

Has the Use of Electrodiagnostic Studies for Carpal Tunnel Syndrome Changed After the 2016 American Academy of Orthopaedic Surgeons Clinical Practice Guideline?

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Purpose A 2016 American Academy of Orthopaedic Surgeons (AAOS) clinical practice guideline (CPG) de-emphasized the need for electrodiagnostic studies (EDS) for carpal tunnel syndrome (CTS). We tested the hypothesis that use of EDS decreased after the AAOS CPG.

Methods Using a national administrative claims database, we measured the proportion of patients with a diagnosis of CTS who underwent EDS within 1 year after diagnosis between 2011 and 2019. Using an interrupted time series design, we defined 2 time periods (pre-CPG and post-CPG) and compared EDS usage between the periods using segmented regression analysis. We conducted a subgroup analysis of preoperative EDS usage in patients who underwent carpal tunnel release.

Results Of 2,081,829 patients with CTS, 315,449 (15.2%) underwent EDS within 1 year after diagnosis. The segmented regression analysis showed a decrease in the level of EDS usage after publication of the AAOS CPG (−11.50 per 1,000 patients [95% CI, −1.47 to −0.95 per 1,000 patients]); however, the rate of EDS usage increased in the post-CPG period (+1.75 per 1,000 patients per quarter [95% CI, 0.97–2.54 per 1,000 patients per quarter]). Of 473,753 eligible patients who underwent carpal tunnel release, 139,186 (29.4%) underwent EDS within 6 months before surgery. After publication of the AAOS CPG, preoperative EDS usage decreased by −23.57 per 1,000 patients (95% CI, −37.72 to −9.42 per 1,000 patients). However, these decreasing trends in EDS usage predated the 2016 AAOS CPG.

Conclusions The overall and preoperative EDS usage for CTS has been decreasing since at least 2014, predating the 2016 AAOS CPG, reflecting the rapid implementation of evidence into practice. However, EDS usage has increased in the post-CPG period, and a considerable proportion of patients who underwent carpal tunnel release still received EDS.

Clinical relevance Given its high costs and disputed value, routine EDS usage should be considered for further deimplementation initiatives. (*J Hand Surg Am.* 2023;48(1):19–27.

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Key words Carpal tunnel syndrome, clinical practice guidelines, electromyography, evidence-based medicine, nerve conduction study.



LOW-VALUE TESTING RESULTS in care cascades, leading to unnecessary and invasive procedures in addition to increasing costs. For example, low-value preoperative tests were obtained before almost 50% of annual cataract procedures at the Veterans' Administration.¹ These low-value tests result in avoidable care cascades, which can result in total preventable costs that exceed the direct costs of the tests themselves by a factor of more than 10-fold.² Low-value testing, including electrocardiography and unnecessary laboratory tests, has also been demonstrated in 50% of carpal tunnel release (CTR) cases in the Veterans' Administration population.³ The persistence of low-value testing despite calls for deimplementation has led to the recognition of unique barriers to the deimplementation of established practices, including psychological biases, lack of understanding of its drivers, fear of litigation, and poor incentives to change.^{4–6} For carpal tunnel syndrome (CTS), some insurance payers may require preoperative electrodiagnostic studies, which may result in the undertreatment of false negatives and overtreatment of false positives.⁷ Additionally, deimplementation is often challenging, in part, because of resistance by specialist societies.⁸

The utility of routine electrodiagnostic studies to confirm the diagnosis of CTS is limited. Carpal tunnel syndrome is primarily a clinical diagnosis based on history and physical examination, and electrodiagnostic studies (EDS) should be reserved for uncertain or atypical cases.^{9,10} Recent evidence has shown that EDS has limited clinical utility for most patients, who can be diagnosed with CTS on the basis of history and physical examination alone.^{10–12} A study showed that the probability of CTS changed only slightly after EDS in patients with a high pretest probability (≥ 0.80) of CTS based on history and physical examination, whereas larger changes in probability were achieved after EDS in patients with a low pretest probability (≤ 0.50).¹¹ Another study found that EDS findings changed the CTS treatment plan in fewer than 20% of cases, and the plan for operative treatment decreased in 9% of cases.¹² Although the use of EDS may lead to changes in management for a minority of patients, EDS itself

