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Quality of Care for Work-associated Carpal Tunnel Syndrome

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Abstract

Objective—To evaluate the quality of care provided to individuals with workers' compensation claims related to CTS and identify patient characteristics associated with receiving better care.

Methods—We recruited subjects with new claims for CTS from 30 occupational clinics affiliated with Kaiser Permanente Northern California. We applied 45 process-oriented quality measures to 477 subjects' medical records, and performed multivariate logistic regression to identify patient characteristics associated with quality.

Results—Overall, 81.6% of care adhered to recommended standards. Certain tasks related to assessing and managing activity were underused. Patients with classic/probable Katz diagrams,

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Authors' Contributions to the Research:

Teryl Nuckols and Steven M. Asch jointly designed and oversaw all aspects of the work.

Craig Conlon served as site principal investigator, overseeing data collection and providing input on issues related to care for CTS and workers' compensation.

Michael Robbins oversaw statistical analyses.

Michael Dworsky provided input on issues related to workers' compensation and assisted with data analysis and interpretation.

Julie Lai and Rachana performed statistical analyses.

Carol P. Roth assisted with the design of and oversaw the completion of the medical record reviews.

Seth Seabury and John Adams contributed to study design, analytical methods, and interpretation of results.

Barbara Levitan assisted with the design of and oversaw the completion of the surveys.

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positive electrodiagnostic tests, and higher incomes received better care. However, age, gender, and race/ethnicity were not associated with quality.

Conclusions—Care processes for work-associated CTS frequently adhered to quality measures. Clinical factors were more strongly associated with quality than demographic and socioeconomic ones.

Keywords

quality of care; underuse; overuse; workers' compensation; occupational diseases; carpal tunnel syndrome; median neuropathy

Introduction

Carpal tunnel syndrome (CTS) is common and contributes to costly disability among working populations. Nationally, 3–4.7% of adults age 30 to 64 who were employed in the prior year report *currently* having CTS that was diagnosed by a clinician. In 67–74% of these cases, a clinician had attributed the CTS to work.¹ The prevalence of CTS is higher, sometimes much higher, in certain employed populations.^{2–5}

CTS can lead to sizeable direct and indirect costs, particularly when the ability to work is impaired.^{2,6,7} State workers' compensation policies require employers to cover, directly or via insurance, the cost of healthcare for a worker's occupational condition as well as any temporary and permanent disability benefits.⁸ Consequently, in workers' compensation settings, higher quality care that facilitates a more rapid return to health and function might both benefit workers and reduce payers' total costs. Initiatives to measure and improve quality of care now exist in a wide variety of other healthcare sectors, but little is known about the quality of occupational healthcare.^{9–12}

Our objective was to evaluate the quality of care processes provided to individuals with workers' compensation claims for suspected or confirmed CTS, and to identify patient characteristics associated with quality of care.

Methods

This work involved recruiting patients with CTS diagnosis codes that were newly linked to workers' compensation claims, conducting telephone surveys at recruitment and 18 months later, and evaluating quality of care by reviewing medical records during the year after recruitment.¹³

Setting and Population

Kaiser Permanente Northern California (KPNC) Regional Occupational Health is a major provider of workers' compensation care, contracting with large and small employers, workers' compensation insurance carriers, and third-party claims administrators. Specialists in 30 KPNC Occupational Health Centers within an integrated healthcare system treat 45,000 individuals with workers' compensation claims per year. These individuals work in diverse industries, and about 70% also have general health insurance through KPNC.

From August 2011 to March 2013, KPNC Regional Occupational Health administrators used internal workers' compensation databases to prospectively identify consecutive adults ages 18 and above who had a newly coded primary or secondary diagnosis of CTS (ICD-9 code 354.0 or 354.1). Within one to three working days after submission of the diagnosis code, staff mailed recruitment packages and then made multiple attempts to obtain consent by telephone. Individuals who did not speak English or Spanish as well as KPNC employees and physicians were excluded.

Of 1009 patients with newly coded diagnoses (Figure 1), 81 were ineligible, 630 eligible individuals (67.9%) consented, 113 declined, and 185 were not reached. Subjects remained eligible if the diagnosis changed (n=20) or the claim was dropped or denied (n=19).

