

Electronic Consultations in a Community Neurology Practice: A Retrospective Study Informing Best Practice

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Abstract

Objective: To describe our practice of electronic consultations (e-consults) and assess safety and risk factors for subsequent face-to-face consultations.

Patients and Methods: A retrospective cohort study of all e-consults completed in a community neurology practice between May 5, 2018, and June 31, 2019, was completed. Clinical and demographic variables were compared between the successful and unsuccessful (defined by presence of subsequent face-to-face consultation) cohorts. Hazard ratios (HR) were calculated using Cox regression model. Kaplan-Meier probability analysis (with 95% CIs) of subsequent face-to-face consultation was performed. Case examples highlighting potential harm were summarized.

Results: In total, 302 e-consults were reviewed. The most frequent referrals were for headache (n=125, 41.4%), dysesthesia (n=40, 13.2%), and abnormal imaging finding (n=27, 8.9%). The most common e-consult questions were for treatment (57.6%) and diagnostic evaluation (48.0%) recommendations. Moreover, 24.8% (n=75) of e-consults were followed by face-to-face consultations, with primary risk factors including female sex (HR, 1.9), referral for headache (HR, 1.7), and final diagnosis of migraine (HR, 2.0) or long-term migraine (HR, 5.0). Potential harm related to delayed diagnosis/treatment was identified in 6 (2.0%) patients with migraine and 4 (1.3%) without migraine presenting to emergency department.

Conclusion: Utilization of e-consults may safely improve access to neurologic expertise and prevent the need for some visits, which may have required a face-to-face visit. In patients with chronic migraine, e-consults should be considered short-term and followed by face-to-face consultation as soon as access allows. Neurologists performing e-consults should be able to triage patients to face-to-face consultation, particularly when diagnosis is uncertain or the neurologic examination may help guide appropriate testing.

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Electronic consultations (e-consults) are a promising and growing care delivery practice to improve patient and referring provider (RP) access to neurologic expertise at a lower cost^{1,2} in settings where high demand for traditional face-to-face or telemedicine visits results in long delays in patient care. E-consults are an asynchronous method typically used by specialty providers to review information contained in the electronic health record (EHR) and offer a written opinion addressing questions from the RP who provides the ongoing care. RPs report high satisfaction³ and value timely answers to questions regarding diagnosis, testing, management, and whether a traditional

consultation is needed. Specialists value the improved communication with primary care providers and ability to help determine which patients should be seen in a face-to-face visit.⁴

The process of implementing e-consults in a practice has been described.^{3,5,6} Billing codes that may be reimbursed by insurance companies have been established,⁷ allowing for potential revenue to sustain the practice. The risk of harm from neurologic e-consults is likely low.⁸ Medicolegally, an e-consult may be viewed as establishing a physician-patient relationship with similar risks as in a traditional face-to-face visit.⁷ The infrastructure required to deliver e-consults is similar to a traditional visit requiring an EHR-based order,

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scheduling process, review of medical record, documentation of a clinical note, and billing. The work for RPs is usually higher than traditional practice⁹⁻¹² and includes reviewing the e-consult, communicating the recommendations to the patient, and coordinating subsequent testing, treatment, or formal consultations if recommended. RP may not be given time for the added work, and there is no billing code or reimbursement for the RP practice, which may be a limiting factor in RP willingness to use e-consults. Whether these RP factors may lead to reduced quality of care with respect to neurologic disorders is unknown.

Other groups have found that e-consults improve access to neurology care while lowering the number of face-to-face visits.^{1,8,12,13} However, the outcomes of care related to e-consults has not been well studied.¹⁴ Our neurology group has previously assessed 68 e-consults retrospectively and did not observe adverse outcomes,⁸ suggesting e-consults may be safely performed. More information is needed to better understand which types of problems or referral questions may be suitable for e-consults and whether the e-consults safely avoid eventual face-to-face consultation, thereby improving overall access to a practice.