increases patient costs by almost \$600 and accounts for 45% of the preoperative cost in patients undergoing CTR.¹³ In another study, preoperative EDS resulted in a 2-month delay in surgery and almost \$1,000 in additional costs.¹⁴ In 2010, the American Academy of Orthopaedic Surgeons (AAOS) released a clinical practice guideline (CPG) stating that physicians “should obtain electrodiagnostic tests if clinical and/or provocative tests are positive and surgical management is being considered.”¹⁵ However, this CPG was updated in 2016, in which this provision was removed and, instead, the CPG stated, “diagnostic questionnaires and/or electrodiagnostic studies could be used to aid the diagnosis of CTS.”⁹ These updates represent efforts to provide a more nuanced understanding of the role of EDS in the diagnosis of CTS.

Given the challenges of deimplementation of established practices, the implementation of evidence on EDS usage in the diagnosis of CTS merits further study. In a recent survey of hand surgeons, 26% of those surveyed still required EDS before evaluating a patient with CTS symptoms and 55% of surgeons required EDS most of the time in a patient with classic CTS symptoms, suggesting that routine use of EDS may still be widespread.¹⁶ Although these results provide valuable insights into self-reported surgeon practices, further evaluation of actual EDS usage at the population level is warranted. In this study, we test the hypothesis that population-level EDS usage for the diagnosis of CTS and preoperative EDS usage decreased after the 2016 AAOS CPG.

METHODS

Data source and cohort creation

Ethical approval for this study was waived by the Stanford University Institutional Review Board. This work was performed at Stanford University, Redwood City, CA, USA. We used the PearlDiver Mariner Patient Claims Database (PearlDiver Technologies) consisting of administrative records from more than 91 million insured individuals from 2010 to 2020. We identified all patients with a diagnosis of CTS using International Classification of Diseases

TABLE 1. Summary of Codes

Description	ICD-9/10 or CPT Codes
Carpal tunnel syndrome	ICD-9-354.0, ICD-10-G56.00, ICD-10-G56.01, ICD-10-G56.02, ICD-10-G56.03
Electrodiagnostic studies	CPT-95860, CPT-95861, CPT-95863, CPT-95864, CPT-95870, CPT-95872, CPT-95900, CPT-95903, CPT-95904, CPT-95905, CPT-95907, CPT-95908, CPT-95909, CPT-95910, CPT-95911, CPT-95912, CPT-95913, CPT-95934, CPT-95936, CPT-95937
Carpal tunnel release	CPT-29848, CPT-64721

CPT, Current Procedural Terminology; ICD-9/10, International Classification of Diseases, Ninth or Tenth Revision.

diagnostic codes 354.0 (International Classification of Diseases, Ninth Revision) and G56.00, G56.01, G56.02, or G56.03 (International Classification of Diseases, Tenth Revision) (Table 1). In patients with bilateral CTS, only the initial diagnosis was considered. To accurately capture comorbidity and outcome data, we required all patients to be continuously enrolled in the database for at least 12 months before and after the initial diagnosis. This resulted in the inclusion of patients from the first quarter of 2011 (2011Q1) through 2019Q4 in the primary analysis. To exclude patients with acute CTS, we excluded patients with concomitant distal radius fractures, wrist dislocations, or compartment syndrome within 1 week before CTS diagnosis. We also excluded patients with cubital tunnel syndrome or cervical radiculopathy within 1 year before diagnosis (Table S1, available online on the *Journal's* website at www.jhandsurg.org). We only included patients with complete demographic data who were aged ≥ 18 years at diagnosis. Only private, Medicare Advantage, and Medicaid managed care plans were included. Other governmental plans and cash payments were excluded. Figure 1 shows a flow diagram of cohort creation.

We identified patients who underwent EDS, defined as electromyography or nerve conduction studies, using their respective Current Procedural Terminology codes (Table 1). We only included EDS performed within 1 year after a diagnosis code for CTS appeared in the patient record to select cases in which CTS was already likely, and thus, EDS was more likely of lower value. We assumed that the EDS that was captured using this methodology was related to CTS. We conducted a subgroup analysis in which the proportion of patients undergoing CTR who underwent EDS within 6 months before the surgery was measured, as defined using Current Procedural Terminology codes (Table 1). This was defined as preoperative EDS usage. The same inclusion criteria were used to define the CTR cohort, with the

exception that the continuous enrollment period encompassed the index CTR and the 6 months before the surgery. We then performed sensitivity analyses in which we modified our definition of overall and preoperative EDS usage to include EDS performed within 1 year before any CTS diagnosis or CTR procedure, respectively.