The institutional Human Subjects' Protections Committees approved the study; participants provided verbal informed consent.

Surveys

Subjects were asked to complete telephone surveys at recruitment and 18 months later (May 2013 to October 2014). Of those initially consenting, 17 were found to be ineligible, 509 eligible individuals (83.0%) completed the baseline survey, 14 declined, and 90 were not reached. At follow-up, 429 (84.3%) responded, 18 declined, 2 were deceased, and 60 were not reached.

When subjects had claims for bilateral CTS, we focused on the dominant hand. Baseline surveys included items related to Boston Carpal Tunnel Questionnaire [BCTQ] symptom severity and functional status scores (and importance of each symptom to the subject),^{14,15} SF-12v2 physical and mental health component scores,^{16–18} prior claim(s) for upper extremity conditions, prior care for the current symptoms outside of KPNC, symptom timing and duration, symptom location (to derive Katz Diagram),^{19,20} occupation, current work status, job satisfaction before developing CTS, self-efficacy in managing symptoms,²¹ gender, and personal income in the past year. Follow-up survey items included attorney involvement, race, Hispanic ethnicity, medical risk factors for CTS (thyroid disease, kidney disease, obesity, and arthritis), and whether patients received concurrent care for the current symptoms outside of KPNC. See Appendix 1 and 2.

Medical Record Review

To evaluate quality, we used 45 process-oriented measures developed previously using a variation of the RAND/UCLA Appropriateness Method, which involved a systematic review of the literature and multidisciplinary expert panel process. Measures addressed underuse and overuse for four aspects of care: evaluation and monitoring, non-operative treatment, activity assessment and management, and surgical appropriateness. Each measure addressed patients with specific clinical characteristics at a given point in the course of care.^{22–26} In addition to the usual measure selection process, panelists rated measure importance on a 9-point scale (9 = highest).

For subjects who completed the baseline survey, specially trained KPNC medical-record abstractors reviewed electronic medical records and excluded patients without visits to

KPNC Occupational Health Centers (n = 19) or with CTS from an acute injury (n = 13). For remaining subjects (n=477), abstractors identified CTS-related visits, extracted electrodiagnostic test results, and extracted variables needed to determine eligibility and adherence for each measure (if subjects were eligible for a measure at multiple visits, abstractors focused on the first applicable visit). For the first three visits and any surgical consultations, abstractors extracted data on symptom timing (continuous, intermittent), location (to derive Katz Diagram), and any neurological signs (thenar atrophy, thenar weakness, or decreased sensibility in digits 1 to 3). If subjects were already receiving care at KPNC Occupational Health Clinics before CTS was diagnosed, abstractors reviewed visits to the clinics occurring up to three months before study enrollment.

Abstractors were trained to use a Microsoft Access data collection tool and detailed guidance document. Initially, they performed 23 reviews in pairs and resolved any discrepancies by consensus. To assess proficiency before abstractors performed independent reviews, we compared their reviews against reviews by an occupational medicine physician. During data collection, an experienced nurse researcher monitored data integrity, answered answers, and provided guidance. Two or more abstractors performed duplicate reviews of 35 records to assess agreement. Cohen's kappas across three pairs of abstractors were 0.69, 0.77, and 0.64 for eligibility and 0.60, 0.55, and 0.24 for adherence given agreement on eligibility. Measure-level rates of eligibility and adherence were similar across abstractors.

Analysis

Derivation of Potential Predictor Variables—Using survey data, we ascertained age, gender, race/ethnicity (as three separate variables: non-Hispanic white vs. all others, non-Hispanic black vs. all others, and Hispanic vs. all others), and log of personal income in the year before claim submission. We used multivariate imputation by chained equations to estimate income and race/ethnicity for the 15–19% of cases with missing values.²⁷ We classified occupation using U.S. Census Bureau occupation codes.²⁸ We identified patients with claims for bilateral CTS and determined symptom duration (>24 months vs. not); BCTQ symptom severity score (weighted by importance of each symptom to the patient);¹⁴ BCTQ functional status score; baseline SF-12v2 mental health composite score, presence of any medical risk factors for CTS, presence of any prior claims for upper extremity conditions, attorney involvement, receipt of prior or concurrent care outside of KPNC, baseline self-efficacy in managing CTS (average of 4 items), and job satisfaction before CTS diagnosis.

