Special requirements for electronic medical records in neurology

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Summary

Electronic medical records (EMRs) are being rapidly adapted in the United States with goals of improving patient care, increasing efficiency, and reducing costs. Neurologists must become knowledgeable about the utility and effectiveness of the important parts of these systems specifically needed for care of neurology patients. The field of neurology encompasses complex disorders whose diagnosis and management heavily relies on detailed medical documentation of history and physical examination, and often on specialty-specific ancillary tests and extensive neuroimaging. Small discrepancies in documentation or absence of an in-hand ancillary test result can drastically change the current workup or treatment decision of a complex patient with neurologic disease. We describe current models and opportunities for improvements to EMRs that provide utility and efficiency in the care of neurology patients.

There has been rapid adoption of electronic medical records (EMRs) over the last few years,¹ spurred in large part by financial incentives allocated by the Health Information Technology for Economic and Clinical Health Act as part of the American Recovery and Reinvestment Act of 2009. There has been enthusiasm in the field about improvements in efficiency of clinical care and system-wide cost reductions associated with this adoption of EMRs. However, commercial EMRs are frequently developed for primary care providers and often do not comprehensively address the specific needs of subspecialists. As neurology is a smaller subspecialty with the need for detailed medical

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histories, precise examination findings, and integration of unique ancillary data, a generally purposed EMR may not be adequate.

Neurologists have written about the challenges of EMR use with many published articles discussing the difficulties of using an EMR in neurology practice. Recent publications report concerns with efficiency of use of EMRs in academic practice,² challenges of implementation,³ improper documentation, issues of privacy, and impairing the physician–patient relationship.⁴ These concerns lead to challenges to the adoption of EMRs⁵ among neurologists.

In this article, we describe neurology-specific recommendations to guide EMR implementation and specific vendor and end user customization. EMR vendors should be encouraged to provide flexible and customizable workflow designs so that neurologists and other specialty providers with their own unique requirements can optimize EMR utility. We aligned our goals to increase EMR usability to expedite workflow for neurologists with that of the recently published American Medical Informatics Association recommendations,⁶ and to improve the quality of care of neurology patients through increased digital capture and real-time access to best-evidence knowledge with the Institute of Medicine's aim to build an adaptive and continuously learning health care system.⁷

Neurology-specific EMR requirements

Neurology as a field has unique complexities in the evaluation, management, and follow-up of patients with neurologic diseases. Specific features of neurology that make it unique are a heavy reliance on a complex physical examination for diagnosis and follow-up; utilization of specialty-specific neurophysiologic testing (e.g., electromyography [EMG]/nerve conduction studies [NCS], EEG, evoked potential studies); high utilization of neuroradiologic imaging (i.e., MRI, CT); use of videotaped examinations by clinicians for movement disorders; utility of patient-recorded videos or pictures in the medical record (e.g., seizures, pseudoseizures, tics, dyskinesias); and importance of patient documentation of episodic complaints (e.g., migraines, seizures).

Intake history forms

History taking of neurologic complaints is often confounded by multiple factors and would benefit from a unique history intake evaluation. The ideal EMR would allow for the incorporation of a previsit intake history that would be completed online by the patient and his or her family or caregivers prior to the appointment. This previsit intake history would be complementary to and verified during the face-to-face encounter. Given that many neurologically ill patients cannot accurately recall important events related to their history (e.g., seizure onset, cognitive changes, triggers of headaches), assistance from family members or caregivers are vital for proper history evaluations. There are multiple existing validated questionnaires to assess disability of disease, such as migraine disability from the Migraine Disability Assessment questionnaire,⁸ parts 1 and 2 of the Unified Parkinson's Disease Rating Scale (UPDRS) for Parkinson disease disability rating,⁹ and the Tremor Disability Questionnaire for essential tremor.¹⁰ Other previsit questionnaires could be incorporated into a patient portal to improve diagnosis, such as the Computerized Headache Assessment Tool for the self-assessment of

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headache disorders.¹¹ These should be adapted to an online form for previsit completion or as waiting room–based questionnaires entered on computer terminals or tablets by patients. Utilization of customized intake history questionnaires will improve the efficiency of the patient visit and expedite neurologist workflow.