We aimed to assess the risk of a traditional face-to-face neurology consultation occurring after an e-consult in our general community neurology practice. In addition, we aimed to assess for adverse outcomes associated with e-consults in a greater number of patients than our first study.⁸

METHODS

We performed a retrospective quality improvement chart review study of all e-consults completed for adult patients (aged 18 years or older) in the Rochester, Minnesota, community neurology practice between May 5, 2018, and June 31, 2019. The Mayo Clinic institutional review board granted a quality improvement study exemption. The date range was selected to allow at least 6 months of follow-up before the COVID-19 pandemic, which disrupted the usual practice. Referrals were categorized by 1 of 3 neurologists (N.A.S., N.P.Y., K.A.T.) on the basis of predominant symptom-based diagnosis and final neurologist determined diagnosis at the time

of chart review. All coauthors participated in the electronic medical records review and abstracted data into a predetermined standardized REDCap database.¹⁵ Accepted diagnostic criteria were used to classify those with migraine.¹⁶ An unsuccessful e-consult was defined operationally by the occurrence of a face-to-face neurology consultation for the same problem/question after the e-consult was performed, under the assumption that the e-consult may have unnecessarily delayed the gold standard of care that we defined as a traditional face-to-face consultation delivered by a neurologist. Potential harm was generally defined by the occurrence of an adverse event after an e-consult complete for the same problem and before a face-to-face visit with a neurologist (gold standard). Examples of harm that were predetermined included an emergency department visit or a patient developing a neurologic deficit, recurrent transient ischemic attack, seizure, and/or other relapse/progression of disease that may have been prevented by earlier face-to-face neurology consultation. The association of a face-to-face visit with clinical and demographic variables with sufficient sample size were assessed using univariate Cox regression models. Hazard ratios with 95% CIs were calculated. A Kaplan-Meier curve was used to estimate the probability (with 95% CI) of having a face-to-face consultation vs time since the e-consult. Follow-up time for each subject ended at the previous chart note date. We observed and summarized case examples of unnecessary diagnostic delay or potential harm seen in association with e-consults.

RESULTS

Demographic /Baseline Characteristics

Between May 5, 2018, and June 31, 2019, there were 302 e-consults completed on individual patients at our community neurology practice (Table 1). Median age was 53 years, and most (68.5%) patients were female. Of these patients, 159 (52.6%) were referred by family medicine and 143 (47.4%) by internal medicine providers. The RP was most commonly an attending physician (51.3%), followed by advanced practice provider (34.1%) and resident trainee under the supervision of an attending physician (14.6%).

TABLE 1. e-Consult Demographic and Clinical Characteristics

	Overall (n=302), n (%)
Age, median (range), y	52.7 (18.2-95.7)
Sex	
Female	207 (68.5)
Male	95 (31.5)
Referring specialty type	
Family medicine	159 (52.6)
Internal medicine	143 (47.4)
Provider type	
Physician	155 (51.3)
Advanced practice provider	103 (34.1)
Resident trainee	44 (14.6)
Primary symptom/question at time of referral	
Headache	125 (41.4)
Abnormal imaging finding	27 (8.9)
Seizure/spell	26 (8.6)
Paresthesia, nonlength dependent	24 (7.9)
Dizziness	21 (7.0)
Paresthesia, length dependent	16 (5.3)
Cognitive impairment	10 (3.3)
Limb pain	9 (3.0)
Tremor/movement disorder	8 (2.6)
Antithrombotic question	7 (2.3)
Weakness limb	4 (1.3)
Anosmia	3 (1.0)
Gait disorder	1 (0.3)
Weakness general	1 (0.3)
Other	20 (6.6)
Reason for e-consult (1 or multiple per consult possible)	
Treatment recommendations	174 (57.6)
Diagnosis unclear, evaluation recommendations	145 (48.0)
Diagnostic test interpretation	57 (18.9)
Unclear/uncertain	36 (11.9)
Treatment plan confirmation	16 (5.3)
Diagnosis confirmation	12 (4.0)
Other	5 (1.7)
Final diagnosis per neurologist at time of study	
Migraine (all)	82 (27.2)
Episodic migraine	44 (53.7)
Chronic migraine	33 (40.2)
Migraine type unclear	5 (6.1)

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TABLE 1. Continued

	Overall (n=302), n (%)
Final diagnosis per neurologist at time of study, continued	
Headache, not migraine	45 (14.9)
Incidental imaging finding	23 (7.6)
Indeterminate paresthesia	18 (6.0)
Transient ischemic attack or stroke	18 (6.0)
Peripheral neuropathy	13 (4.3)
Epilepsy	11 (3.6)
Spell, not epilepsy	11 (3.6)
Meningioma	10 (3.3)
Radiculopathy	9 (3.0)
Peripheral vestibular disorder	8 (2.6)
Dementia or mild cognitive impairment	6 (2.0)
Movement disorder NOS	5 (1.7)
Autonomic disorder	3 (1.0)
Essential tremor	3 (1.0)
Lumbar spinal stenosis	2 (0.7)
Demyelinating disease	1 (0.3)
Parkinson disease	1 (0.3)
Myelopathy	1 (0.3)
Myopathy	1 (0.3)
Other, neurologic	20 (6.6)
Other, nonneurologic	11 (3.6)