Using survey and medical record data, we assigned symptom timing (constant, intermittent, unclear/missing in both data sources) and probability of CTS per Katz Diagram (classic/probable vs. not) based on the most severe characterizations recorded. Based on medical record data, we identified the presence of neurological signs and positive electrodiagnostic test results.

Analytical Approach—To account for variation across patients in measure eligibility and variation across measures in the ease of adherence, we created a patient-measure-level data set. The unit of observation was a quality measure for an individual patient. Each patient

contributed multiple observations depending on the number of measures for which he or she was eligible. Each observation included a categorical variable corresponding to the measure, a binary variable reflecting adherence, and patient-level characteristics. This approach also allowed for patient-level random effects.

With this dataset, we used Kruskal-Wallis tests to compare rates of adherence according to measure characteristics (overuse vs. underuse, aspect of care, and importance score).

Next, we examined predictors of adherence to recommended care (dependent variable) using a multivariate logistic regression model that included patient-level variables of interest (independent variables), patient-level random effects, and measure-level fixed effects. We included several variables in the model because we had strong *a priori* reasons to believe that they could influence adherence. Sociodemographic characteristics have been associated with quality; therefore, we included age, gender, race/ethnicity, as well as the log of personal income.²⁹ Given that having more clinical evidence of CTS may be associated with adherence,³⁰ the model included medical risk factors for CTS, bilateral CTS, classic/probable symptom pattern, symptom duration, symptom timing, BCTQ symptom severity score, BCTQ functional status score, neurological signs, and positive electrodiagnostic tests. Claim characteristics included having a prior claim, retaining an attorney,³¹ and receiving concurrent care outside of KPNC. In a model with all candidate variables, we tested the baseline SF-12v2 mental health component score, job satisfaction, prior care outside of KPNC, and self-efficacy; only the SF-12v2 mental health component score statistically significant ($p < 0.05$) and retained in the model.

A published consensus definition of CTS includes having both classic/probable symptoms and a positive electrodiagnostic test.³² In a sensitivity analysis, we included a variable that indicated when patients met this definition, instead of having symptom pattern and electrodiagnostic testing as two separate variables in the model.

For each patient-level predictor variable in our final model, we derived the adjusted odds ratio (OR) and 95% confidence interval (CI). Continuous predictors were standardized by subtracting the mean value from the value of each observation, and then dividing by the standard deviation; therefore, the OR indicates the proportional change in the odds of adherence that can be attributed to a one-standard deviation increase in the value of the predictor. We also tested whether results differed when including a variable for abstractor identity in the model. All analyses were programmed in SAS v9.4.

Results

The mean age was 48 and 74% of subjects were female (Table 1). Based on survey responses, 43% were white, 13% black, 6% Asian, 18% other, and 19% missing; 20% were Hispanic. Personal income was relatively high, consistent with the geographic area. Nearly half (48.4%) were in sales and office occupations. Fifty-three percent of subjects had bilateral symptoms and claims. Symptoms were present longer than 24 months in 30%, constant in 60%, consistent with classic/probable CTS in 51%, associated with neurological signs in 44%, and electrodiagnostically confirmed in 67%. Twenty-three percent had a

previous claim and 12% had retained an attorney. About 75% had medical risk factors for CTS.

Figure 2 displays adherence rates for each measure. The length of the bar represents the number of subjects eligible for each measure (denominator). The black portion of the bar represents the number of subjects for whom care adhered to the measure (numerator). Overall, 81.6% of care adhered to the measures. White and grey portions of the bars represent underuse (subjects who did not receive necessary care) and overuse (subjects who received inappropriate care), respectively. Adherence was lower for measures of underuse (78.9%) than overuse (88.5%, $p = 0.037$).

