

Research and Analysis

Physical Medicine Treatments and Their Impact on Opioid Use and Lost Time in California Workers' Compensation



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Executive Summary

Starting in 2014, the four-year transition to the Resource-Based Relative Value Scale (RBRVS) physician fee schedule in California's workers' compensation system increased reimbursements for most types of primary care treatment. Since then, physical medicine (including physical therapy [PT], chiropractic care and acupuncture), as a leading primary care treatment for injured workers, has experienced a continuous increase in the paid per claim at 8% annually in the workers' compensation system without a proportional increase in the level of utilization.¹ Meanwhile, the number of opioid prescriptions as well as the payments for opioids per claim has plummeted since 2012. The increase in physical medicine costs concurrently with the sharp decline in the utilization and payments for opioids suggests that physical medicine may have been used to substitute for opioids to control pain in the workers' compensation system. The WCIRB's 2019 study on high-risk opioid use and potential alternative measures² showed that PT, acupuncture and chiropractic care were consistently and significantly utilized more on claims involving lower doses of opioids compared to similar claims involving high-risk opioid use.³

Increasing physical medicine treatment is part of a trend toward conservative care. While PT is generally recommended by clinical guidelines for treating chronic pain⁴ and shown to be associated with less opioid use in some health care systems,⁵ limited information is available on the impact of early physical medicine on initiation of opioid use to control pain in the workers' compensation system. California lacks an in-depth analysis of the overall trends and patterns of physical medicine treatment cost and utilization in its workers' compensation system. In addition to examining these issues, this study assesses how using physical medicine during the early life of a claim may affect the likelihood of having lost time on the job.

Principal Findings

Overall patterns and trends in physical medicine cost and utilization:

- The average medical payment for physical medicine continued to rise from 2013 through 2018, contributing to a growing proportion of the total medical paid per claim (8% to 11%) as well as the medical paid for physician services per claim (16% to 25%). The significant increase in physical medicine payments was mostly due to changes in the fee schedule and billing of the most frequently used procedure codes as well as a slight shift in the service mix.
- The number of physical medicine services per claim (indicator for utilization) in the workers' compensation system declined moderately (10%) between 2013 and 2018; the average number of visits involving physical medicine, however, remained stable. Overall, only about 2% of claims reached the 24-visit cap within 12 months following the injury.

Characteristics of claims involving physical medicine:

- The distributions of industry sector and diagnostic group for claims involving physical medicine remained essentially unchanged between 2013 and 2017.⁶ In any given year, claims in transportation and warehousing and claims with soft tissue injuries or carpal tunnel syndrome tended to have more physical medicine treatments than others.
- The share of claims involving physical medicine treatment remained fairly stable over time across regions in California, although the Central Coast experienced a slight decrease in the claim share while that in San Diego County increased slightly between 2015 and 2017.
- Starting from 2014, the time from injury to the first treatment has decreased for all physical medicine types, indicating that injured workers are getting earlier physical medicine treatments overall. Chiropractic care and PT, in particular, were first rendered within three weeks of the injury one-half of the time. Access to PT care was found to be fastest in Los Angeles (LA) County (16 days), and access to chiropractic care was fastest in Sacramento and the Central Valley (11 days for both).

1 WCIRB Actuarial Committee Meeting, December 5, 2019, Item AC16-06-05, [Meeting Presentation](#).

2 Zhang, Julia, and Yichen Yu. "Early indicators of high-risk opioid use and potential alternative treatments." WCIRB, April 24, 2019. <https://www.wcirb.com/news/early-indicators-high-risk-opioid-use-study-released>.

3 High-risk opioid use is defined, for the purpose of the study, as using 50 morphine milligram equivalents (MME) or more for at least 30 consecutive days.

4 [CDC Guideline for Prescribing Opioids for Chronic Pain](#).

5 Rhon, Daniel I., Suzanne J. Snodgrass, Joshua A. Cleland, Tina A. Greenlee, Charles D. Sissel, and Chad E. Cook. "Comparison of downstream health care utilization, costs, and long-term opioid use: physical therapist management versus opioid therapy management after arthroscopic hip surgery." *Physical Therapy*, 98, no. 5 (2018): 348-356.

Thackeray, Anne, Rachel Hess, Josette Dorius, Darrel Brodke, and Julie Fritz. "Relationship of opioid prescriptions to physical therapy referral and participation for Medicaid patients with new-onset low back pain." *The Journal of the American Board of Family Medicine*, 30, no. 6 (2017): 784-794.

6 Accident year 2017 is the latest year that we have information in the WCIRB Unit Statistical Report (USR) data at the time of the study.

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- For claims involving physical medicine, there was a continuous and sharp decline (86%) in the utilization of both opioids and other pain medications; meanwhile there was a rapid increase (70%) in the concurrent use of physical medicine treatments and medical treatments other than pain medications.

Impact of early physical medicine on initiating opioid use on soft tissue injury claims:

- Overall, soft tissue injury claims involving PT during the first 30 days of the initial medical visit were less likely to initiate opioid use within one year of the injury, compared to similar claims without early PT.
- The impact of early PT on initiation of opioid use varies over time. Before 2015, soft tissue injury claims involving early PT did not have a lower risk of opioid use within one year of the injury; however, between 2015 and 2017, utilization of claims involving early utilization of PT were found to have significantly lower odds of opioid use by about 14% on average.
- While chiropractic care was less frequently used on soft tissue injury claims, its early use was found to be associated with a significantly lower probability of opioid use.

Impact of early physical medicine on doses of opioids prescribed on soft tissue injury claims:

- Among soft tissue injury claims that had at least one opioid prescription within one year of the injury, those with early PT had, on average, significantly lower doses of opioids prescribed, by 23%, than similar claims without early PT.

Impact of early physical medicine on having lost time:

- Comparing claims of similar characteristics but different timing of utilizing PT, those with early PT had significantly lower odds of having lost time, by 12%.