Variables

The primary outcome variable was whether a patient underwent EDS within 1 year after diagnosis. Demographic data were characterized, including age, sex, insurance plan, region, year of diagnosis, and Elixhauser comorbidity scores. The proportion of patients undergoing CTR within 1 year after CTS diagnosis was also measured as a secondary outcome in the primary analysis.

Statistical analysis

Categorical variables were reported as frequencies and evaluated using chi-square tests. Elixhauser comorbidity scores were reported as mean (SD) and compared using Mann-Whitney U tests. We plotted EDS usage, defined as the number of patients who underwent EDS per 1,000 patients diagnosed with CTS or undergoing CTR, on a quarterly basis throughout the study period. We divided the data into 2 distinct periods: pre-CPG (2011Q1–2016Q4) and post-CPG (2017Q1–2019Q4). We chose 2016Q4 as the segmentation point, corresponding to the publication of the AAOS CPG.⁹ We evaluated the differences in EDS usage between these periods using segmented regression analysis. We allowed for changes in slope (rate of use) and intercept (level of use) between the periods. A linear model was specified in the following form: $y = \beta_0 + \beta_{\text{pre}} \times t_{\text{pre}} + \beta_{\text{post-CPG}} \times D_{\text{CPG}} + \beta_{\text{post}} \times t_{\text{post}}$, where t_{pre} represents the period since the first quarter in the study, D_{CPG} represents a post-CPG indicator (binary), and t_{post} represents the period since the first quarter in the post-CPG period. The coefficient β_0 represents the

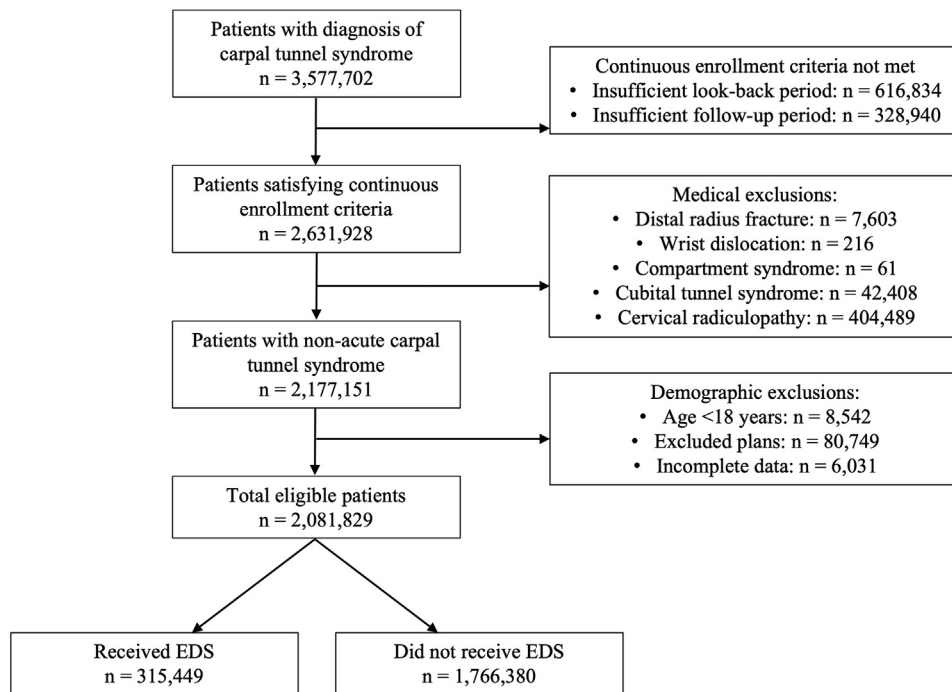


FIGURE 1: Flowchart of cohort creation.

EDS usage level at baseline, β_{pre} represents the EDS usage rate in the pre-CPG period, β_{CPG} represents the change in the EDS usage level from the pre-CPG to the post-CPG period, and β_{post} represents the change in the EDS usage rate in the post-CPG period. The level of EDS usage was defined as the number of patients who underwent EDS per 1,000 patients diagnosed with CTS, and the EDS usage rate was defined as the number of patients who underwent EDS per 1,000 patients diagnosed with CTS per quarter. As is standard for interrupted time series designs, this model assumed that population characteristics do not vary over time.

