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AANEM QUALITY MEASURE

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Quality measures in electrodiagnosis: Carpal tunnel syndrome—An AANEM Quality Measure Set

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Abstract

Carpal tunnel syndrome (CTS) is a common neuromuscular condition and a major cause of work-related disability. As healthcare in the United States transitions toward a value-based system from fee-for-service, quality measures assume importance in the evaluation of care provided. This report from the American Association of Neuromuscular & Electrodiagnostic Medicine Quality Improvement Committee provides an introduction to quality measures and outlines a quality measurement set for the electrodiagnosis of CTS. The measures attempt to standardize technical requirements for electrodiagnostic (EDX) studies of CTS, the criteria for diagnosing median neuropathy at the wrist and assessing its severity, and the role of operative EDX testing. The assumption is that implementation of these measures will improve the accuracy of CTS diagnosis when EDX is performed, help exclude mimics, and, therefore, improve care of patients with CTS with the ultimate goal of improving outcomes. Postimplementation assessment of outcomes will refine these measures.

KEYWORDS

carpal tunnel syndrome, electrodiagnosis, process measures, quality measures, quality of care

1 | INTRODUCTION

Healthcare reform in the United States is shifting rapidly from traditional fee-for-service models to value-based payment models.[1,2] Value is defined as healthcare outcomes achieved per dollar spent.[3] The Centers for Medicare and Medicaid Services (CMS) implemented the Quality Payment Program (QPP) as a steady transition to value-based programs after the Medicare Access and CHIP Reauthorization Act was signed into law in 2015, although the stage for this transition was set by the Affordable Care Act of 2010.[4] The reporting of performance on quality measures is an integral part of the QPP, and clinician payments are linked to the ability to demonstrate adherence to quality measures. Quality measures are tools for evaluating healthcare outcomes, care processes, patient perceptions, or organizational systems of care. Quality measures for neuromuscular medicine have been developed for amyotrophic lateral sclerosis,[5] distal symmetric polyneuropathy,[6] muscular dystrophy,[7] imaging of low back pain, pain assessment, and fall-risk management.[8]

Carpal tunnel syndrome (CTS) is the most common entrapment neuropathy and a major cause of work-related disability.[9,10] It is a high-impact condition because it is frequent and affects both job performance and quality of life,[10] and, as a result, interventions to diagnose and treat it substantially affect healthcare expenditures. In 2010,

Abbreviations: AAN, American Academy of Neurology; AANEM, American Association of Neuromuscular & Electrodiagnostic Medicine; CI, confidence interval; CMS, Centers for Medicare and Medicaid Services; CTR, carpal tunnel release; CTS, carpal tunnel syndrome; EDX, electrodiagnostic; NCS, nerve conduction study; QPP, Quality Payment Program.

Sandin and colleagues[11] used the RAND-UCLA Appropriateness method of formal consensus to develop quality measures for electrodiagnosis of CTS. In 2017, the Quality Improvement Committee of the American Association of Neuromuscular & Electrodiagnostic Medicine (AANEM; Appendix) was charged with refining these measures for potential application in quality measurement programs such as QPP.

Quality measures consist of a numerator and a denominator. When quality measures focus on care processes, the numerator represents the number of times that care adhered to evidence- or consensus-based recommendations (something was performed "correctly"), and the denominator represents the number of times that care was eligible for evaluation (something could have been performed "correctly"). Performance on a quality measure is often compared between organizations or physicians or against a defined benchmark. An example of a measure from the muscular dystrophy quality measure set[7] developed by the American Academy of Neurology (AAN) is

> Patients with muscular dystrophy who had cardiac status evaluation ordered during outpatient evaluation "over" all patients with muscular dystrophy undergoing outpatient evaluation in a year

To account for circumstances when the measure cannot be performed, denominator exclusions and exceptions are defined to narrow the denominator. For instance, a patient with an undefined myopathy should be excluded from the denominator when calculating proportions in the above measure. Exceptions refer to situations when the numerator criteria are not met because of certain factors during measurement. For example, a medical exception would be a phenotype of muscular dystrophy that is not associated with cardiac involvement, and, hence, ordering a cardiac evaluation is not necessary. A patient exception may be applied when the patient declines testing. A third type of exception is a systems exception, such as insurance not covering the evaluation or the test being unavailable.