Primary referral symptoms and questions are summarized in Table 1. The most frequent primary symptom/question for the e-consult was headache (n=125, 41.4%), followed by abnormal imaging (n=27, 8.9%), seizure and/or indeterminate spell (n=26, 8.6%), non-length-dependent paresthesia (n=24, 7.9%), and dizziness (n=21, 7.0%). The most common reason(s) for referral were for treatment (57.6%) and diagnostic evaluation (48.0%) recommendations, with 11.9% of e-consults not having a clear referral question stated by the RP.

The most common final diagnosis was migraine (n=82, 27.2%), which was further subdivided into episodic migraine (n=44/82, 53.7%), chronic migraine (n=33/82, 40.2%), and unclear migraine type (n=5/82, 6.1%). This was followed by nonmigraine headache disorder (n=45, 14.9%), incidental imaging finding (n=23, 7.6%), indeterminate paresthesia (n=18, 6.0%), and transient ischemic attack or stroke (n=18, 6.0%).

e-Consult Outcomes

The e-consult outcomes are summarized in [Table 2](#). The median time from e-consult order by RP to completion was 3 (range 0-32) days. There was documented EHR evidence that the RP communicated e-consult results and recommendations to patients after 84.4% of e-consults.

Diagnostic testing was recommended by the neurologist in 58 (19.2%) of e-consults. Of the diagnostic testing that was recommended, magnetic resonance imaging (MRI) of the brain and/or spine was most recommended (n=28/58, 48.3%), followed by serum laboratory studies (n=11/58, 19.0%), electroencephalogram (n=8/58, 13.8%), electromyogram (n=7/58, 12.1%), and ultrasound (n=4/58, 6.9%). All recommended diagnostic testing was completed after 46 of the 58 (79.3%) e-consults. The median time from e-consult completion to recommended diagnostic testing completion was 8 days. Diagnostic testing considered by RP before e-consult was avoided on the basis of the recommendations of the neurologist in 32 patients (10.6%), with the most avoided testing being MRI (n=25/32, 78.1%).

Specific medical treatment was recommended in 119 (39.4%) e-consults. Subsequent face-to-face neurology consultation was performed after 75 (24.8%) e-consults, most of which were not specifically recommended in the e-consult (n=47/75, 62.7%).

Subsequent Face-to-Face Neurology Consultations

A Kaplan-Meier curve demonstrating the probability of face-to-face consultation subsequent to e-consult over time is found in [Figure](#). Demographic and clinical variables associated with unsuccessful e-consults are summarized in [Table 3](#). E-consults involving patients presenting with headache as the primary symptom for referral (HR, 1.7) were more likely to have subsequent face-to-face neurology consultation ($P=.02$). In e-consults where migraine was the final diagnosis, subsequent face-to-face neurology consultation was more likely (HR, 2.0; $P=.003$), particularly for the chronic migraine subtype (HR, 5.2; $P<.001$) relative to those without migraine. Patients with indeterminate paresthesia as the

final diagnosis were less likely to have subsequent face-to-face neurology consultation (HR, 0.1; $P=.005$). When treatment recommendation was among the reason(s) for the e-consult, a subsequent face-to-face neurology visit was more likely (HR, 2.6; $P<.001$). In e-consults where diagnostic testing was recommended, a subsequent face-to-face neurology visit was also more likely (HR, 1.7; $P=.04$). Finally, subsequent face-to-face neurology consultation was also more likely when specific medical treatment was recommended (HR, 2.9; $P<.001$).

Safety and Adverse Outcomes

Case examples are summarized in [Table 4](#). No mortality attributable to e-consult was observed. There was evidence of attributable patient harm or adverse event after e-consult in 10 (3.3%) patients, which most commonly was emergency department visit (n=9/10, 90%). Of these patients, most (n=6/9, 66.7%) presented to the emergency with symptoms secondary to migraine. Whether the emergency department visits could have been prevented by an earlier face-to-face visit with a neurologist is unclear. In the remaining patients presenting with nonmigrainous symptoms, delayed diagnosis or treatment was identified (n=4, 1.3%), including 3 patients with a final diagnosis of myelopathy and 1 patient with recurrent seizure.

