounter to ensure validity.[23,24]

The Work Group has identified certain aspects of the neurologic examination that may or may not be appropriate for teleneurologic consultation.[25] We again emphasize caution as these are only the Work Group's current recommendations and may not necessarily reflect the evolving and diverse practice of telemedicine. See table 5 for our recommendations.

Documentation in teleneurology. The importance of proper clinical documentation is evident in the classic saying, "If it isn't documented in the medical chart, then it never happened." Documenting the teleneurology encounter is substantially different from documenting an in-person encounter and residents must be taught to appropriately document all aspects of the encounter.[26]

The names of everyone involved in the teleneurology encounter (including the provider who requested

Table 5 Components appropriate for teleneurology

Appropriate for teleneurology[26]	Difficult but possible via teleneurology (variable and dependent on telepresenter)	Likely not appropriate via teleneurology
Functional strength testing and sensory examination (spinothalamic tests and vibration with the help of a telepresenter)	Detailed motor testing (reliant on the telepresenter to determine tone and specific grades of Medical Research Council grading scale)	Comprehensive vestibular testing (given current peripheral devices in existence)
Cerebellar and gait testing (movement disorders physicians have been some of the earlier and most successful adopters of telemedicine)	Muscle stretch reflexes testing	Comprehensive neuro-ophthalmologic (without requisite peripherals)
Mental status examination including MoCA or other cognitive measures	Proprioception	Comprehensive neuromuscular examination
Cranial nerve examination (the funduscopic examination currently requires peripheral devices that are not always available)	Functional testing for positive psychogenic examination components	Brain death examination
Various measurement scales including the NIHSS and UPDRS		

Abbreviations: MoCA = Montreal Cognitive Assessment; NIHSS = NIH Stroke Scale; UPDRS = Unified Parkinson's Disease Rating Scale.

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the consultation, the provider the consult will be reported to, and the telepresenter) should be appropriately noted.

The components to be documented at the beginning of each encounter are (1) that informed consent was obtained (where required); (2) identification of the patient, physician, and physician's credentials; and (3) the patient's agreement and understanding that the consulting physician will determine whether the condition being diagnosed or treated is appropriate for the telemedicine encounter.[15,27]

When documenting a telemedicine examination, residents need to make the distinction between the components of the physical examination that they observed themselves, those that are communicated by the telepresenter, and those that are subjective. For example, a facial droop can be easily observed on camera and documented as such. However, assessment of tone, give way weakness, strength, and other findings rely on the telepresenter's ability to correctly assess these features. In such situations, it is best to document that "per the bedside examiner…" Documenting in this way helps to delineate which components of the examination the remote practitioner can be most confident in when making an assessment.

Regarding documenting ancillary studies, residents will generally have access to any imaging performed through an accessible server. However, imaging may not be available to them outside of a verbal or written report and should be documented. For instance, "Images were not available for my personal review, but per the report provided by staff…" Making note of the health care provider that supplied or read the report can be helpful in accounting for all the information that contributes to an assessment, should there be any future discrepancy or change in the report.

Any relevant examination components that cannot be assessed due to lack of expertise or technical limitations at the originating site should be documented. For example, if there is a need to assess for papilledema, but there is no funduscopic camera or peripheral device that allows for remote personal review of the optic nerve head, then these limitations must be documented. This can be explained as such: "Due to the limitations of the telemedicine examination, I was unable to personally assess the fundus." Any other technical limitations that prevent a remote examiner from performing key components of the examination should be recorded to account for an incomplete patient examination that may affect assessment and management.