Here we present the development process of quality measures for the electrodiagnosis of CTS. The overall theme of this work is to establish technical requirements for performance of an electrodiagnostic (EDX) study for CTS, standardize EDX criteria for the diagnosis of median neuropathy at the wrist, and clarify the role of preoperative EDX testing. In the absence of an ideal EDX (nerve conduction studies [NCS] and needle electromyography) reference standard for CTS, these efforts attempt to identify and standardize the best available EDX methods for confirming median neuropathy at the wrist. The intent of this measure set is not to suggest that EDX is a required part of the evaluation of patients with suspected CTS. Rather, the objective is to reduce practice variation and ensure accurate diagnosis by standardizing the EDX evaluation. The assumption is that high-quality, standardized testing will improve diagnostic accuracy, exclude mimics, and inform the selection of appropriate treatments with better outcomes.[12]

2 | BACKGROUND

2.1 | Prevalence of CTS

The incidence of CTS adjusted to the 2000 US population is 376 per 100 000 person-years and 491 and 258 per 100 000 person-years for women and men, respectively.[13] For a clinical definition, lifetime prevalence of CTS among workers approximates 6.7%, with a 12-month prevalence of 3.1%. An estimated 4.8 million workers in the United States have CTS, of which 67.1% of cases are work related.[10]

2.2 | Challenges in the symptom-based diagnosis of CTS

The lack of a reference standard for CTS hinders the accurate estimation of prevalence, which varies depending on the reference standard used: symptoms, clinical examination, or EDX evidence for median neuropathy at the wrist. In a study of 262 patients with symptoms suggestive of CTS,[14] the population prevalence of numbness/tingling in the median distribution was 14.4% (95% confidence interval [CI], 13–15.8). The prevalence of clinically certain CTS (symptoms plus examination findings) was 3.8% (95% CI 3.1–4.6). The prevalence of CTS with EDX confirmation was 2.7% (CI 2.1–3.4). This study concluded that one in five symptomatic patients would be expected to have CTS on the basis of clinical examination and EDX testing and reaffirmed the relevance of EDX studies in symptom-based classification.

2.3 | Impact of appropriate diagnosis and care of CTS on health-related quality of life

In a prospective observational study of adults with a diagnosis of CTS, physician adherence to recommended care processes (80th vs 20th percentile for adherence) was associated with greater improvements in symptom severity, functional status, and overall quality of life. Symptom improvement occurred when physicians assessed and managed activity, patients underwent necessary surgery, and employers adjusted job tasks.[15]

2.4 | Disparities in CTS care and costs of care of CTS

Carpal tunnel syndrome is often work-related, particularly in jobs with high hand/wrist exposure and is a major cause of workers' compensation claims. Annually, more than 500 000 carpal tunnel release procedures (CTR) are performed in the United States, with an associated cost of $2 billion dollars and additional productivity losses because of CTS.[16,17]

At an integrated healthcare system that assumes responsibility for costs and quality measures by contracting with worker's compensation payers, a prospective observational study demonstrated that, despite 82% adherence to quality measures, important care recommendations were overlooked, particularly monitoring of symptoms,

modifying work status, and modifying exacerbating activities. In addition, there were modest disparities in quality of care by income. No significant disparities attributed to age, sex, or race/ethnicity were noted.[18]

3 | METHODS

The committee focused on gaps in care to identify opportunities for improvement and reviewed available clinical evidence. No high-level