Background

Starting in 2014, the four-year transition to the RBRVS in the California workers' compensation physician fee schedule increased reimbursements for most types of primary care. The fee schedule changes recognize the important role of preventative and rehabilitative medical treatments in helping workers with occupational injuries and diseases. Since then, physical medicine (including PT, chiropractic care and acupuncture) as a leading primary care treatment has experienced a continuous increase in the paid per claim at 8% annually. During the same time, however, the number of physical medicine services per claim has decreased moderately.

Recent legislation has also encouraged medical providers to treat injured workers in the California workers' compensation system with non-opioid drugs and physician services. For example, some provisions in Senate Bill No. 1160 (SB 1160), effective in January 2018, remove the requirement of prospective utilization review (UR) for certain medical services, such as physical medicine, that are provided within the first 30 days of the injury.⁷ While it may still be too early to conclude the impact of SB 1160 UR provisions on utilization of physical medicine, there was indication of increased utilization of PT within the first 30 days on claims that had an injury in 2018 compared to prior years.⁸

Meanwhile, the number of opioid prescriptions has plummeted since 2012; the medical paid for opioids per claim decreased, on average, by 32% annually from 2014 through 2018.⁹ The increase in the cost of physical medicine per claim that coincides with the sharp decline in the utilization and payments for opioids suggests that physical medicine may have been used to substitute for opioids to control pain in the workers' compensation system. The WCIRB's 2019 study on high-risk opioid use and potential alternative measures¹⁰ showed that PT, acupuncture and chiropractic care were consistently and significantly utilized more on claims involving lower doses of opioids¹¹ compared to similar claims involving high-risk opioid use and analyzed the extent to which physical medicine appeared to be used as a substitute for high-risk opioid use.

Increasing physical medicine treatment is part of a trend toward conservative care. While PT is generally recommended by clinical guidelines for treating chronic pain¹² and shown to be associated with less opioid use in some health care systems,¹³ limited information is available on the impact of early physical medicine on initiation of opioid use to control pain in the workers' compensation system. This study examines the association between use of physical medicine within 30 days after the first doctor visit and opioid prescriptions for California workers with soft tissue injuries. Specifically, the study assesses if early physical medicine reduces the likelihood of initiating opioid use among workers with soft tissue injuries and, when an injured worker already used opioids, whether early physical medicine leads to lower doses of opioids prescribed. This study also analyzes how using physical medicine during the early life of any claim may affect the likelihood of having lost time based on the WCIRB's database on indemnity transactions.

Research Questions

The study addresses the following research questions:

- What are the trends and patterns of physical medicine treatment cost and utilization in the California workers' compensation between 2013 and 2018?
- What are the characteristics of claims involving physical medicine treatment, including industry mix, diagnostic group, geographic location and time to access care?

7 See [Senate Bill No. 1160](#) (Department of Industrial Relations, January 2018) for more information.

8 WCIRB Actuarial Committee Meeting, August 1, 2019, [Meeting Minutes](#).

9 WCIRB Actuarial Committee Meeting, December 5, 2019, Item AC16-06-05, [Meeting Presentation](#).

10 Zhang, Julia, and Yichen Yu. "Early indicators of high-risk opioid use and potential alternative treatments." WCIRB, April 24, 2019. <https://www.wcirb.com/news/early-indicators-high-risk-opioid-use-study-released>.

11 High-risk opioid use is defined, for the purpose of the study, as using 50 MME or more for at least 30 consecutive days.

12 [CDC Guideline for Prescribing Opioids for Chronic Pain](#).

13 Rhon, Daniel I., Suzanne J. Snodgrass, Joshua A. Cleland, Tina A. Greenlee, Charles D. Sissel, and Chad E. Cook. "Comparison of downstream health care utilization, costs, and long-term opioid use: physical therapist management versus opioid therapy management after arthroscopic hip surgery." *Physical Therapy*, 98, no. 5 (2018): 348-356.

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- What is the impact of physical medicine treatment on opioid use among claims with soft tissue injuries?
 - a. Were claims with soft tissue injuries involving early physical medicine less likely to involve opioid use within 12 months of the injury?
 - b. For soft tissue injury claims involving opioid use, was early use of physical medicine associated with lower doses of opioids prescribed?
- Were claims involving early physical medicine treatments less likely to have lost time within 12 months of the injury?

Research Methods

This study analyzed over 1.5 million claims that had a work-related injury and had at least one medical service that was paid by the insurer in the California workers' compensation system between 2013 and 2018 using the WCIRB medical transaction data.¹⁴ The WCIRB Unit Statistical Report (USR) data was linked with the medical transaction data for claim information on industry sector. The study also analyzed a subset of the claims in the medical transaction data, specifically, claims with soft tissue injuries, for the association between early physical medicine and opioid use. Soft tissue injury claims were defined as those with a diagnostic group of soft tissue disorder (including both single and multiple injuries). The diagnostic group represents the early primary diagnosis for the claim based on the International Classification of Diseases (ICD) codes reported within the first 30 days of the first medical treatment.

Patterns of physical medicine treatment in the workers' compensation system were measured by service utilization and cost. Utilization was measured by the number of physical medicine transactions and the number of physical medicine visits per claim. The study also examined the differential use of the primary categories of physical medicine, including PT, acupuncture and chiropractic care, as well as the subcategories of PT, including active and passive therapies.¹⁵ The average cost of physical medicine treatment was measured by the medical payments for physical medicine per claim and per visit.

Other outcomes of interest in this study include any opioid use, doses of opioids prescribed and lost time within 12 months of the injury, with a particular focus on the relationship between physical medicine and opioid use for soft tissue injury claims. Of those, claims that involved any opioid use were defined as those having at least one opioid prescription within a year of the injury, and opioids used during the peri-operative period (seven days before and seven days after the major surgery) were excluded from the analysis.¹⁶ Doses of opioids prescribed were calculated by summing the morphine milligram equivalents (MME) of each opioid used by the injured worker during the same time period, based on the MME information for different types of opioids in the conversion table published by the Centers for Disease Control and Prevention (CDC).¹⁷

Information on lost time was obtained through the WCIRB indemnity transaction data, which includes indemnity benefits reported by a subset of private insurers in California.¹⁸ The indemnity data is based on the Workers' Compensation Information System (WCIS) California Electronic Data Interchange (EDI) Implementation Guide for First Report of Injury (FROI) and Subsequent Report of Injury (SROI) and captures accident-to-benefit details of California injured workers.¹⁹ Indemnity claims, for the purpose of this study, were defined as those that have any benefit payment in the SROI transaction. Claims with any lost time, for purposes of this study, were defined as indemnity claims that reported a valid last date worked or a return to work date later than the last date worked within a year of the injury. The analysis of the association between early physical medicine and lost time was performed on the claims in the medical data matched to the indemnity data and USR data.