We then constructed a separate model, assuming more gradual changes in evidence adoption. We modeled 3 distinct periods, allowing for changes in the slope between the periods: post-2010 CPG to 2013Q4, 2014Q1–2016Q4, and post-2016 CPG. The 2014Q1–2016Q4 period was chosen empirically by visual inspection. A linear model was specified in the following form: $y = \beta_0 + \beta_{\text{post-2010 CPG}} \times t_{\text{post-2010 CPG}} + \beta_{2014-2016} \times t_{2014-2016} + \beta_{\text{post-2016 CPG}} \times t_{\text{post-2016 CPG}}$, where $t_{\text{post-2010 CPG}}$ represents the period since the first month in the study, $t_{2014-2016}$ represents the period since the first month in the 2014–2016 era, and $t_{\text{post-2016 CPG}}$ represents the period since the first month in the post-2016 CPG era. The coefficient $\beta_{\text{post-2010 CPG}}$ represents the EDS utilization rate in the post-2010 CPG–2013Q4

period, $\beta_{2014-2016}$ represents the change in the EDS utilization rate in the 2014Q1–2016Q4 period, and $\beta_{\text{post-2016 CPG}}$ represents the change in the EDS utilization rate in the post-2016 CPG period. Statistical significance was defined *a priori* as $P < .05$.

RESULTS

We identified a total of 2,081,829 eligible patients with CTS, of whom 315,449 (15.2%) underwent EDS within 1 year after CTS diagnosis. The demographics of these cohorts are shown (Table 2). The cohorts differed by age, sex, insurance plan, region, and Elixhauser comorbidity scores (these differences may not be clinically relevant). The mean (SD) patient-level reimbursement for EDS was \$481.90 (\$583.40). Of the claims corresponding to an initial CTS diagnosis, 510,363 (24.5%) were from primary care specialists (internal medicine, geriatrics, family practice, or general practice), 176,025 (8.5%) were from hand surgery specialists, 230,488 (11.1%) were from orthopedic surgery (nonhand) specialists, 272,584 (13.1%) were from neurology specialists, 113,866 (5.5%) were from physical medicine and rehabilitation specialists, 42,307 (2.0%) were from rheumatology specialists, and 335,738 (16.1%) were from other specialties. The remainder of the claims had no documented specialty. There was a higher incidence of CTR in patients who underwent EDS

TABLE 2. Demographics of Cohorts by EDS Usage

Demographic	No EDS (n = 1,766,380)	EDS (n = 315,449)	P Value
Age, n (%)			
<35 years	188,266 (10.7)	30,569 (9.7)	<.001
35–44 years	249,901 (14.1)	46,667 (14.8)	
45–54 years	383,255 (21.7)	74,107 (23.5)	
55–64 years	412,690 (23.4)	77,234 (24.5)	
≥65 years	532,268 (30.1)	86,872 (27.5)	
Sex, n (%)			
Men	582,186 (33.0)	102,838 (32.6)	<.001
Women	1,184,194 (67.0)	212,611 (67.4)	
Insurance plan, n (%)			
Commercial	1,315,541 (74.5)	242,858 (77.0)	<.001
Medicare*	320,416 (18.1)	49,669 (15.7)	
Medicaid*	130,423 (7.4)	22,922 (7.3)	
Region, n (%)			
Northeast	415,211 (23.5)	90,246 (28.6)	<.001
South	668,625 (37.9)	112,052 (35.5)	
Midwest	446,183 (25.3)	79,767 (25.3)	
West	236,361 (13.4)	33,384 (10.6)	
ECI, mean (SD)	3.28 (2.97)	3.68 (3.12)	<.001
Underwent CTR, n (%)	229,015 (13.0)	81,485 (25.8)	<.001

ECI, Elixhauser comorbidity index; EDS, electrodiagnostic study.

*Managed care plans. Percentages may not sum to 100% because of rounding.

than in those who did not ($P < .001$) (Table 2). Electrodiagnostic study usage in the pre-CPG and post-CPG periods is shown in Figure 2A. The mean EDS usage in the pre-CPG period was 158 per 1,000 patients diagnosed with CTS, compared with 136 per 1,000 patients diagnosed with CTS in the post-CPG period. Overall, EDS usage seems to have been decreasing since at least 2014 (Fig. 2A).