Technical difficulties are not uncommon in telemedicine practice, and residents should be prepared to document factors that could affect teleneurology care, such as a technical disturbance or interruption of the remote connection. The provider should document any error that limits, interferes with, or otherwise delays the telemedicine encounter. Disturbances, either at the remote or originating sites, could include unstable Internet connectivity, poor signal quality, misplacement of the telemedical equipment, camera or device malfunction, absentee telepresenter, limited technical capacity of the patient, and unavailable records.[28]

Teleneurology is ideal for quality improvement projects. For instance, it is very important from both a quality improvement as well as a patient care standpoint to document specific times in emergency neurology cases. Documenting when the remote physician was contacted to provide emergency services, the time that physician was connected to video, when that physician recommended treatment, and when the treatment was provided (especially in the case of thrombolytic therapy or status epilepticus) are crucial to identifying any delays or interruptions in the workflow. Should a critical treatment window be missed or treatment excessively delayed, documentation can serve as a source of data to help streamline the future workflow and ultimately improve patient care.[29]

When discussing the plan of care with the referring provider, it is best to ensure that, as a consultant, residents can answer any key questions and that everyone involved agrees moving forward. The provider should document any disagreement in how to proceed that cannot be resolved. Documenting discussions with the patient and his or her family is as important in a telemedicine encounter as it is in an in-person encounter for establishing current and future care plans.

Ultimately, the teleneurology encounter involves more logistical considerations than an in-person encounter, accounting for technology and additional personnel. Proper documentation is crucial to determine accountability for different components of the workflow and to identify areas for improvement.

The interplay of these equivalencies will ultimately result in the development of highly effective interdisciplinary care teams. Telemedicine is particularly suited to supporting interdisciplinary care teams, streamlining communication, and information-sharing between providers.[30]

EVALUATION OF THE TRAINEE: MEASURING RESIDENT PERFORMANCE Developing equivalencies in teleneurology is a lifelong learning process. The standards will continue to evolve as teleneurology practice advances. The Work Group recommends evaluating residents in all equivalencies identified here, in addition to the global evaluation of milestones.

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Each residency can define their own objectives for the teleneurology rotation and develop individualized milestones based on the content we have recommended. In addition, the programs can define a minimum number of teleneurology patients (both inpatient and outpatient) that each resident needs to evaluate, document, and log to achieve clinical competency.

The Work Group has identified 5 additional ways to evaluate the resident's proficiency in teleneurology:

1. Direct supervision of the resident's teleneurology history and examination skills
2. Case simulation to assess webside manners
3. Objective structured clinical evaluation of different teleneurology cases
4. 10–20 clinical vignettes with multiple-choice questions to assess resident's knowledge in technology, medicolegal issues, and professional/ethical standards
5. Self-reflection essay on the future role of teleneurology in the trainee's practice or journal club discussion on teleneurology 360-degree evaluations (where attending, patients, peers, and allied health care professionals assess the residents and residents assess themselves as well as evaluate the rotation) are ideal for the improvement of teleneurology rotations

Table 1 provides an outline for a model curriculum and suggested evaluation of equivalencies.

DISCUSSION This outline for teleneurology curricula is not meant to be prescriptive but is rather a set of equivalencies the AAN Work Group believes any practitioner should be proficient in to safely practice teleneurology. This curriculum is an evolving document that will continue to adapt to best practice standards and guidelines not only in the field of teleneurology but telemedicine in general.

The Work Group is compiling a list of useful telemedicine curriculum resources (seminal articles, books, and web links) and is collaborating with the Education Committee in creating core teleneurology cases that will be used to build interactive clinical vignettes (table 2) to emphasize the skills and knowledge that we have described here. These resources will be made available on the AAN website as they are created. The cases are by no means exhaustive, but rather are reflective of the most common clinical scenarios in which teleneurology might be used.

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Raghav Govindarajan: acquisition of relevant literature/data, interpretation of relevant literature/data, drafting the manuscript, critical revision of the manuscript for important intellectual content. Eric R. Anderson: drafting the manuscript, critical revision of the manuscript for important intellectual content. Roger R. Hesselbrock: manuscript review/revision. Ramesh Madhavan: manuscript review/revision. Lauren R. Moo: manuscript review/revision. Nima Mowzoon: drafting of manuscript, manuscript review/revision. James Otis: manuscript review/revision. Mark N. Rubin: manuscript review/revision. Madhu Soni: manuscript review/revision. Jack W. Tsao: manuscript review/revision. Scott Vota: manuscript review/revision. Hannah Planalp: manuscript review/revision.

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