Three multivariate regression models were constructed to assess the effects of early use of physical medicine on (1) the likelihood of initiating opioid use among soft tissue claims; (2) the doses of opioids prescribed for workers with soft tissue injuries; and (3) the likelihood of having lost time. In each model, the key explanatory variable is early use of PT, acupuncture

¹⁴ The WCIRB collects medical transaction data from 50 WCIRB insurer groups and their vendors, representing 92% of the pure premium in the California insured market. This data includes medical payments by insurers for services provided to injured workers, but does not include payments made directly to any known third party who may be assigned medical management. The data for the analysis also excludes the medical payments for liens.

¹⁵ Active physical therapies are Current Procedural Terminology (CPT) codes that run from 97110 to 97799, excluding codes 97161 to 97172, which are classified as physical therapy evaluation. Active physical therapy procedures train patients how to self-manage their care. Passive physical therapies are CPT codes that run from 97010 to 97039, which tend to be modalities.

¹⁶ Five claims that had only opioids during the peri-operative period were removed from the analysis of early physical medicine and opioid use.

¹⁷ CDC compilation of benzodiazepines, muscle relaxants, stimulants, zolpidem and opioid analgesics with oral MME conversion factors, 2017 version.

¹⁸ The WCIRB collects indemnity transaction data from a subset of private insurers, representing approximately one-quarter of the pure premium in the California insured market. These insurers write policies covering a broad range of industries and locations.

¹⁹ [WCIS California EDI Implementation Guide for First and Subsequent Reports of Injury \(FROI/SROI\)](#).

and chiropractic care, and early use was defined as having any physical medicine transactions within the first 30 days of the first medical treatment.²⁰ A logistic regression with binomial family and logit link was used in model (1). A log-linear regression was used in model (2) to address the skewed distribution of total MME at the claim level through logarithm transformation of the claim's MME. A second logistic regression with binomial family and logit link was used in model (3).

In each model, we controlled for a comprehensive set of factors that may influence the outcome of interest so that the model results represent the independent effects of physical medicine on opioid use or lost time. Selection of these influencing factors was informed by exploratory data analysis and model fit. These factors are:

- **The demographic and injury characteristics** include worker's age at the time of injury, gender, accident year, type of pain, if the worker had a surgery, industry sector and diagnostic group. Type of pain was identified using the ICD codes representing chronic and/or acute pain.²¹ Injured workers with any surgery were identified as having a major surgery²² within the first 30 days of the first medical treatment. Industrial sector was determined from the North American Industry Classification System (NAICS) information in the WCIRB USR data, in which 2017 was the latest accident year available at the time of the study.²³
- **Injured workers' concurrent medical treatments** were defined as any non-physical medicine treatments and non-opioid prescription drugs rendered on claims within the first 30 days. These include the number of non-opioid pain medications prescribed and filled, information on the specialty of the primary medical provider and the number of different providers seen in the first 30 days. The non-opioid pain medications were analyzed based on the therapeutic groups of the pain medications besides opioids.²⁴ The specialty of the primary provider seen was determined by the provider type associated with the majority medical transactions during the 30-day period and includes medical doctors (MDs), pharmacists and other non-MDs. Similarly, the number of different providers visited by an injured worker includes the same scope of practice and was counted within the same timeframe.
- **Access to care information** includes the time between the accident date and the first medical service as well as the region where the injured worker received care. The analysis defined regions based on the provider's three-digit zip code information associated with the medical transaction and divides California into eight regions.²⁵

In addition to the aforementioned controlled variables, model (2) also included the quantity (i.e., number of tablets or capsules) of prescription drugs filled within the first 30 days and limited the quantity amount to the 95th percentile of the quantity distribution to remove extreme outliers.

For both logistic models, overall model fit was evaluated using model discrimination (C-statistic) and calibration (Hosmer-Lemeshow goodness of fit test). The fit of the log-linear model was evaluated using standard model diagnostics for linear regression, including tests for model assumptions and influential outliers.

Sensitivity analysis was conducted for all models, such as a multinomial logistic regression for model (1) in which the distribution of the number of opioid prescriptions was examined, and claims with only one opioid prescription within one year of the injury were grouped separately from the claims with no opioid prescription and those with two or more opioid prescriptions. The reason for the multinomial logistic regression was to recognize the potential differentials in the clinical rationale for using opioids to relieve acute pain compared to chronic pain. The results from the multinomial model showed similar patterns as the logistic regression. For model (2), a gamma regression with log link was used to validate the log-linear regression. The results from the gamma regression model showed similar patterns as the log linear regression. Lastly, a Cox proportional hazards model was used to validate model (3), and it showed a similar pattern as the logistic regression, indicating a strong negative association between early use of PT and the likelihood of having lost time from work.

²⁰ For model (3), early use of physical medicine was defined as within the first 30 days of the first medical treatment or within the date of return to work, depending on which occurred first.

²¹ CDC: Quality Improvement and Care Coordination: Implementing the CDC Guideline for Prescribing Opioids for Chronic Pain.

²² Major surgery was identified using the Global Surgery indicator derived from global surgery data field within National Physician Fee Schedule Relative Value File Calendar Year 2017. Value "90" in the Global Surgery indicator determines the surgery as a major one.

²³ For model (3), the industrial sector was the NAICS information provided in the WCIRB indemnity transaction data.

²⁴ Morelli, Jim. "Pain relief medications: OTC, prescription & side effects." RxList. April 27, 2016. https://www.rxlist.com/pain_medications/drug-class.htm.