The segmented regression analysis showed a decreasing rate of EDS usage in the pre-CPG period (-1.21 per 1,000 patients diagnosed with CTS per quarter), a decrease in EDS usage after the CPG publication (-11.50 per 1,000 patients diagnosed with CTS), and an increasing rate of EDS usage in the post-CPG period ($+1.75$ per 1,000 patients diagnosed with CTS per quarter) (Table 3). In 2019Q4, EDS usage was 143 per 1,000 patients diagnosed with CTS, which was still lower than that in any pre-CPG quarter. In a sensitivity analysis in which we measured the proportion of patients undergoing EDS within 1 year before (as opposed to after) CTS diagnosis, 81,076 of the 2,081,829 (3.9%) patients underwent EDS, indicating that most patients who underwent EDS did so after the diagnosis of

CTS appeared in the record. The sensitivity analysis showed no change in the EDS usage level after the publication of the 2016 CPG; however, EDS usage decreased before the 2016 CPG (-0.40 per 1,000 patients diagnosed with CTS per quarter) and increased ($+0.79$ per 1,000 patients diagnosed with CTS per quarter) in the post-CPG period (Table S2 and Fig. S1, available online on the *Journal's* website at www.jhandsurg.org).

In the CTR subgroup analysis, we found that 139,186 (29.4%) of 473,753 patients underwent EDS within 6 months before surgery. Electrodiagnostic study usage in each period is shown in Figure 2B. In the segmented regression analysis, we found that the EDS usage level decreased by 23.57 per 1,000 patients undergoing CTR after the CPG publication (Table 4). The results were similar when preoperative EDS usage was defined as EDS within 1 year before CTR, with an overall preoperative EDS usage of 145,785 (32.9%) of 443,631 (Table S3 and Fig. S1, available online on the *Journal's* website at www.jhandsurg.org).

Finally, because EDS usage seemed to be decreasing before the publication of the 2016 AAOS

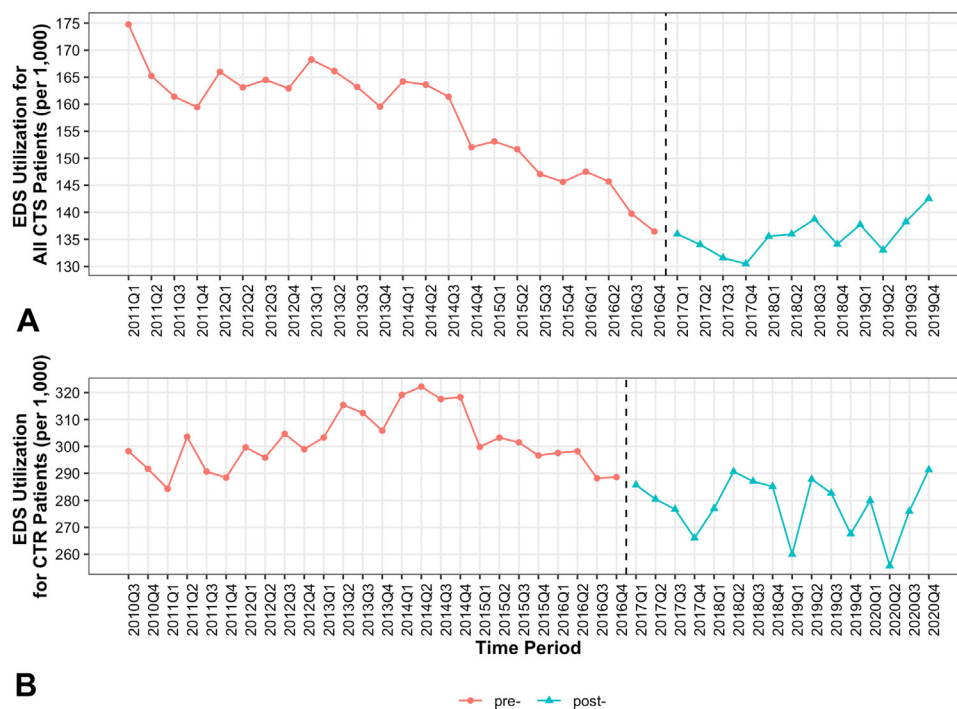


FIGURE 2: Usage of electrodiagnostic studies **A** for CTS diagnosis or **B** before CTR.