DISCUSSION

In this study, we present the largest assessment of various outcomes related to the practice of e-consults in a general neurology community practice. E-consults in our cohort not only efficiently delivered neurologic expertise in a timely manner within 3 days of the RP request but also minimized unnecessary evaluations such as MRI for some patients. Overall, we observed that approximately 1 in 4 (25%) e-consults were eventually followed by a traditional face-to-face neurology consultation for the same problem. RPs in our practice most frequently requested e-consults for headache and migraine. Patients with chronic migraine carried the highest risk of eventual face-to-face visit.

Overall, the practice of e-consults appears to be safe. We did not observe any mortality. However, case examples were observed in

TABLE 2. Assessment of Care Delivery and Utilization After an e-Consult

Time from RP order to e-Consult completion, median days (range)	3.0 (0-32.00)
Did RP communicate e-consult results with patient?	
No or unclear/yes	47 (15.6)/255 (84.4)
Was diagnostic testing recommended?	
No/yes	244 (80.8)/58 (19.2)
Which diagnostic testing was recommended? n=58	
MRI brain or spine	28 (48.3)
EMG	7 (12.1)
EEG	8 (13.8)
Laboratory studies	11 (19.0)
Ultrasound	4 (6.9)
Other	13 (22.4)
Was all the recommended diagnostic testing completed? n=58	
No/yes	12 (20.7)/46 (79.3)
Time from e-Consult to recommended diagnostic testing completion, median days (range)	8.0 (0-99.0)
Was e-Consult associated with test avoidance?	
No/yes	270 (89.4)/32 (10.6)
Which diagnostic test was avoided? n=32	
MRI brain or spine	25 (78.1)
EMG	0 (0)
EEG	3 (9.4)
Laboratory studies	0 (0)
Ultrasound	1 (3.1)
Other	6 (18.8)
Was a treatment recommended in the e-Consult?	
No/yes	183 (60.6)/119 (39.4)
Was a face-to-face neurology consultation performed after the e-consult?	
No/yes	227 (75.2)/75 (24.8)
Was the face-to-face neurology consultation specifically recommended in the e-consult? n=75	
No/yes	47 (62.7)/28 (37.3)

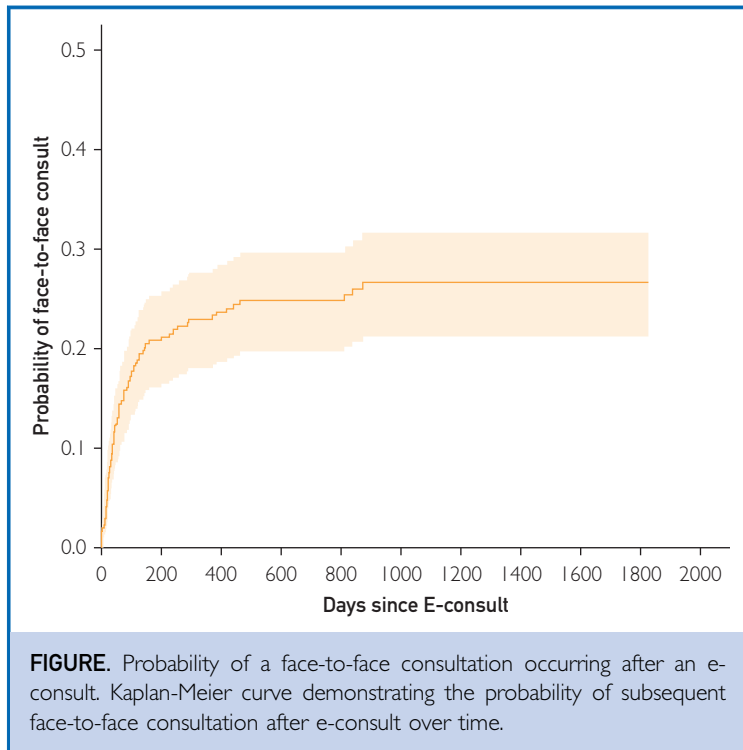
Evidence of attributable potential harm or adverse event occurring after the e-Consult	10 (3.3)
Emergency department visit and/or hospitalization	9 (3.0)
Morbidity	4 (1.3)

EEG, electroencephalogram; EMG, electromyogram; MRI, magnetic resonance imaging; RP, referring provider.

which morbidity related to delayed diagnosis or utilization of the emergency department (n=10, 3.3%). Whether earlier face-to-face consultation with a neurologist may have prevented such harm is unclear. The cases associated with morbidity tended to have uncontrolled symptoms of predominately migrainous headache or had symptoms without a clear diagnosis and possible neurologic examination abnormalities suggesting the potential value for an earlier face-to-face neurologic consultation in select cases.