²⁵ The eight regions included are LA County, remainder of LA Basin, Central Valley, Central Coast, Bay Area, San Diego County, Sacramento and the remainder of California.

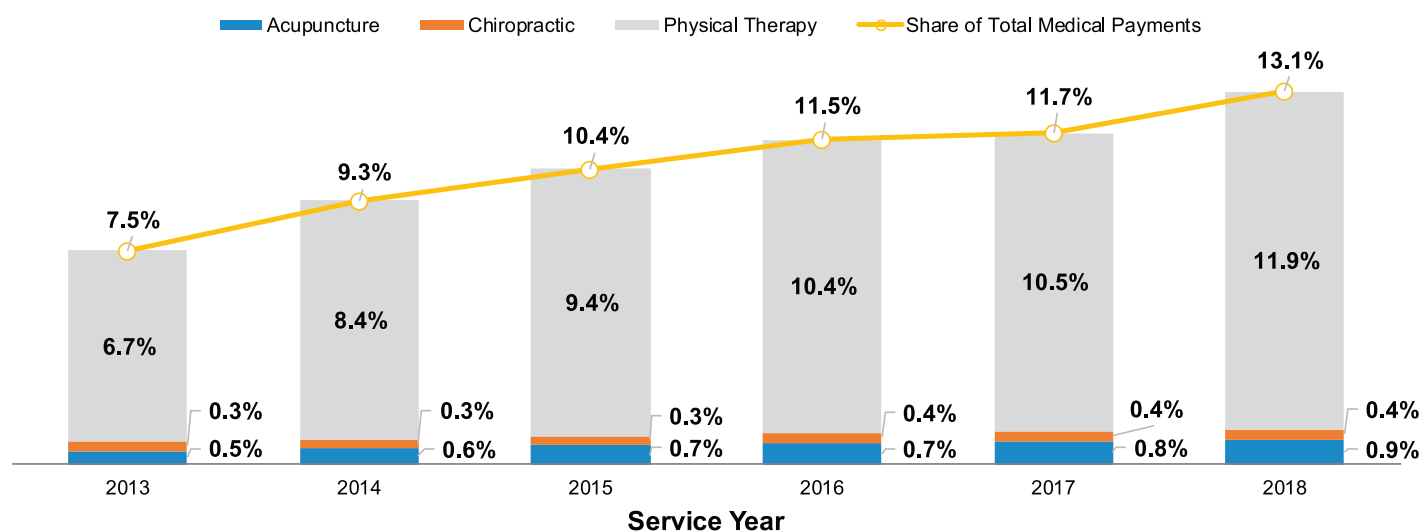
Results

Overall Patterns and Trends in Physical Medicine Treatment Cost and Utilization

Medical Payments

The share of total medical payments in the WCIRB's medical transaction database²⁶ for physical medicine increased steadily and continuously, by 75%, from 2013 through 2018 (Figure 1). The increase in physical medicine payment share is primarily attributable to: 1) the significant increase (by 78%) in the average medical payments for PT (the leading type of physical medicine); 2) some slight increases in the acupuncture payment share; and 3) the steep decline in the pharmaceutical payment share.

Figure 1. Share of Total Medical Payments for Physical Medicine



The increase in the share of medical payments for PT was mostly driven by the increases in the payment share for active PT and PT evaluation (Figure 2). The average payments for both have increased since 2014, by more than 30%. Active PTs are procedures that train patients how to manage care on their own and typically involve exercises and movements performed by the patients. Passive PTs, on the other hand, are mostly modalities administered by the manual therapy provider to the affected area of the patient and involve less patient participation. As shown in Figure 2, the share of payments for passive PT, although less than 1% in 2013, continued to decline to 0.3% in 2018. The decline was largely attributable to a decrease in the number of passive PT services provided. The increases in the payment share of active PT and the decreases in that of passive PT suggest a slight change in the mix of PT care.

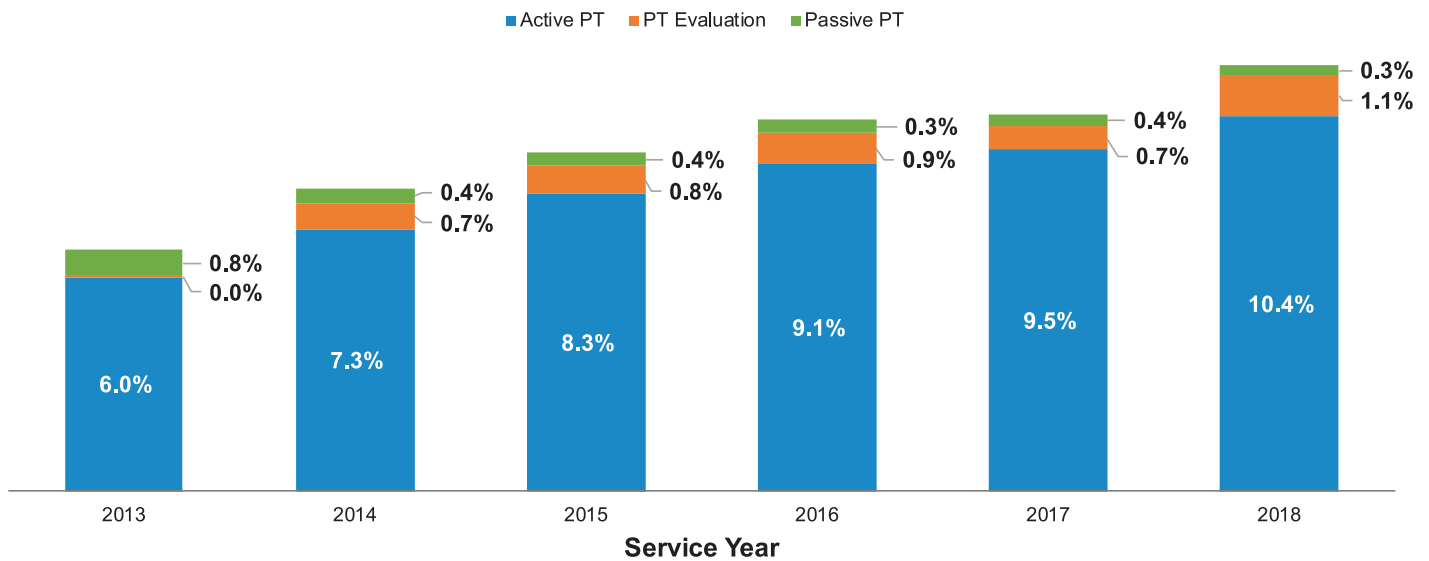
In addition to the change in the mix of PT care, the increase in the average payments for PT was also driven by the RBRVS-based fee schedule that increased the reimbursement for primary care between 2014 and 2017 as well as by the changes in the billing of new PT codes, which started to incorporate different complexity levels in 2017.²⁷