TABLE 3. Segmented Regression Analysis of Interrupted Time Series for EDS Usage After CTS Diagnosis

Variable	Coefficient	95% CI	P Value
β_0 , baseline EDS usage level (per 1,000 patients diagnosed with CTS)	172.78	169.06 to 176.49	<.001
β_{pre} , pre-CPG trend in EDS usage (per 1,000 patients diagnosed with CTS per quarter)	-1.21	-1.47 to -0.95	<.001
β_{CPG} , change in the EDS usage level from the pre-CPG to post-CPG period (per 1,000 patients diagnosed with CTS)	-11.50	-17.95 to -5.05	<.001
β_{post} , change in the EDS usage trend from the pre-CPG to post-CPG period (per 1,000 patients diagnosed with CTS per quarter)	1.75	0.97 to 2.54	<.001

TABLE 4. Segmented Regression Analysis of Interrupted Time Series for Preoperative EDS Usage

Variable	Coefficient	95% CI	P Value
β_0 , baseline EDS utilization level (per 1,000 patients undergoing CTR)	298.95	290.13 to 307.76	<.001
β_{pre} , pre-CPG trend in EDS utilization (per 1,000 patients undergoing CTR per quarter)	0.20	-0.37 to 0.78	.47
β_{CPG} , change in the EDS utilization level from pre-CPG to post-CPG (per 1,000 patients undergoing CTR)	-23.57	-37.72 to -9.42	.002
β_{post} , change in the EDS utilization trend post-CPG (per 1,000 patients undergoing CTR per quarter)	-0.51	-1.83 to 0.80	.44

CPG, we constructed a separate model that allowed for gradual changes in EDS usage in 3 empirically chosen periods: post-2010 CPG to 2013Q4, 2014Q1–2016Q4, and post-2016 CPG (Fig. S2,

available online on the *Journal's* website at www.jhandsurg.org). The segmented regression analysis showed that the rate of EDS usage was decreasing in the 2014–2016 period before the publication of the

2016 CPG and has been increasing in the post-2016 CPG period (Table S4). Further, the rate of preoperative EDS usage increased in the period after the 2010 AAOS CPG to 2013Q4 before decreasing from 2014 to 2016 and increasing in the post-2016 AAOS CPG period (Table S4).

DISCUSSION

In this population-level study, we showed that although overall EDS usage was lower in the post-2016 CPG period than in the pre-2016 CPG period, this decreasing trend predated the publication of the AAOS CPG. In patients undergoing CTR, EDS usage increased after the publication of the 2010 AAOS CPG and also exhibited a decreasing trend that predated the publication of the 2016 AAOS CPG. These data suggest that physicians were already implementing the evidence on which the 2016 AAOS CPG was based, into practice before the official CPG recommendations. Nevertheless, given the increasing rate of EDS usage in the post-CPG period, further efforts to accelerate the implementation of evidence into practice are warranted.

In a recent survey of hand surgeons, a majority of the surgeons still required EDS >50% of the time in patients with classic CTS symptoms.¹⁶ Only 38.3% of the surgeons surveyed believed that the 2016 AAOS CPG was appropriate, whereas 89.4% stated that it did not change their EDS requirements.¹⁶ Another study in Michigan showed that 57% of hand surgeons required diagnostic testing before CTS evaluation.¹⁷ However, these studies were limited by cross-sectional designs and either a low response rate (23.4%) or limited geographic reach.^{16,17} In contrast, our population-level study enabled us to evaluate trends over time, showing that overall and preoperative EDS usage for CTS has been decreasing nationally, a trend predating the 2016 AAOS CPG. Interestingly, our data showed that preoperative EDS usage increased from 2011Q1 through 2013Q4, reflecting the 2010 AAOS CPG recommendations, before decreasing in 2014–2016.¹⁵ Taken together, this suggests that the implementation of evidence into practice has been relatively rapid, predating CPGs. The reasons for this may include a more informed physician workforce, wider dissemination of evidence, and use of technology, and should be further explored.