In the figure, measures are grouped by type of care. Adherence rates were similar across evaluation and management (85.4%), non-operative treatment (76.4%), activity assessment and management (81.5%), and surgical appropriateness (90.1%, $p = 0.749$). Adherence did not vary across measure importance scores, which ranged from 6 to 9 ($p = 0.436$, not shown).

Regarding overuse, providers generally used imaging selectively; limited the number of steroid injections; avoided the use of diuretics, muscle relaxants, and opioids; and avoided surgery when inappropriate. Physicians often prescribed nonsteroidal anti-inflammatory drugs (NSAIDs), which our panelists recommended against based on randomized-controlled-trial data showing no benefit for CTS symptoms.^{23,33–36} (Other recent sources suggest that a trial of NSAIDs may be appropriate for some patients.³⁷)

Adherence varied for measures of underuse. Elements of the evaluation were usually performed as recommended, including obtaining key aspects of the clinical history and ordering electrodiagnostic tests before surgery. However, physicians did not consistently check for signs of median nerve injury on physical examination or monitor patients adequately. Most non-operative therapies were performed in the manner recommended. However, while 312 patients received splints, physicians seldom documented that these were placed in a neutral position, which panelists believed is important because many splints come in a cock-up position and have to be manually adjusted.²³ Sometimes physicians neglected to suggest surgery when necessary.

Regarding activity assessment and management, adherence was high for obtaining a detailed occupational history, assessing harmful occupational exposures, and identifying exacerbating activities. However, adherence was lower for documenting why symptoms appeared work-associated, minimizing any harmful exposures, monitoring functional limitations, and evaluating factors contributing to prolonged disability. Similarly, physicians often overlooked non-occupational factors and medical conditions that may contribute to CTS symptoms.

Figure 3 displays patient characteristics included in the final model predicting adherence to the quality measures, with adjusted ORs and 95% CIs. Effect sizes were modest. Having more clinical evidence of CTS was associated with higher adherence, including having symptoms reflecting classic/probable CTS (OR 1.25 relative to possible/unlikely, 95% CI 1.04–1.50) or a positive electrodiagnostic test (OR 1.48 relative to no testing or a test that

was not positive, 95% CI 1.21–1.82). Adherence tended to be higher for patients with neurological signs including weakness, loss of sensibility, or atrophy (OR 1.20, 95% CI 0.99–1.45) or medical risk factors for CTS (OR 1.20, 95% CI 0.96–1.50). About 2.3% of patients had symptoms of unclear timing, which was associated with reduced adherence (OR 0.41 relative to patients with constant symptoms, 95% CI 0.21–0.80). A higher baseline SF-12v2 mental health component score tended to be associated with greater adherence (OR 1.09, 95% CI 0.99–1.19). Higher personal income was associated with adherence (OR 1.12, 95% CI 1.01–1.23), but significant differences were not observed for age or race/ethnicity. Results were similar with adjustment for abstractor identity (except unclear symptom timing was no longer significant).

In the sensitivity analysis, meeting the consensus definition of CTS was associated with greater adherence (OR 1.38, 95% CI 1.31 to 1.68), and having medical risk factors for CTS (OR 1.26, 95% CI 1.00 to 1.58) and neurological signs (OR 1.23, 95% CI 1.02 to 1.49) exhibited slightly stronger associations with adherence. Other associations were unchanged.

Conclusions

In this prospective observational study of 477 patients with suspected or confirmed carpal tunnel syndrome (CTS) treated in 30 occupational health centers within an integrated health system, quality of care was relatively high. Care processes adhered to recommended standards 82% of the time. Nonetheless, important aspects of care were underused, particularly monitoring symptoms, function, and work status, and assessing and managing activities that may exacerbate CTS symptoms. Overuse of inappropriate steroid injections, imaging studies, and surgery was low. Patients having more evidence that CTS was the correct diagnosis and higher incomes tended to receive higher quality care, although effect sizes were modest.

Until now, little has been known about quality of care for occupational conditions. Prior studies in workers' compensation settings have assessed the timeliness of initial visits and claims, the completeness of claim forms, visit frequency among those off work, population-based rates of spinal imaging and opioid prescribing, disability duration, and patient satisfaction.^{11,38–43} In Washington State, disability days declined by 20% after policymakers gave physicians financial incentives to communicate with employers, prescribe appropriate activity, and assess barriers to return to work.⁴⁰ Our work affirms that activity assessment and management warrant improvement.