While chiropractic care and acupuncture were utilized less frequently in workers' compensation, there was some indication of a shift in acupuncture from that with electrical stimulation to that without electrical stimulation between 2013 and 2018 as well as a shift in chiropractic treatments from manipulations on one to two spinal regions to three to four spinal regions during the same time period.

²⁶ This data includes medical payments by insurers for services provided to injured workers, but does not include payments made directly to any known third party who may be assigned medical management and does not include the settlement amounts for future medical included in compromise and release settlements. The data for the analysis also excludes the medical payments for liens.

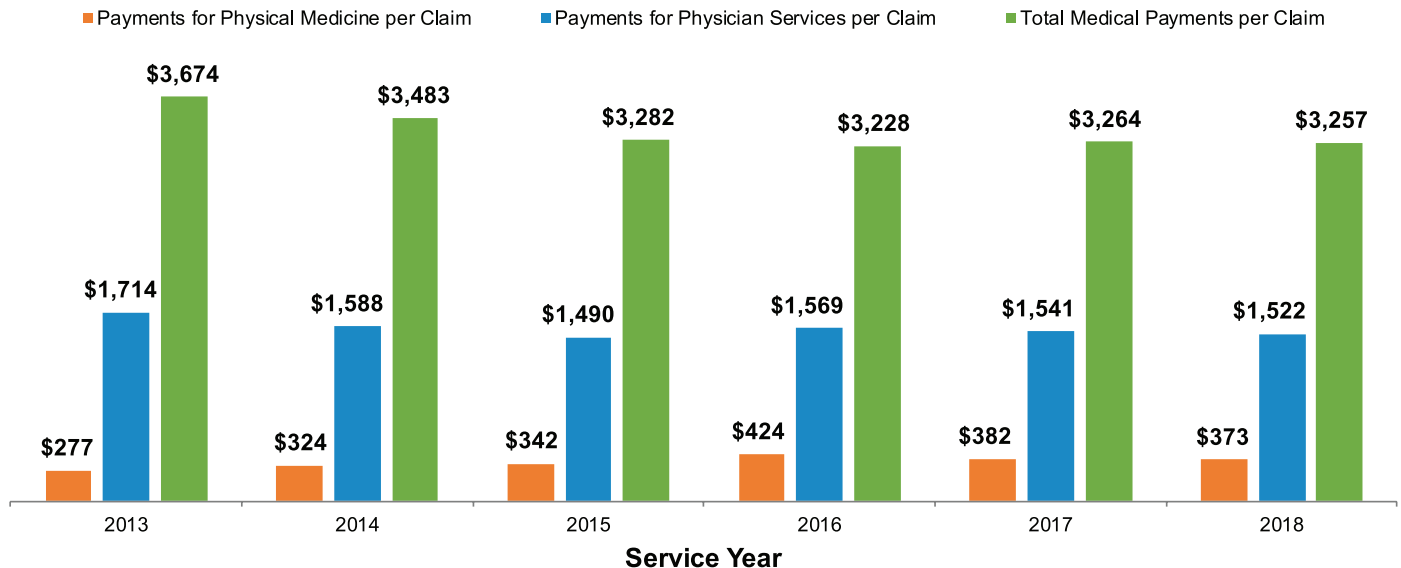
²⁷ For example, PT code 97001 was replaced by three different codes to represent different complexity levels of evaluations in 2017: low-complexity (97161), moderate-complexity (97162) and high-complexity (97163).

Figure 2. Share of Total Medical Payments for Physical Therapy by Type



The average medical payment for physical medicine rose from 2013 through 2018, contributing to a growing proportion of the total medical paid per claim (8% to 11%) as well as of the medical paid for physician services (16% to 25%) over time (Figure 3). During this period, payments per claim for physical medicine increased by 35%, whereas the total medical payments per claim decreased by 11%. The increase in the average payments for physical medicine was, as mentioned earlier, mainly driven by the changes in the fee schedule, the billing of new physical medicine codes as well as the service mix.

Figure 3. Physical Medicine Paid per Claim Compared to Total Medical Paid per Claim and Physician Services Paid per Claim



Physical medicine services were paid, on average, at 13% below the fee schedule, reflecting discounting in many networks. Only about 8% of all physical medicine transactions were paid above the fee schedule. There was a slight rural-urban divide in the payments relative to the fee schedule maximum allowable. Specifically, physical medicine services provided in the urban areas, such as the LA Basin and the Bay Area, were more likely to be paid above the fee schedule amount than those in the more rural areas (Figure 4). The majority of the procedures paid above the fee schedule were for active PT services.

