

Decision for Carpal Tunnel Surgery: High-deductible Health Plans versus Traditional Health Plans

Hayley M. Sanders, BS*
 Yanlin Tong, BS†
 Rachel C. Hooper, MD‡
 Lu Wang, PhD‡
 Kevin C. Chung, MD, MS‡

Background: Delay in surgical treatment for carpal tunnel syndrome (CTS) may result in long-term decreased functional outcomes. Few investigators have examined the relationship between type of health insurance plan and time to definitive treatment of CTS following diagnosis. We investigated the relationship between insurance type, treatment decision, and the time between diagnosis and surgery across groups.

Methods: This was a retrospective cohort study using the MarketScan Commercial Claims and Encounters Database 2011–2020. We used χ^2 tests, linear regression, and logistic regression models to analyze demographic data and the time lag interval between CTS diagnosis and treatment.

Results: Overall, 28% of high-deductible health plan (HDHP) patients underwent carpal tunnel release, compared with 20% of traditional insurance patients ($P < 0.001$). HDHPs are defined by the internal revenue service as a deductible of \$1400 for an individual or \$2800 for a family per year. The odds of undergoing surgery versus no treatment for HDHP patients were 47% higher than traditional patients ($P < 0.001$). Among the patients who underwent surgery, HDHP patients underwent surgery 65 days earlier on average following diagnosis compared with traditional patients ($P < 0.001$).

Conclusions: Patients with HDHPs who receive a diagnosis of CTS are more likely to undergo surgery, with a shorter time lag between diagnosis and surgery. The results from this study call attention to differences in surgical decision-making between patients enrolled in different insurance plans. (*Plast Reconstr Surg Glob Open* 2024; 12:e5659; doi: 10.1097/GOX.0000000000005659; Published online 1 March 2024.)

INTRODUCTION

High-deductible health plans (HDHPs) are health insurance policies that have higher deductibles than traditional plans, resulting in increased out-of-pocket (OOP) costs for enrollees with the benefit of decreased monthly premiums.¹ Enrollment in HDHPs has risen in recent years, appealing primarily to young, healthy people.² For adults between the ages of 18 and 64 with healthcare coverage from their employers, HDHP enrollment in conjunction with a health savings account (HSA) increased

from 4.2% to 18.9% from 2007 to 2017 and from 10.6% to 24.5% without an HSA.³ The financial and healthcare-related impact of the increasing popularity of HDHP on enrollees has been mixed, and studies have demonstrated differing results.

Because of high OOP expenses, HDHP enrollees frequently choose to delay care for nonurgent health conditions.⁴ Specifically, individuals enrolled in HDHP coverage were 6% more likely to present to the emergency room with an incarcerated or strangulated hernia, rather than electively to the general surgeon for hernia repair.⁴ Delayed presentation and surgical intervention among hernia patients can be associated with increased risk of wound infection, need for bowel resection, and other associated complications.⁵ Among HDHP patients with cancer, coordinated care from radiation oncologists, oncologists, surgeons, and other members of the care team is required. High OOP costs associated with these

From the *Section of Plastic Surgery, Department of Surgery, University of Michigan Medical School, Ann Arbor, Mich.; †Department of Biostatistics, University of Michigan, Ann Arbor, Mich.; and ‡Division of Plastic Surgery, Department of Surgery, Michigan Medicine, Ann Arbor, Mich.

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visits result in delayed and fragmented care; this has deleterious implications on the patients' outcome.^{4,6,7}

It is unclear if HDHP enrollment results in delay of care for hand conditions. Carpal tunnel syndrome (CTS) is the most common compressive neuropathy impacting hand function; delay in treatment can lead to adverse outcomes, including permanent sensory loss and decreased motor strength.^{8,9} As previously discussed, patients enrolled in HDHPs are more likely to neglect routine care, delay care, and pay more for the care they do receive. The current study investigates time between diagnosis of CTS and intervention among HDHP patients. We hypothesize that HDHP enrollees will exhibit a greater time lag to between diagnosis and surgery, compared with traditional health plan enrollees.

METHODS

Study Cohort

This study received institutional review board exemption from the University of Michigan. We used the Truven MarketScan Commercial Claims and Encounters Database and Medicare Supplemental and Coordination of Benefits Database years 2011–2020. MarketScan provides data on inpatient and outpatient medical and surgical services for more than 273 million patients.