Another similar e-consult practice found the most common e-consult referral questions were related to headache, incidental imaging findings, paresthesia, seizures, and cerebrovascular disease.¹³ Referral questions were focused on diagnosis (51%), drug treatment (23%), and management (17%). Most e-consults were completed within 10 minutes and within 1 day of the referral but long-term outcomes including subsequent face-to-face consultation and safety were not assessed.

In a headache subspecialty practice, only 33% of e-consults requested were felt to be appropriate for an e-consult, and the clinical information lacked important detail in 41.7% for referrals.¹⁷ Triage before performing an e-consult was suggested along with use of e-consults to reach patients with migraine earlier to ensure delivery of guideline recommended care.¹⁷ In this study, we did not assess the appropriateness of e-consult for the headache cases but rather offered the best opinion possible given the information documented in the medical record by the RP. The underlying reasons why patients with headache, especially those with chronic migraine, often required subsequent face-to-face visits in our



study is unclear. Factors that may contribute to the “failure” of e-consult in patients with chronic migraine may be related to insufficient clinical documentation in RP notes,¹⁷ degree of disability associated with chronic migraine, high utilization of health care resources, and/or RP unfamiliarity with prescribing newer migraine treatments, ultimately suggesting that patients with chronic migraine are likely to benefit from and value a face-to-face consultation with a neurologist. Our study’s findings suggest that use of e-consults may be best for episodic migraine and for short-term management of chronic migraine while planning for face-to-face neurology evaluation as soon as local access allows, assuming a patient is able to access such care.

In this study, relatively few (n=10, 3.3%) patients were referred for e-consult with the primary symptom of cognitive decline, and the final diagnosis for most of these patients was dementia or mild cognitive impairment. With the overwhelming prevalence of dementia secondary to Alzheimer disease in the United States¹⁸ and a recent clinical trial treating patients with a novel monoclonal antibody targeting amyloid- β that found moderately less

decline on cognitive and functional measures at 18 months relative to placebo,¹⁹ early diagnosis and potentially disease-modifying treatment of Alzheimer disease is at the forefront of neurology currently. In this study, cognitive decline as the primary symptom for e-consult referral was not associated with increased risk of subsequent face-to-face neurology consultation; however, it is important to note that our study was conducted before recent US Food and Drug Administration approval of the aforementioned potentially disease-modifying therapy in select patients with Alzheimer disease.²⁰ Patients with mild cognitive impairment or mild Alzheimer disease and their family and/or caregivers may prefer face-to-face neurology consultation to discuss risks, benefits, and candidacy regarding these novel treatments and ongoing clinical trials; however, e-consults may serve as a method to facilitate expedited workup as appropriate before face-to-face neurology consultation. The role and extent of which e-consults may have in the diagnosis and potential treatment of cognitive disorders remains to be seen but is an important topic requiring further investigation.

Limitations

This study has several limitations such as the retrospective design and associated bias in assessing outcomes of somewhat subjective outcomes related to potential delayed diagnosis or potential harm. We attempted to minimize bias by predetermining definitions of harm and defining clear outcomes, such as an emergency department visit occurring for the same problem. It is possible that valuable information was not ascertained during the chart review. The definition of an unsuccessful e-consult was purely operational, defined by the occurrence of a face-to-face consultation for the same problem under the assumption that face-to-face consultation is the gold standard that may have been delayed because of the e-consult. We did not specifically assess the positive value of the e-consult advice to which the patient had access to likely much sooner than waiting for the face-to-face consultation in an access-challenged practice environment. The risk of an unsuccessful e-consult resulting in subsequent face-to-face consultation for categories of symptoms or

TABLE 3. Demographic and Clinical Variables Associated With Face-to-Face Neurology Consultation Subsequent to an e-Consult