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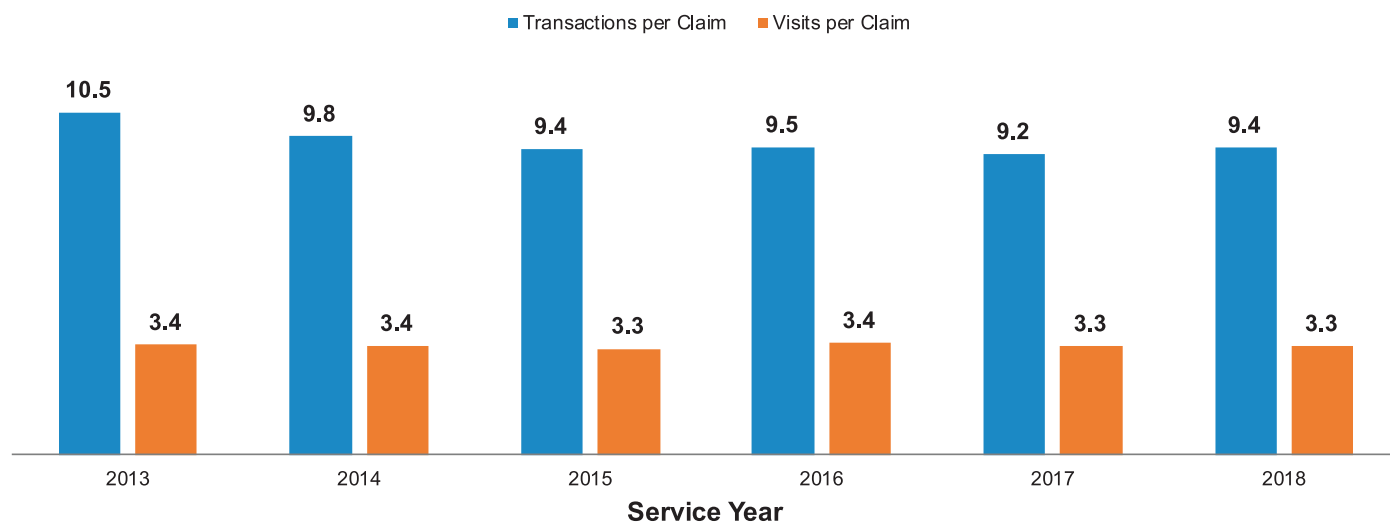
Figure 4. Share of Physical Medicine Transactions Paid above the Fee Schedule Maximum Allowable



Service Utilization

Overall, utilization of physical medicine in the workers' compensation system remained stable over time. The average number of physical medicine services per claim experienced a moderate decline between 2013 and 2018, by 10%; the average number of visits per claim remained stable during the same period (Figure 5). The slightly different trends in transaction-based compared to the visit-based utilization measure potentially suggest the impact of the cascading billing practice on the number of physical medicine services provided per visit.

Figure 5. Number of Physical Medicine Services and Visits per Claim



Similar to the flat trend of the average number of physical medicine visits, claims with 12-month experience that reached the 24-visit cap²⁸ remained low at about 2%. Over 60% of all claims did not involve any physical medicine visits, and the share of claims without physical medicine remained the same between 2013 and 2017, the latest year that we have data on claims with 12 months of experience at the time of the study.

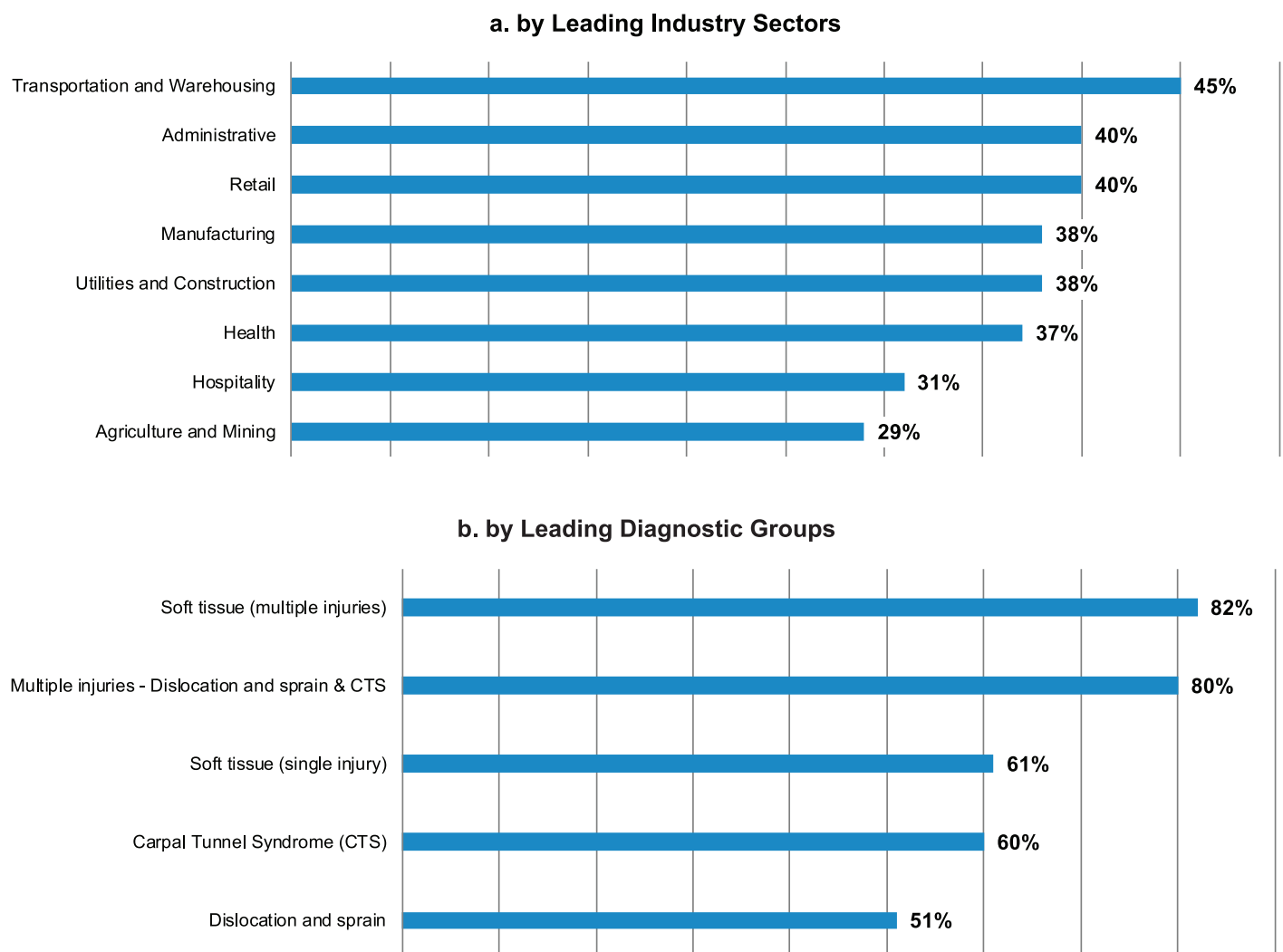
²⁸ California Labor Code Section 4604.5.