Patient portals

Part of the Meaningful Use recommendations is the utilization of patient portals to obtain access to parts of the EMR data and use electronic communication with providers. Neurologic disorders often are episodic in nature and require patient documentation of events. There are previously studied self-assessment online diary tools for documenting seizure frequency and medication use in epilepsy patients,¹² and for documenting medication utilization and triggers for patients with episodic migraine headaches.¹³ Incorporation of patient portals into existing EMRs for the utilization of these and other self-assessment questionnaires for documentation of episodic events, disease progression, and medication utilization between clinic visits could improve efficiency of care, enhance patient–physician communication, and provide an objective method for assessing the clinical progression of patients.

Clinical documentation of the neurologic examination

One of the most complex parts of the neurologic patient evaluation is the detailed neurologic examination. Neurologists take great pride in their ability to diagnose based on this extensive clinical examination and are actively seeking more evidence-based studies using examination findings for disease diagnosis and prognosis.¹⁴ Without structure, many practitioners do not document a proper or complete neurologic examination,¹⁵ which could lead to missed or incorrect diagnosis. Given that many neurologic disorders are only diagnosed via a detailed neurologic examination with ancillary testing used as an adjunct diagnostic tool, the proper and detailed documentation of this examination is crucial to accurately diagnosing and following progression of neurologic disease. Since many components of the neurologic examination are graded (e.g., muscle strength and deep tendon reflexes), an EMR that allows discrete documentation of these components will be important for determining whether there have been any changes or trends over time. Options for end user customized examination templates and discrete field entries can improve communication, completeness, and tracking of our neurologic examinations. The users should additionally have the option of using narrative text for alternative documentation of complex findings. The benefit of discrete fields (e.g., drop-down boxes) must be weighed against the extra time and effort they may require for end user data entry compared to narrative text.

Examination documentation should also include commonly utilized standardized scales with discrete fields for their documentation such as the NIH Stroke Scale, Parkinson disease motor rating scale of the UPDRS, screening examinations for patients with memory impairment (e.g., Montreal Cognitive Assessment), and disability scales such as the Expanded Disability Status Scale for multiple sclerosis. A universal and standardized approach of using discrete fields to capture most of the complex physical examination findings and standardized rating scales will improve opportunities for future research and quality improvement assessments. These scales should be made easily visible and passive clinical reminders could be utilized to encourage the use of standardized documentation in the EMR.

Table 1 Multimedia data used in neurology to incorporate into EMRs

Data	Explanation	Potential effect
Radiologic imaging (i.e., MRI, CT, ultrasound)	DICOM and other image formats with associated text reports	Reduce redundant imaging
Video EEG records	Video and continuous EEG recording data integrated into EMR with associated text reports	Reduce ambiguity and variability between reports; reduce redundant recordings
EMG/NCS records	Selected images, video and sound recordings integrated into EMR with associated text reports	Reduce ambiguity and variability between reports; reduce redundant recordings
Clinical images	Pictures of patients (e.g., neurocutaneous findings)	Improve clinical communication and clarify diagnosis
Pathology images	High-quality images of clinical pathology specimens (e.g., brain tumor biopsy pathology)	Improve clinical communication and clarify diagnosis
Clinician recorded videos	Videos of patients with dynamic disorders and neurologic examination findings (e.g., movement disorders)	Improve diagnosis and tracking of movement disorders; verify and validate neurologic examination findings
Patient-recorded videos	Videos recorded by patients outside the clinic or hospital setting of episodic neurologic disorders (e.g., seizures, pseudoseizures, periodic dyskinesias)	Improve patient-physician communication and documentation of episodic neurologic disorders
Abbreviations: EMR = electronic medical records; NCS = nerve conduction studies.		