TABLE 1 CTS Quality Measures

Measure No.	Measure Description	Numerator	Denominator	Measure exceptions
1a	Percentage of patients referred for EDX evaluation of CTS who had adequate NCS performed	All patients with suspected CTS who had adequate EDX studies, as defined in measure description	All patients with suspected CTS who underwent EDX studies	Patient exception: study stopped at patient's request System exception: power failure, communication barrier Medical exception: EDX physician recognizes an alternative diagnosis
1b	Percentage of EDX studies on patients referred for evaluation of CTS in whom hand temperature was maintained at or above 32°C	EDX studies for suspected CTS when hand temperature was maintained at or above 32°C	All EDX studies for suspected CTS	Patient exception: documented inability to maintain hand temperature despite reasonable attempts at warming
2a	Percentage of EDX reports that provide a diagnosis of median neuropathy at the wrist which describe EDX data supporting the diagnosis as defined[a]	EDX reports that are consistent with median neuropathy at the wrist that describe EDX findings/data supporting this diagnosis	All EDX reports that are consistent with a diagnosis of median neuropathy at the wrist	Medical exception: EDX reports that do not pertain to a median neuropathy at the wrist (ie, EDX reports for other diagnoses Patient exception: study stopped before completion at patient's request System exception: power failure during EDX, communication barrier
2b	Percentage of EDX reports consistent with severe median neuropathy at the wrist that describe data supporting this diagnosis as defined[a]	EDX reports diagnosing severe median neuropathy at the wrist that describe EDX findings/data supporting this diagnosis	All EDX reports diagnosing severe median neuropathy at the wrist	Medical exception: EDX reports that do not pertain to median neuropathy at the wrist (ie, EDX reports for other diagnoses) Patient exception: study stopped before completion at patient's request System exception: power failure during EDX, communication barrier
3	Percentage of patients undergoing surgery for CTS who had EDX testing within 12 mo prior to surgery	No. of patients with CTS undergoing carpal tunnel release who had EDX performed within 12 months prior to surgery	All patients with CTS who underwent carpal tunnel release	Medical exception: alternative confirmative test performed (ultrasound/MRI) Patient exception: declined EDX testing System exception: EDX testing not available, insurance coverage

Abbreviations: CTS, carpal tunnel syndrome; EDX, electrodiagnostic; NCS nerve conduction study.
[a]See Appendix S1 for aditional details.

evidence (large prospective cohort studies or evidence-based guidelines on standardized EDX testing for CTS) was available. Process, outcome, practitioner-level, and system-level measures were considered, according to the AAN Quality and Safety Subcommittee manual for measure development.[19] The measures developed previously were refined for application to both non-occupational and occupational CTS.[20] Each measure was weighed against the six aims of healthcare improvement recommended by the National Academy of Medicine.[21] Table 1 and Appendix SA detail the measurement set, topic importance, and desired outcomes. The measure set was posted for public comments on the AANEM website, and AANEM members and stakeholder organizations were contacted by email requesting comments. Sixteen comments were received, and minor changes were made to the original measure set (Appendix SB).

4 | MEASURES AND RATIONALE

4.1 | Measure 1a: Essential components of EDX evaluation for median neuropathy at the wrist

1. Electrodiagnostic testing augments the clinical diagnosis of patients with CTS symptoms. It is an objective and quantitative means to assess nerve function with good sensitivity and specificity.[22,23]
2. Adequate and accurate NCSs are important for diagnosis of CTS, particularly when CTR is considered. Approximately 10% to 15% of CTR patients have an unsatisfactory result, often because of incorrect diagnosis.[24,25]
3. The minimum requirements for the EDX evaluation of CTS outlined in the AANEM Practice Parameters and in Clinical Quality Measures published by the Carpal Tunnel Quality Group are testing of median sensory latency, testing of median distal motor latency, another sensory and motor nerve study in the same extremity, and, if these results are normal, followed by comparison short segment studies.[11,22]

4.2 | Measure 1b: Hand temperature measured and maintained during EDX testing

Nerve conduction studies are susceptible to technical factors that affect the evoked responses. Low temperatures increase sensory response amplitudes and compound motor action potential duration, prolongs latencies, and reduces conduction velocities. The use of correction factors for temperature does not accurately normalize data from cool limbs.[26] Although maintaining limb temperature throughout an EDX test is potentially time consuming, it is necessary to avoid false positive EDX results and misdiagnosis of median neuropathy at the wrist.