For other aspects of diagnosis and treatment, we found high rates of performance. Although we found specific opportunities for improvement, the overall adherence rate was higher than in many studies of musculoskeletal conditions. We are not aware of prior studies of CTS. However, adherence to recommended care in other studies was 67% for low back pain,⁴⁴ 62% for rheumatoid arthritis,⁴⁵ 36–79% for osteoarthritis,^{44,46} 20–22% for fragility fracture,^{44,47} and 57% for other orthopedic conditions.⁴⁴ Among U.S. adults with common causes of morbidity and mortality, underuse occurred among 46% and overuse among 11%.⁴⁴ Among patients undergoing surgery in prior studies, the rate of underuse was 24–57% and overuse 0–70%.⁴⁸

Several factors could contribute to the relatively high quality we observed. One is the fact that the care we evaluated was provided by occupational medicine physicians. At least a quarter of patients received care for CTS before filing a workers' compensation claim, and we did not assess the quality of this care. A second factor is alignment of financial and quality incentives. KPNC contracts with workers' compensation payers, which are financially responsible for healthcare and disability costs. In contrast, other types of healthcare payers have fewer incentives to demand improvements in quality or outcomes like disability.⁴⁹ Overuse may be low in our study because California implemented utilization review guidelines to curtail excessive utilization in the workers' compensation system,⁵⁰ and KPNC physician salaries are not linked to the volume of services provided. KPNC Regional Occupational Health employs systems for clinical quality assurance that include training for physicians and spot medical record reviews. For example, newer practices related to the management of disability before surgery have already been widely implemented.⁶ Finally, performance may also be related to calibration of the measure set, meaning difficulty of adherence.

In addition to finding relatively high quality care, we detected modest disparities in quality by income and no significant disparities by age, gender, or race/ethnicity. These findings may be related to the fact that the population had workers' compensation coverage and active claims—i.e., access to care. Prior studies have found that barriers to accessing workers' compensation care are greater for young, black, Hispanic, and lower-income populations, and associated with worse health and occupational outcomes. Some employers do not carry workers' compensation coverage, or may discourage or contest claims more actively among workers with these characteristics. Similarly, workers may differentially understand how the workers' compensation system works or fear retaliation if they file a claim.^{51–53} Prior research has extensively documented disparities in quality of care in the U.S., especially for expensive procedures.⁵⁴ Our work is consistent with a large national study that found fewer racial or income disparities in the quality of more routine and less intensive care processes once access barriers, like lack of insurance coverage, had been surmounted.^{55–57}

This study has several limitations. Survey data are subjective and affected by recall bias. Medical record review relies on provider documentation, which is often incomplete; however, we accounted for this in the selection and operationalization of the measure set. Care at KPNC Occupational Health Clinics may differ from care provided elsewhere, as noted above. We have yet to adapt these measures to electronic data sources, which would reduce the burden of data collection.⁵⁸ Future work should examine the relationship between quality of care for work-associated CTS and clinical, occupational, and economic outcomes.

In conclusion, we found that care processes for work-associated CTS frequently adhered to recommended standards in a large regional system for providing occupational healthcare. Clinical factors were more strongly associated with quality than demographic or socioeconomic ones. However, certain tasks related to assessing and managing activity at work and at home were underused, which might contribute to avoidable disability.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Figure 1.
Enrollment of Study Subjects, Survey Responses, and Medical Record Review

Figure 2.