Multimedia data integration

There are a number of neurologic tests that are specific to neurologic disorders including EEG, somatosensory evoked potentials, visual evoked potentials, EMG, and NCS that are often not well-integrated into the EMR. For example, EEGs and their corresponding videos are often stored in a separate record system and the integration of only the final report, often without images or clips, is included into the EMR. Transmission of EMG/NCS or EEG data (other than reports) is not standardized and often results in repeat and possibly unnecessary testing when the patient transfers facilities. Additionally, neuroimaging, which is vital to the practice of neurology, is often not directly incorporated into the medical record. The incorporation of key images, videos, or clips of these ancillary tests should be included into EMRs to enable the optimal coordination and organization of this information to improve clinical care (table 1).

Clinical decision support

Clinical decision support tools such as alerts, reminders, and evidence-based order sets can support standards of practice and quality measures to improve patient outcomes. There is strong evidence to show a positive and consistent benefit of clinical decision support systems in improving care quality, safety, and efficacy as described in a recent systematic review.¹⁶ Some of the most common neurologic issues could utilize clinical decision support to improve standards of practice care. Stroke is an ideal neurologic disease for including clinical decision support as there is a great deal of literature supporting improvements in stroke care with improved guideline adherence.¹⁷

Furthermore, recent changes in Medicare reimbursement focus on standards of quality adherence and quality measures were initially described in 2007 and again in December 2012 as the Physician Quality Reporting System Measures List.¹⁸ These quality measures will affect all physicians who treat Medicare patients with financial penalties for those who do

Table 2 EMR features for neurology practice

Patient intake forms
Electronic patient intake evaluations linked to the EMR
Disease-specific rating scales and questionnaires based on history and chief complaint
Patient portals
Tracking of episodic events (e.g., seizures, migraines)
Medication adherence tracking
Patient-physician electronic communication
Clinical documentation
Discrete and standardized neurologic examination documentation options
Tracking of changes to neurologic examination findings or severity
Utilization of standardized rating scales for diagnosis, disability, and outcomes
Multimedia data integration
Incorporation of clinical data (neuroradiology, neurophysiology, pathology)
Video and picture support for clinicians in EMR and patients in patient portal
Clinical decision support
Incorporated rating scales and standardized assessments for dementia, Parkinson disease, multiple sclerosis, migraine, stroke, and others
Incorporate quality measures such as those from the CMS Physician Quality Reporting System into discrete fields and clinical reminders
Incorporate evidence-based clinical decision rules and algorithms for quality improvement
Health information exchange
Support for the electronic exchange of documentation, radiology, and neurophysiologic data
Abbreviation: EMR = electronic medical records.

not comply with these measures. Neurology-specific quality measures¹⁹ (including those in epilepsy, stroke, sleep apnea, Parkinson disease, back pain, and dementia) should be included into EMR documentation as discrete fields, preferably with clinical decision support aids.

Additionally, the development of standardized best evidence clinical decision support rules by specialty organizations such as the American Academy of Neurology can be incorporated into EMRs to improve clinician adherence and patient outcomes. One such example of an evidence-based decision rule that could improve neurologic patient outcomes is an algorithm for the evaluation and management of localization-related medically refractory epilepsy.²⁰ Utilizing these guidelines, clinical decision support tools and reminders can help improve adherence to recommendations for at least a standard level of care.

Health information exchange

A health information exchange (HIE) is one method that allows health care providers to securely access and transmit a patient's medical information electronically between different organizations. Spurred in part by Meaningful Use recommendations, the increased use of health information exchanges, with integration of this information into the EMR, will be of great utility in improving quality and efficiency of neurologic care. Specifically, the ability to electronically exchange detailed data from multiple sources, previously challenging to acquire quickly via nonelectronic routes, can rapidly decrease costs, decrease medical resource utilization, and improve proper neurologic diagnosis and treatment of patients. For example, if a patient with known medically refractory epilepsy is seen at an emergency department with a recurrent seizure, the workup and treatment would vary considerably based on how much of the history

is known or able to be quickly acquired. The patient may get an extensive and costly workup with expensive and likely redundant neuroimaging, laboratory testing, and neurophysiologic testing. But if the patient has detailed medical records readily available through an electronic HIE for review including pertinent recent neuroimaging and EEG findings, the workup would likely be limited, cost-effective, and expedited.