Characteristics of Claims Involving Physical Medicine

The industry sector distribution of claims involving physical medicine remained essentially unchanged between 2013 and 2017. Even within the same year, the share of all claims involving physical medicine varies only moderately across industry sectors. In 2017, for example, the industry sector with the highest proportion of claims with physical medicine services is Transportation and Warehousing, as about 45% of all claims in that sector received physical medicine treatments (Figure 6a). Also, the average payment for physical medicine in each sector remains consistent over time, with claims in Utilities and Construction incurring the highest average medical payment for physical medicine during the first six months after the injury (\$909).

Unsurprisingly, the injury mix of claims involving physical medicine was also consistent between 2013 and 2018. This analysis uses diagnostic group to represent the early diagnostic information of each claim. Claims involving soft tissue injuries or carpal tunnel syndrome (CTS) were more likely to have physical medicine treatment than those with acute injuries, such as dislocation and sprain (Figure 6b). For claims involving soft tissue injuries, PT, especially active PT, was the primary physical medicine treatment provided. Also, about 80% of claims involving multiple injuries including CTS and dislocation received physical medicine.

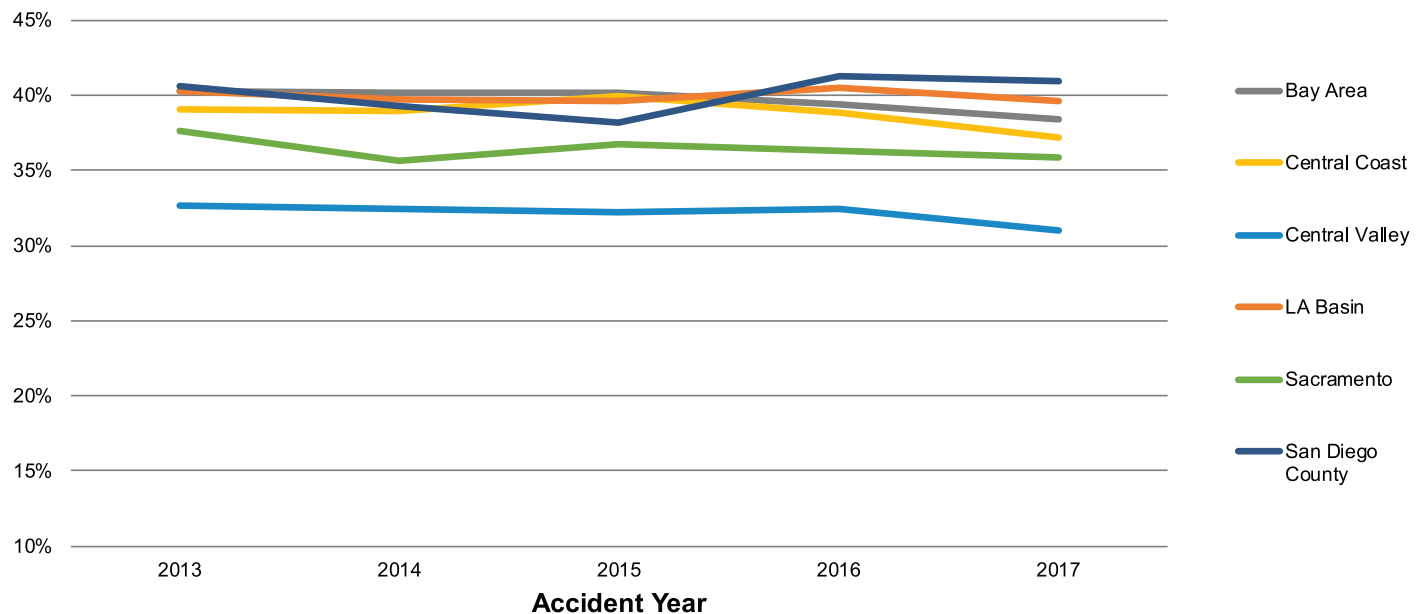
Figure 6. Share of Claims Involving Physical Medicine in Accident Year 2017 (6-Month Experience) by Leading Industry Sectors and Diagnostic Groups