Although hand surgeons may order EDS to quantify the degree of nerve compression to aid in patient counseling, the clinical benefit of this approach should be weighed against the pain and cost of EDS and potential surgical delays.¹⁴ Our data

show that despite the decreasing trends in EDS usage, 27.5% of patients undergoing CTR in 2020 still underwent preoperative EDS. The continued use of EDS despite the updated AAOS CPG suggests that barriers to deimplementation exist. Multiple physician factors, including habit, fear of malpractice, and insurer requirements, have been cited as barriers to deimplementing low-value care.^{7,18,19} Deimplementation frameworks have been developed to address these unique challenges.^{20,21} For example, a deimplementation intervention, consisting of interactive education, feedback, and benchmarking, has been used in efforts to reduce autologous blood salvage and preoperative erythropoietin use in total joint arthroplasty.²² Future initiatives for reducing routine EDS use could apply similar deimplementation principles embedded within pathways that create standardized criteria for obtaining EDS.²³

The decrease in EDS usage was relatively larger for preoperative EDS than for overall EDS usage. This suggests potential variation between physicians who obtain EDS for diagnosing CTS and those who obtain EDS as part of a preoperative workup. For example, in a prior study, the majority of referrals for EDS for suspected CTS originated from family physicians.²⁴ If guidelines are not as effectively disseminated among general practitioners, then this could account for the relatively smaller observed decrease in overall EDS usage. In our study, 19.6% of initial CTS claims originated from hand or orthopedic surgeons, whereas 24.5% originated from primary care specialists. Although this may not directly correspond to the ordering physician, it suggests that wider dissemination of the AAOS guidelines may help further reduce routine EDS usage. Nonspecialists could use the CTS-6, a highly sensitive and specific instrument, to identify cases with high pretest probability and refer uncertain or atypical cases to hand specialists who have more experience in determining the appropriateness of EDS.²⁵ This discrepancy could also be addressed using multispecialty initiatives for deimplementing low-value tests and procedures, most notably the Choosing Wisely campaign.^{26,27} Given that EDS still occurred in 27.5% of patients undergoing CTR in 2020 and 13.7% of patients diagnosed with CTS in 2019 despite the promising trends in EDS usage, it could be included in multidisciplinary deimplementation initiatives.

Studies show that evidence-based guidelines are more effective when paired with corresponding changes in the payment paradigm.²⁸ Thus, pay-for-performance programs tied to quality measures are an effective strategy for reducing low-value care.²³

For example, the implementation of bundled payments for joint arthroplasty led to decreased usage of post-hospitalization services without affecting the quality of care.²⁹ Within upper limb surgery, there are over 130 process quality measures already in existence.^{30,31} Additionally, studies show that quality assessment can be effectively performed using administrative data (eg, in CTS).^{32–34} Based on our results, the proportion of patients with CTS or those undergoing CTR who receive EDS could be validated as a process quality measure using administrative data. This could then be used to establish national benchmarks for EDS usage (accounting for appropriate use cases).

Limitations to our study exist. Owing to our use of a large, national claims database, our results rely on accurate and complete claims coding, specifically on the clinical CTS diagnosis. It is possible that some patients who underwent EDS were not noted to have findings consistent with CTS or had other pathology that was not examined in this study (eg, ulnar nerve compression). However, this effect is unlikely to be time-varying. Although this is a population-level study, it is possible that some EDS represented appropriate use cases (eg, atypical presentations). However, at the population level, EDS usage was decreasing, which was likely driven by cases of unnecessary usage. Because coding for EDS is not specific for CTS, a small number of patients within the EDS cohort may have received an upper limb EDS for a different indication. We attempted to limit this by imposing time constraints on EDS usage. We minimized the inclusion of EDS performed for CTR revisions by including only the initial diagnosis of CTS and the first instance of CTR; however, some patients may have undergone CTR before entering the database. However, this effect is also unlikely to be time-varying. Overall, EDS usage in this study differed from that in a prior study, which showed up to 47% usage.³⁵ However, that study did not impose a time constraint for EDS use, which may have led to the inclusion of more tests, and is based on older (2009–2013) data.

In summary, the overall and preoperative EDS usage for CTS has been decreasing, a trend that predates the publication of the 2016 AAOS CPG. On average, the current levels of EDS usage are lower than EDS usage levels before the 2016 AAOS CPG. However, a substantial proportion of patients undergoing CTR still underwent EDS. Although these trends in EDS usage are promising, future efforts to continue decreasing inappropriate EDS usage should focus on the evaluation of EDS usage as a process

quality measure in hand surgery and its adoption into pay-for-performance paradigms.

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