We identified patients with a diagnosis of CTS between January 1, 2011, and December 31, 2020, using International Classification of Diseases 9th and 10th revisions (ICD-9 and ICD-10) diagnosis codes. We then excluded patients younger than 26 years and older than 64 years to eliminate potential confounding among patients younger than 26 who remained on their parents' insurance, and patients older than 64 with Medicare eligibility. We used Current Procedural Terminology codes to identify patients who underwent steroid injection and carpal tunnel release (open and endoscopic). Patients with unidentified insurance were excluded. We checked for 1 year enrollment before initial carpal tunnel diagnosis, along with continuous enrollment following diagnosis, and excluded individuals who did not meet these parameters. Cohort assignment was defined by internal revenue service deductible cutoffs that currently define an HDHP as one with a deductible of at least \$1400 for an individual or \$2800 for a family. All other insurance plans were assigned to the traditional cohort. [Figure 1](#) shows a workflow of the CTS diagnosis cohort construction.

Dependent Variables

Our primary outcome variable was whether a patient with CTS underwent surgery, steroid injection, both, or neither, and the secondary outcome was the time lag difference (TLD) between date of diagnosis and surgery between patients enrolled in traditional plans or HDHPs.

Independent Variables

Our main independent variable was insurance type (traditional versus HDHP). Other variables investigated were sex, age, geographic region of residence, place of service, and provider type of service.

Takeaways

Question: How does having a high-deductible health plan (HDHP) impact treatment decision for carpal tunnel syndrome?

Findings: This retrospective cohort study found that HDHP patients elected to have surgery more frequently, and on a shorter timeline than traditional health plan patients. HDHP patients chose to have surgery on average 65 days earlier than traditional health plan patients.

Meaning: This study highlights the need for patients to make informed decisions on insurance coverage based on their risk factors and potential need for specialized medical and surgical care. Physicians can also increase educational efforts on the long-term consequences of untreated carpal tunnel syndrome, in both clinical and financial realms.

Data Analysis

We summarized and compared the distribution of demographic variables, socioeconomic variables and provider variables using χ^2 test and Wilcoxon rank sum test between HDHP and traditional groups for patients with CTS, patients undergoing surgery, and patients undergoing surgery or injection treatment. The TLD between diagnosis and the treatment date among HDHP and traditional patients with different treatment types (open release surgery, endoscopic release surgery, and injection only) were also summarized, and the raw group differences across insurance types were assessed by two-sample *t* tests. The number of patients with CTS enrolled in each insurance type and the corresponding proportions across years from 2011 to 2020 were summarized to demonstrate the national trend in HDHP versus traditional plan enrollment.

To adjust for other confounders, we conducted multivariable linear regression models for TLD and logistic regression models for surgery decisions controlling for demographic factors and provider factors. For the primary analysis to examine the association between TLD and health insurance type, we adjust for sex, age, region, and provider type. Provider type is defined in MarketScan as surgeon, admitting or nonadmitting physician, or other. As a secondary analysis, multivariable logistic regression models were fit to evaluate the odds of undergoing surgery for HDHP patients versus traditional patients, adjusting for sex, age, region, place of diagnosis, and provider types.

RESULTS

We identified 1,552,409 patients in MarketScan with a diagnosis of CTS after applying exclusion criteria ([Fig. 1](#)). In comparing patients with traditional health insurance plans and HDHPs, there was no significant difference in patient age ($P = 0.646$), but a greater proportion of patients in both groups were women (66% women versus 34% men). A high proportion of patients were from the south, at 43% overall. CTS-related OOP