	Hazard ratio (95% CI)	P
Age, per 1 year	1.002 (0.99-1.01)	.78
Sex, female vs male	1.883 (1.07-3.32)	.03
Referring specialty, FM vs IM	0.791 (0.50-1.24)	.31
Provider type (physician reference group)		
Advanced practice provider	0.896 (0.55-1.47)	.66
Resident trainee	0.675 (0.32-1.43)	.31
Primary symptom/question at time of referral		
Headache	1.697 (1.08-2.67)	.02
Abnormal imaging finding	0.510 (0.19-1.39)	.19
Seizure/spell	1.490 (0.72-3.10)	.29
Numbness/paresthesia	0.440 (0.14-1.40)	.16
Dizziness	0.165 (0.02-1.19)	.07
Peripheral neuropathy	1.414 (0.57-3.50)	.45
Cognitive impairment	0.826 (0.20-3.37)	.79
Limb pain	0.404 (0.06-2.90)	.37
Tremor/movement disorder	1.032 (0.25-4.21)	.97
Antithrombotic question	0.526 (0.07-3.78)	.52
Weakness limb	0.884 (0.12-6.36)	.90
Other	1.224 (0.53-2.82)	.63
Final diagnosis per neurologist at time of study		
Migraine	2.020 (1.28-3.20)	.003
Episodic migraine vs no migraine	0.548 (0.22-1.38)	.20
Chronic migraine vs no migraine	5.192 (3.19-8.47)	<.001
Headache, not migraine	0.757 (0.38-1.52)	.43
Incidental imaging finding	0.293 (0.07-1.20)	.09
Indeterminate paresthesia	0.087 (0.01-0.60)	.005
Transient ischemic attack or stroke	1.794 (0.82-3.90)	.14
Peripheral neuropathy	1.266 (0.46-3.47)	.65
Epilepsy	0.689 (0.17-2.81)	.60
Spell, not epilepsy	0.751 (0.18-3.06)	.69
Meningioma	0.354 (0.05-2.55)	.30
Radiculopathy	0.939 (0.23-3.83)	.93
Other, neurologic	1.048 (0.42-2.60)	.92
Other, nonneurologic	0.766 (0.19-3.12)	.71
Reason for e-consult		
Treatment recommendations	2.559 (1.51-4.35)	<.001

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TABLE 3. Continued

	Hazard ratio (95% CI)	P
Reason for e-consult, continued		
Diagnosis unclear, evaluation recommendations	0.993 (0.63-1.56)	.98
Diagnostic test interpretation	0.723 (0.38-1.37)	.32
Unclear/uncertain	1.651 (0.89-3.06)	.11
Treatment plan confirmation	0.452 (0.11-1.84)	.27
Diagnosis confirmation	1.146 (0.36-3.64)	.82
Other	1.882 (0.46-7.68)	.38
Subsequent to e-consult		
e-Consult results communicated to patient	1.243 (0.64-2.42)	.52
Diagnostic testing recommended	1.734 (1.04-2.89)	.04
MRI	1.264 (0.61-2.63)	.53
EMG	0.564 (0.08-4.06)	.57
EEG	1.809 (0.57-5.74)	.32
Laboratory studies	2.693 (1.17-6.21)	.02
Ultrasound	2.607 (0.64-10.64)	.18
Other	3.929 (1.89-8.19)	<.001
Recommended test avoidance	0.593 (0.24-1.47)	.26
Recommended treatment	2.852 (1.79-4.54)	<.001
Time from RP order to e-consult completion, per 1 day	0.957 (0.88-1.04)	.30

EEG, electroencephalogram; EMG, electromyogram; FM, family medicine; IM, internal medicine; MRI, magnetic resonance imaging; RP, referring provider.

diagnoses with small numbers were underpowered. The e-consults in this study may be skewed toward more complex questions and problems relative to other community neurology practices because we also offer formalized curbside consultations, and such RP may have used the curbside option for straightforward questions.^{8,17} The population we studied was predominantly Caucasian and biased toward patients who have access to a primary care provider and her, which would allow them to read the neurologist's recommendations communicated by the RP.

An important topic not addressed in this study is patient satisfaction with e-consults and how it compares to patient experience with traditional face-to-face consultations.

TABLE 4. Summary of Case Examples of Risk of Harm and Best Practice Recommendations