Rate of Adherence to Quality Measures, by Aspect of Care and Individual Measure

- Recommended Care
- Overuse of Inappropriate Care
- Underuse of Necessary Care

Figure 3.
Patient Characteristics Associated with Adherence to Quality Measures

Table 1

Study Population: Adults with Suspected or Confirmed CTS that Was Newly Linked to a Workers' Compensation Claim and Who Completed the Baseline Survey (N = 477)

Sociodemographic Characteristics	
Age, Mean (S.D.) *	48 (10.4)
Gender, Female, N (%) *	351 (73.6)
Race, N (%) **	
White	205 (43.0)
Black	62 (13.0)
Asian	29 (6.1)
Other	90 (18.9)
Missing	91 (19.1)
Hispanic Ethnicity, N (%) **	93 (19.5)
Missing	72 (15.1)
Personal Income during 12 Months before Claim, N (%) *	
\$18,000	103 (21.6)
>\$18,000 – \$36,000	110 (23.1)
>\$36,000 – \$54,000	98 (20.6)
>\$54,000 – \$72,000	100 (21.0)
>\$72,000	66 (13.8)
Occupation, N (%) *	
Natural Resources, Construction, and Maintenance Occupations	47 (9.9)
Management, Business, Science, and Arts Occupations	99 (20.8)
Production, Transportation, and Material Moving Occupations	35 (7.3)
Sales and Office Occupations	231 (48.4)
Service Occupations	65 (13.3)
Psychosocial Factors	
Self-efficacy in Managing CTS Symptoms (averaged across 4 items, scale 1–4, 1 = best), Mean (S.D.) *	2.3 (0.8)
Job Satisfaction before CTS (scale 1–4, 1 = best), Mean (S.D.) *	3.5 (0.7)
Symptoms, Signs, Tests	
Right Handed, N (%) *	424 (88.9)
Duration of Symptoms, N (%) *	
< 6 Months	144 (30.2)
6–24 Months	184 (38.6)
> 24 Months	144 (30.2)
Bilateral Symptoms and Claims for CTS, N (%) *	251 (52.6)
Symptom Pattern on Katz Diagram, N (%) *,***	

Classic or Probable CTS	252 (50.6)
Possible CTS	197 (41.3)
CTS Unlikely	38 (8.0)
Symptom Timing, N (%) ^{*,***}	
Constant	287 (60.2)
Intermittent	179 (37.5)
Unclear/ Missing	11 (2.3)
Neurological Signs, N (%) ^{***}	211 (44.2)
Thenar Weakness	71 (14.9)
Thenar Atrophy	49 (10.3)
Loss of Sensibility in Digits 1, 2, or 3; %	165 (34.6)
Result of Electrodiagnostic Testing for CTS, N (%) ^{***}	
One or More Positive Tests	318 (66.7)
All Tests Indeterminate	14 (2.9)
One or More Tests Negative and None Positive	52 (10.9)
No Tests Done	93 (19.5)
Baseline Boston Carpal Tunnel Questionnaire, Mean (SD) [*]	
Symptom Severity Score (scale 1–5, 1 = best), Weighted by Importance of Each Symptom to Patient	3.0 (0.7)
Functional Status Score (scale 1–5, 1 = best)	2.5 (0.9)
Health Status	
Medical Risk Factors for CTS	358 (75.1)
Overweight (BMI > 25) or Obese (BMI > 30), N (%) ^{**}	327 (68.6)
Missing, N (%)	72 (15.1)
History of Thyroid Disorder, N (%) ^{**}	46 (9.6)
History of Kidney Disorder, N (%) ^{**}	14 (2.9)
History of Arthritis, N (%) ^{**}	177 (37.1)
SF-12v2, Mean (S.D.) [*]	
Mental Health Component Score (scale 0–100, 100 = best)	50.4 (11.5)
Physical Health Component Score (scale 0–100, 100 = best)	40.2 (9.6)
Workers' Compensation Claim and Care	
Hand(s) Subject to Claim, N (%) [*]	
Right	163 (34.2)
Left	63 (13.2)
Both	251 (52.6)
Previous Claim in Upper Extremity, N (%) [*]	108 (22.6)
Same Hand	31 (6.5)
Other Hand	21 (4.4)
Both Hands	24 (5.0)

Attorney Involved in Claim, N (%) **	56 (11.7)
Received Concurrent Care Outside KPNC, N (%)	149 (31.2)
Received Care for CTS prior to Care at KPNC, N (%)	126 (26.4)

* Based on baseline survey. For personal income, includes imputed values.

** Based on follow-up survey

*** Based on medical record review