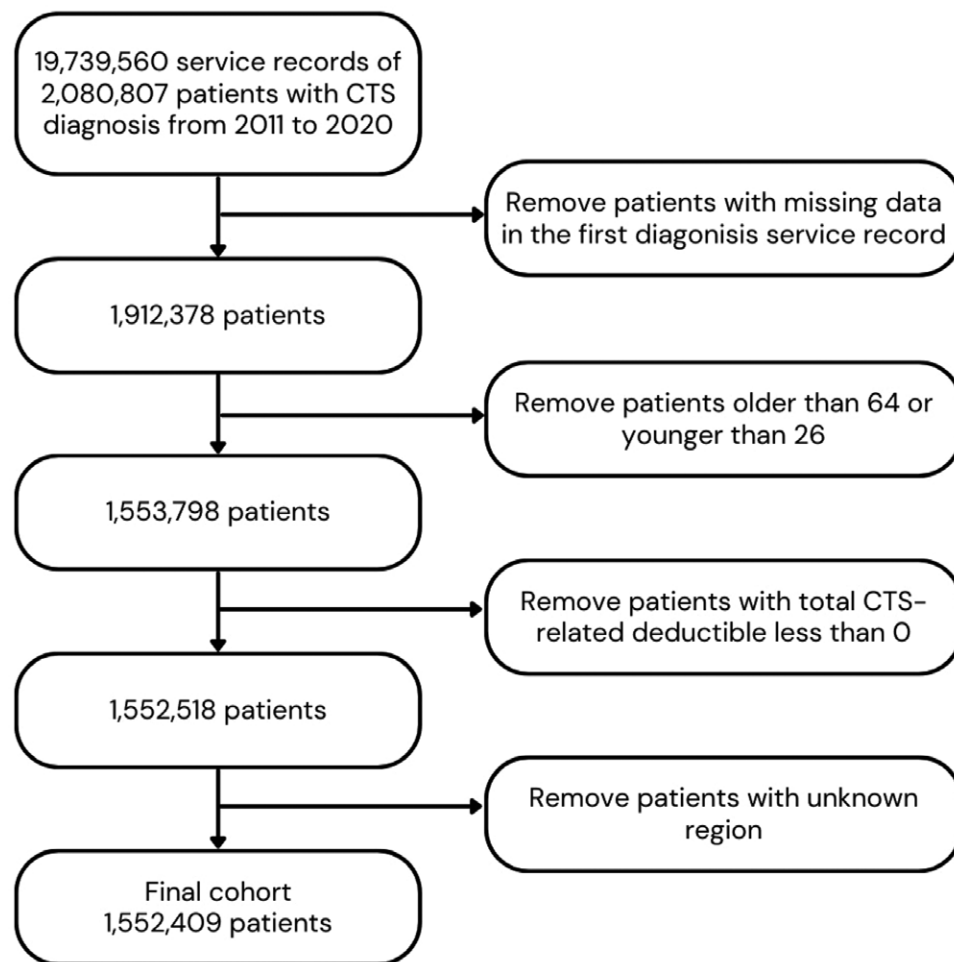


Fig. 1. Workflow of constructing the CTS diagnosis cohort (n = 1,552,409).

costs were significantly different, with HDHP enrollees paying \$747 on average, over two times higher than traditional plan enrollees at \$307 ($P < 0.001$). [See table, Supplemental Digital Content 1, which displays the demographics table of patients undergoing treatment for CTS (n = 404,030, <http://links.lww.com/PRSGO/D98>.]

In addition, from 2011 to 2020, the proportion of patients enrolled in traditional insurance decreased from 93% to 79%, whereas the proportion of HDHP patients steadily increased from 7% to 21%. [See figure, Supplemental Digital Content 2, which displays (A) the proportion of both traditional insurance and HDHP from 2011 to 2020. B, The mean TLD of traditional patients and HDHP patients for steroid only, surgery only, steroid then surgery, and surgery then steroid groups, <http://links.lww.com/PRSGO/D99>.]

Among 201,240 HDHP patients, 55,429 underwent carpal tunnel release (28%); among 1,321,169 traditional patients, 263,683 underwent carpal tunnel release (20%). Among surgical patients, TLD was significantly different across insurance groups; with HDHP and traditional patients waiting an average of 103 and 168 days postdiagnosis, respectively ($P < 0.001$). Among patients

who underwent treatment (both or either of surgery and injection), the overall TLD for traditional and HDHP patients was 159 and 100 days, respectively ($P < 0.001$). We also analyzed mean TLD for both traditional and HDHP groups based on treatment order, comparing steroid only, surgery only, steroid then surgery, and surgery then steroid (Supplemental Digital Content 2, <http://links.lww.com/PRSGO/D99>). After adjusting for other variables, the average TLD of HDHP patients was 65 days less than that of traditional patients ($P < 0.001$). Furthermore, odds ratio calculations showed that the odds of surgery only versus no treatment for HDHP enrollees were 47% higher than traditional patients ($P < 0.001$).

DISCUSSION

The Medicare Modernization Act of 2003 created HSAs to encourage enrollment in HDHPs, providing a consumer-minded solution to high healthcare costs.² The goal of the HSA/HDHP combination was to provide high-quality care at a lower cost; however, HDHP enrollees frequently choose to delay necessary care for certain conditions, often because of high-deductible and OOP costs. Schilling et al¹⁰ found that HDHPs reduced the use

of care for mental health conditions, leading to worsening outcomes in this population. In addition, studies on delay in care for HDHP enrollees have investigated conditions such as cancer and hernias, along with emergency department visits.^{5,6,11} Diagnoses such as cancer require multiple visits for imaging, biopsies, and surgery, leading to a buildup of visits, each with a high deductible for HDHP patients.^{6,7}