Case	Symptom	Final diagnosis	Potential risk/harm	Pitfall	Theme	Best practice recommendation
1	Persistent limb sensory and motor syndrome	Myelopathy	Delayed diagnosis	Overreliance and “honoring” the RP judgment that e-consult is appropriate	Persistent neurologic symptoms with unclear diagnosis	Recommend and order/advice neurology care team to offer/schedule a face-to-face examination AND use e-consult to advise further work-up for RP to consider in the meantime
2	Frequent uncontrolled function limiting headache ^a	Long-term migraine	Delayed effective treatment and associated morbidity and disability	Overreliance on RP and care team to coordinate an effective individualized care plan that may include specialty specific treatments such as botulinum toxin	Chronic disabling condition that may benefit neurologic expertise	Offer short-term e-consult management recommendations AND arrange for a face-to-face visit
3	Right thoracic neuropathic patient and abdominal wall weakness and atrophy associate with shingles	Myelopathy due to cord compression due to mass	Delayed diagnosis	Overreliance on Occam razor	A comprehensive neurologic examination might have discovered signs of myelopathy and led to earlier spine MRI	Use the e-consult to potential expand a differential diagnosis and/or offer face-to-face evaluation to confirm neurologic examination
4	Recurrent seizure in a patient who initially preferred no antiseizure medication after a first seizure	Poststroke epilepsy	Delayed treatment with antiseizure medication	Overreliance of RP to fully inform patient of risks and benefits of a treatment and is commonly offered by a neurologist	Neurologist face-to-face discussion of risk and benefits of treatment may lead to better informed patients and medical decision	Carefully discuss risks and benefits of a treatment in the e-consult and offer to offer to arrange face-to-face visit when patients may benefit from more

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TABLE 4. Continued

Case	Symptom	Final diagnosis	Potential risk/harm	Pitfall	Theme	Best practice recommendation
						time and discussion to confirm patient understanding of the risk and benefits
5	Symptoms of a possible myelopathy in a cancer patient	Compressive myelopathy	Delayed diagnosis	Overreliance of RP to follow recommendation to order an important test in a higher-risk patient	Assuming electronic communication of important recommendations will occur	Telephone call to RP to enhance communication and collaboration; consider proxy order to RP to asking neurology care to communicate recommendation to patient
6	Episodic migraine presenting to ED ^a	Episodic migraine	Delayed effective therapy	E-consult recommendations not followed by the RP	Overreliance of RP to execute orders for recommended treatment	Consider sharing e-consult directly with patient and RP

^aCommon theme in more than 1 case.
MRI, magnetic resonance imaging; RP, referring provider.

We did not have a mechanism in place to account for patient complaints or dissatisfaction with neurology e-consults if present. In this study, only 28 of the 75 (37.3%) subsequent face-to-face neurology consultations were specifically recommended in the preceding e-consult. Although numerous demographic and clinical variables associated with increased risk of subsequent face-to-face consultations were found, the number of subsequent face-to-face neurology consultations due primarily to patient preference was not analyzed in this study. This could be a key factor in determining in which patients e-consults may not be appropriate or efficient. Further studies including evaluation of e-consults from the patients' perspective are needed.

Strengths

Strengths of the study include the comprehensive review of our mature and established e-consult practice and duration of follow-up. Neurologists performing this retrospective study reviewed all pertinent medical records and categorized the final diagnoses. The e-consults were only performed with local community patients referred from primary care providers, suggesting that the results may be generalizable to other community neurology practices that share an EHR with RP.

Implications for Practice

On the basis of our experience and the findings in this study, we recommend other neurology providers or groups strongly consider implementing e-consults into their practice. E-consults are an efficient use of time and resources particularly for patients with a clear or likely correct diagnosis and management questions. E-consults can improve triage for patients who would benefit most from face-to-face neurology expertise and aid in prioritizing downstream diagnostic testing, procedures, and surgical consultations. The comfort level of individual RP and neurologist used an e-consult will likely continue to vary, and for the safety and best care of patients, the neurologist should always start an e-consult by asking the question, "Would this patient be better managed in a face-to-face or video visit with the neurologist?" The practice should develop a practical and efficient way for the neurology team to assist with scheduling of face-to-face

consultations when recommended while using the e-consult to provide short-term focused advice to RP. On the basis of the findings in our practice, we now offer all patients with chronic headache/migraine a face-to-face or video visit to minimize potential delay in expert care for this common disabling condition. Finally, the neurology team should not feel obligated or limited to provider care only through e-consult and maintain the autonomy to recommend and arrange for a traditional face-to-face evaluation when the patient is willing and able to access such care.

CONCLUSION

E-consults can be an effective and time-efficient method for neurologists to provide clinical recommendations for patients unlikely to require face-to-face consultations for appropriate neurologic care. However, e-consults should be viewed by as a triage tool and the neurologist should not feel obligated to manage patient care solely through e-consult when it is felt a patient may benefit from a formal face-to-face consultation including a detailed neurologic examination. E-consult requests for patients with chronic migraine or chronic headache with unclear phenotype should be focused on short-term management recommendations and be combined with an offer to schedule face-to-face or telemedicine visit with a neurologist when feasible. Further studies evaluating patient satisfaction and associated out-of-pocket costs for patients are needed to ensure the benefits of e-consults are inclusive of patient perspective as well.