DISCUSSION

EMRs can improve quality of care of neurology patients and increase workflow efficiency for neurologists. Features such as we describe (table 2) will be critical in alleviating many of the concerns about EMR use and help to make the EMR an adept clinical utility rather than a source of undue burden for the neurology care provider. Neurologists can be proponents of adapting and utilizing systems that meet our needs to aid our daily workflows and improve the care of our patients. By focusing on the use and utility of these systems to enhance clinical care, neurology as field can enthusiastically embrace the era of the EMR.

REFERENCES

1. Jha AK, Burke MF, DesRoches C, et al. Progress toward meaningful use: hospitals' adoption of electronic health records. *Am J Manag Care* 2011;17:SP117–SP124.
2. Josephson SA, Johnston SC, Hauser SL. Electronic medical records and the academic neurologist: when carrots turn into sticks. *Ann Neurol* 2012;72:A5–A6.
3. Ramos VF. Reflections: Neurology and the Humanities: a neurologist, an EMR, and a patient. *Neurology* 2012;79:2079–2080.
4. Bernat JL. Ethical and quality pitfalls in electronic health records. *Neurology* 2013;80:1057–1061.
5. Boonstra A, Broekhuis M. Barriers to the acceptance of electronic medical records by physicians from systematic review to taxonomy and interventions. *BMC Health Serv Res* 2010;10:231.
6. Middleton B, Bloomrosen M, Dente MA, et al. Enhancing patient safety and quality of care by improving the usability of electronic health record systems: recommendations from AMIA. *J Am Med Inform Assoc* 2013;20:e2–e8.
7. Institute of Medicine. Best care at lower cost: the path to continuously learning health care in America. 2012. Available at: www.iom.edu. Accessed April 22, 2014.
8. Stewart WF, Lipton RB, Kolodner KB, Sawyer J, Lee C, Liberman JN. Validity of the Migraine Disability Assessment (MIDAS) score in comparison to a diary-based measure in a population sample of migraine sufferers. *Pain* 2000;88:41–52.
9. Harrison MB, Wylie SA, Frysinger RC, et al. UPDRS activity of daily living score as a marker of Parkinson's disease progression. *Mov Disord* 2009;24:224–230.
10. Louis ED, Barnes LF, Wendt KJ, et al. Validity and test-retest reliability of a disability questionnaire for essential tremor. *Mov Disord* 2000;15:516–523.
11. Maizels M, Wolfe WJ. An expert system for headache diagnosis: the Computerized Headache Assessment tool (CHAT). *Headache* 2008;48:72–78.
12. Le S, Shafer PO, Bartfeld E, Fisher RS. An online diary for tracking epilepsy. *Epilepsy Behav* 2011;22:705–709.
13. Marmura MJ, Nahas SJ. What might the ideal electronic medical record for migraine headache look like? *Curr Pain Headache Rep* 2010;14:233–237.
14. Johnston SC, Hauser SL. The beautiful and ethereal neurological exam: an appeal for research. *Ann Neurol* 2011;70:A9–A10.
15. Sarko J. Emergency medicine residents do not document detailed neurologic examinations. *Acad Emerg Med* 2009;16:1371–1373.
16. Jones SS, Rudin RS, Perry T, Shekelle PG. Health information technology: an updated systematic review with a focus on meaningful use. *Ann Intern Med* 2014;160:48–54.
17. Schwamm LH, Fonarow GC, Reeves MJ, et al. Get With the Guidelines—Stroke is associated with sustained improvement in care for patients hospitalized with acute stroke or transient ischemic attack. *Circulation* 2009;119:107–115.
18. Centers for Medicare and Medicaid Services. 2013 Physician Quality Reporting System (PQRS) Measures List. Available at: <http://www.cms.gov>. Accessed April 22, 2014.
19. Cohen AB, Sanders AE, Swain-Eng RJ, et al. Quality measures for neurologists: financial and practice implications. *Neurol Clin Pract* 2013;3:44–51.

20. Jobst BC. Treatment algorithms in refractory partial epilepsy. *Epilepsia* 2009;50(suppl 8):51–56.

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