Enrollee demographics in HDHPs are stratified by income, with one report finding that HDHP-enrolled employees earned 7% higher on average than those enrolled in a PPO plan, in some cases the difference of over \$100,000 a year versus \$70,000.¹² This wage gap has continued to widen, doubling between 2017 and 2018, with higher-wage earners selecting HDHPs more often.¹² Previous literature has shown that wealthier patients and those with higher levels of education are more likely to seek care quickly, potentially explaining the phenomenon shown in our data.¹³ Conditions such as cancer and diabetes stand in contrast to CTS in terms of overall cost, timeline, and the sheer number of procedures and treatments required. Diseases such as breast cancer often require multiple years of imaging, testing, general visits, and procedures—and carry potentially excessive costs for each visit. CTS can be treated with fewer visits or procedures—steroid injection or release surgery. CTS patients with HDHP differ from cancer patients in the coordination and number of visits/treatments required. In addition, delaying care for CTS has known long-term consequences such as muscle atrophy.^{8,9} However, our finding of a 65-day difference in undergoing surgery between HDHP and traditional health plan patients may not carry the same implications as a delay of multiple years. In some cases, CTS symptoms were even found to spontaneously improve, particularly in younger patients, whereas patients who presented with milder symptoms tended to worsen over time.^{14,15} Nevertheless, physicians recommend treating CTS based on factors such as symptom severity and patient preference.¹⁶ The potential for experiencing long-term CTS symptoms may matter more to patients of different backgrounds with different priorities.

We found that HDHP patients with CTS had a shorter time lag between diagnosis and intervention (steroid injections and surgery) compared with traditional plan patients. We attribute this finding to HDHP enrollees perhaps having greater incomes and perhaps higher education/better understanding of the severity of the disease compared with those with traditional healthcare plans.² It is feasible that HDHP patients have a shorter time lag from diagnosis to surgery compared with traditional patients, related to the definitive nature of the treatment of CTS as compared with cancer treatments. Earlier definitive treatment accelerates recovery and return to work. Important to consider when analyzing our results is the potential impact of HSAs. Earlier in the discussion, we stated how HSAs were created to encourage HDHP enrollment. Through this, patients can save money over time for healthcare-related expenses and can pay OOP for visits and procedures. Although an HDHP patient may be able to pay immediately for a procedure OOP, a

traditional plan patient may have to save money over time. The impact of HSAs may provide an explanation for our results of HDHP patients waiting a shorter time between diagnosis and intervention. On the same vein of discussing time, HDHP patients have higher deductibles to meet before insurance begins to cover costs. Therefore, HDHP patients may push for surgery before the end of the calendar year to meet their deductible, potentially explaining our results further.

This study carries the same limitations as all large database studies. However, MarketScan is a validated database used frequently in similar studies. Notably, MarketScan does not include race, income levels, ZIP codes, or other wealth approximations such as the area deprivation index. As a result, these factors are not able to be quantified in this study. We built our cohort using the internal revenue service definition of someone enrolled in an HDHP, following the methodology of Yelorda et al.⁵ MarketScan contains insurance claims only, and we are unable to view circumstances where a procedure was performed but no claim was submitted; however, our number of claims is large enough that we anticipate this number of procedures without insurance claims to be negligible for our results. Another potential limitation of this study is the inability to separate authorization timelines from our time delay measurements. If procedure costs are low enough to fall under a patient's OOP deductible, the authorization time from insurance companies has the potential to be quicker, lessening our measurement of the time between diagnosis and procedure. In this article, we discuss our hypothesis that HDHP patients are more likely to seek treatment for CTS. What we did not study was the breakdown of first seeking a diagnosis for symptoms and the following act of then seeking treatment based on a diagnosis. The scope of this article follows the second act of seeking treatment based on diagnosis, creating a type of selection bias. This was done to follow the design of previous literature.⁵ Finally, we did not use electrodiagnostic data in our analysis, which may play a role in diagnosis and treatment timing.

Our results represent a divergence from previous studies on HDHP versus traditional health plan patients. The trend of HDHP patients as healthy and wealthy indicates their ability to seek treatment quickly because of factors such as higher income, employee benefits such as time off, and increased impact and understanding of the long-term consequences of CTS. Further studies should aim to investigate potential trends across elective hand procedures and other outpatient procedures. If HDHP patients continue to undergo surgery quicker than traditional patients in outpatient settings, then an association is made between these types of procedures and time to surgery for different insurance populations. In addition, our study focuses on the transition from diagnosis to treatment, rather than symptoms to diagnosis, another potential avenue of study. The current study provides insight into the impact of insurance plan coverage and OOP cost on medical and surgical decision-making for HDHP patients. Patients can make more informed decisions on insurance coverage based on their risk factors and potential need

for specialized medical and surgical care. Physicians can also increase educational efforts on the long-term consequences of untreated CTS, in both clinical and financial realms.

Kevin C. Chung, MD, MS

University of Michigan Comprehensive Hand Center
 Section of Plastic Surgery
 The University of Michigan Health System
 1500 E. Medical Center Drive
 2130 Taubman Center, SPC 5340
 Ann Arbor, MI 48109-5340
 E-mail: kecchung@med.umich.edu

DISCLOSURES

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