POTENTIAL COMPETING INTERESTS

The authors disclose no financial or personal relationships with other people or organizations that could inappropriately influence/bias their work.

Abbreviations and Acronyms: EHR, electronic health record; e-consult, electronic consultation; HR, hazard ratio; RP, referring provider

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REFERENCES

- Saxon DR, Kaboli PJ, Haraldsson B, Wilson C, Ohl M, Augustine MR. Growth of ELECTRONIC CONSULTATIONS IN THE Veterans Health Administration. *Am J Manag Care.* 2021;27(1):12-19.
- Whittington MD, Ho PM, Kirsh SR, et al. Cost savings associated with electronic specialty consultations. *Am J Manag Care.* 2021;27(1):e16-e23.
- Malik MT, Zand R, Vezendy SM, Newman E, Holland NR. Implementation and follow-up experience of an e-consult program in a rural neurology setting. *Neurol Clin Pract.* 2021;11(4):e430-e437.
- Liddy C, Rowan MS, Afkham A, Maranger J, Keely E. Building access to specialist care through e-consultation. *Open Med.* 2013;7(1):e1-e8.
- Larson A, Wheeler J. E-consult innovation: a middle-ground model to enhance adoption and improve care. *NEJM Catal.* 2020;1(6).
- Liddy C, Maranger J, Afkham A, Keely E. Ten steps to establishing an e-consultation service to improve access to specialist care. *Telemed J E Health.* 2013;19(12):982-990.
- Kass JS, Rose RV. Interprofessional internet consultations: the potential benefits and perils of eConsults. *Continuum (Minneapolis Minn).* 2021;27(6):1785-1789.
- Young NP, Elrashidi MY, Crane SJ, Ebbert JO. Pilot of integrated, colocated neurology in a primary care medical home. *J Eval Clin Pract.* 2017;23(3):548-553.
- Pecina JL, Frank JM, North F. A retrospective study on how primary care providers manage specialists' recommendations after an e-consultation. *SAGE Open Med.* 2016;4:2050312116682127.
- Lee MS, Ray KN, Mehrotra A, Giboney P, Yee HF, Barnett ML. Primary care practitioners' perceptions of electronic consult systems: a qualitative analysis. *JAMA Intern Med.* 2018;178(6):782-789.
- Lee M, Leonard C, Greene P, et al. Perspectives of VA primary care clinicians toward electronic consultation-related workload burden: a qualitative analysis. *JAMA Netw Open.* 2020;3(10):e2018104.
- North F, Uthke LD, Tulledge-Scheitel SM. Integration of e-consultations into the outpatient care process at a tertiary medical centre. *J Telemed Telecare.* 2014;20(4):221-229.
- Bradi A, Sitwell L, Liddy C, Afkham A, Keely E. *Ask a Neurologist: What Primary Care Providers Want to Know, and the Potential for Reducing Referrals Through eConsults.* AAN Enterprises; 2017: 184.
- Vimalananda VG, Orlander JD, Afable MK, et al. Electronic consultations (E-consults) and their outcomes: a systematic review. *J Am Med Inform Assoc.* 2020;27(3):471-479.
- Harris PA, Taylor R, Thielke R, Payne J, Gonzalez N, Conde JG. Research electronic data capture (REDCap)—a metadata-driven methodology and workflow process for providing translational research informatics support. *J Biomed Inform.* 2009;42(2):377-381.
- Headache Classification Committee of the International Headache Society (IHS). The International Classification of Headache Disorders, 3rd edition. *Cephalalgia.* 2018;38(1):1-211.
- Robblee J, Starling AJ. E-consultation in headache medicine: a quality improvement pilot study. *Headache.* 2020;60(10):2192-2201.
- Rajan KB, Weuve J, Barnes LL, McAninch EA, Wilson RS, Evans DA. Population estimate of people with clinical Alzheimer's disease and mild cognitive impairment in the United States (2020-2060). *Alzheimers Dement.* 2021;17(12):1966-1975.
- van Dyck CH, Swanson CJ, Aisen P, et al. Lecanemab in early Alzheimer's disease. *N Engl J Med.* 2023;388(1):9-21.
- Larkin HD. Lecanemab gains FDA approval for early Alzheimer disease. *JAMA.* 2023;329(5):363.