4.3 | Measure 2a: EDX criteria for diagnosing median neuropathy at the wrist

1. Diagnosis of carpal tunnel syndrome is often based on history and physical examination, with EDX studies performed adjunctively. Electrodiagnostic testing is valuable to confirm median neuropathy at the wrist, assess severity and evaluate axonal loss, identify conditions that coexist with or mimic CTS such as cervical radiculopathy, and investigate potential reasons for poor outcomes after CTR.
2. The AANEM practice parameter for EDX in CTS and the Normative Data Task Force outline EDX studies and reference values that are considered standard of care in patients with clinical suspicion of CTS. These studies are valid and reproducible in confirming median neuropathy at the wrist with a high degree of sensitivity (>85%) and specificity (95%).[11,22,27]

4.4 | Measure 2b: EDX criteria for diagnosing severe median neuropathy at the wrist

1. Electrodiagnostic criteria for severity of median neuropathy at the wrist are defined in the AANEM minimonograph "The Electrodiagnosis of Carpal Tunnel Syndrome."[28]
2. The severity of median neuropathy informs treatment options and prognosis. Severe axonal loss requires urgent surgery to preserve remaining function and suggests incomplete recovery after surgery.

4.5 | Measure 3: Preoperative EDX testing for CTS

Electrodiagnostic testing confirms the diagnosis of median neuropathy at the wrist, evaluates its severity, determines its pathophysiology (axon loss vs demyelination), and excludes cervical radiculopathy and coincidental ulnar nerve disease or polyneuropathy. In a retrospective case series, EDX testing led to identification of an alternative diagnosis (polyneuropathy, radiculopathy, motor neuron disease, spondylotic myelopathy, syringomyelia, and multiple sclerosis) in 12 patients undergoing CTR without resolution of symptoms. Review of operative EDX studies in 11 patients revealed errors in either the performance or the interpretation.[29] This measure evaluates the proportion of patients with CTS who did not have EDX or other studies, such as MRI of the wrist, ultrasound, or other tests, prior to CTR.

5 | DISCUSSION

The development of these quality measures for EDX of CTS is a first step in EDX quality measures. Carpal tunnel syndrome was chosen for this project because of its high prevalence and because EDX studies are most frequently performed for CTS. The three main types of quality measures assess structure, processes or care, and outcomes resulting from care.[30] Although stakeholders may prefer outcome measurements in which the direct result of care processes can be measured, measuring improvement in clinical status is complex, and there is a time lag between care and outcomes. Process measures are more straightforward, without substantial time lag, and often used as a surrogate to outcomes. These CTS measures are process measures, with the expectation that appropriate EDX will lead to appropriate

treatment without underuse, overuse, or misuse, and, therefore, will result in better outcomes. However, this "dot connecting" is implicit, and may or may not be achieved. This is a limitation of process measures in general.

A challenge with the CTS EDX measures is their implementation in clinical practice and the ability to use them for reporting purposes such as in the QPP. Reporting mechanisms for measures may be through claims, registries, or by attestation on the CMS website. Registries that report to CMS use data that can be easily collected from the electronic health record, usually available in discrete fields. Electrodiagnostic data are granular and buried in narrative reports and do not lend themselves easily to discrete field formatting. Hence, accessing and submitting these data for programs such as QPP remain difficult. However, this work represents an important step in quantitating the value of EDX measures. The performance of these measures after implementation will provide insights into gaps in care of EDX testing for CTS and help to close these gaps in an ongoing cycle of quality improvement.

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CONFLICT OF INTEREST

The authors declare no conflicts of interest related to this report.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of this article.

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APPENDIX: LIST OF QUALITY MEASURE SUBCOMMITTEE MEMBERS

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