**Physical Medicine Treatments and Their Impact on Opioid Use
and Lost Time in California Workers' Compensation**

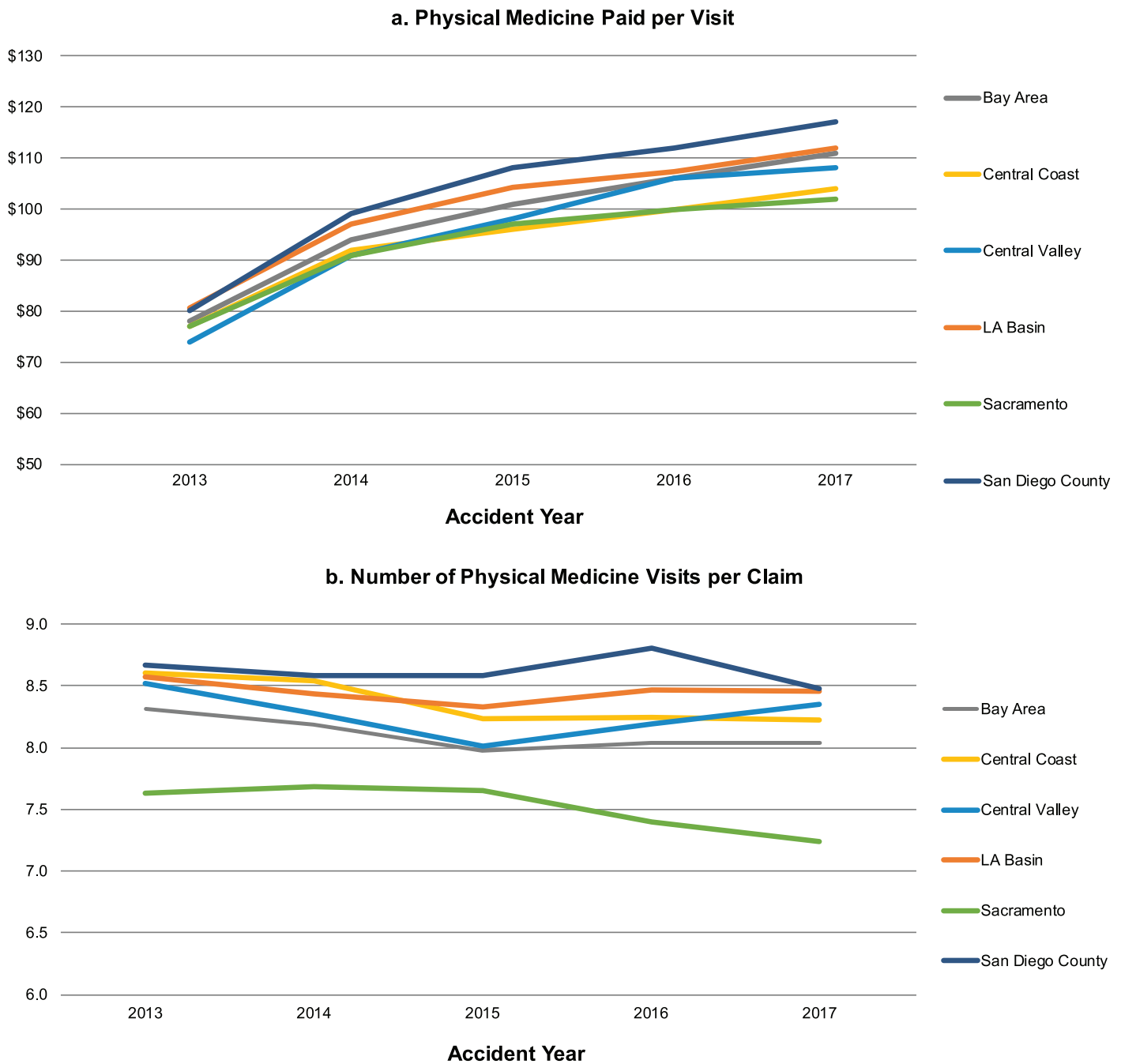
The share of claims involving physical medicine treatment remains fairly stable across regions within California, although there was a slight decrease in the claim share in the Central Coast and a slight increase in San Diego County between 2015 and 2017 (Figure 7). The Central Valley, in particular, has the lowest share of claims involving physical medicine of all years.

Figure 7. Share of Claims Involving Physical Medicine by Geographic Region (6-Month Experience)



Similar to the overall pattern, the average paid for physical medicine visit among physical medicine claims was trending up in all regions (Figure 8a). San Diego County showed the largest growth, with a 47% increase in the paid per visit from 2013 to 2017. The number of physical medicine visits per claim involving any physical medicine treatment, however, was stable over time, with claims in Sacramento having the lowest number of visits on average (Figure 8b).

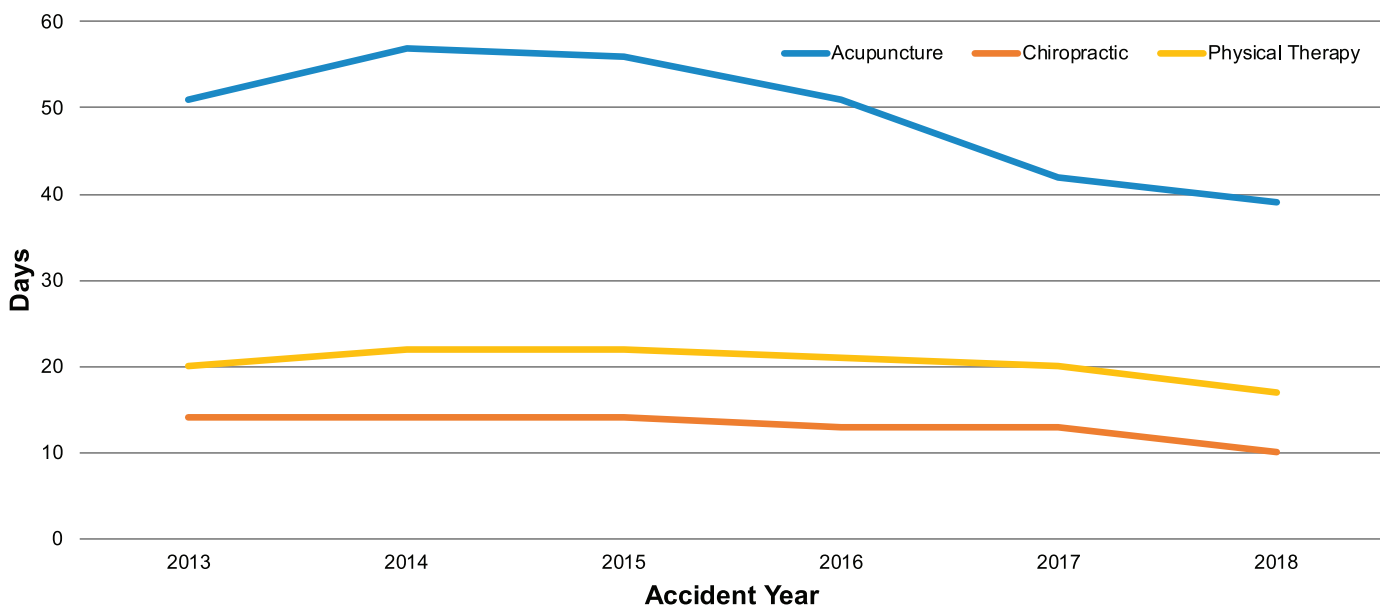
Figure 8. Physical Medicine Paid per Visit and per Physical Medicine Claim by Region (6-Month Experience)



Starting from 2014, the time from injury to the first treatment decreased for almost all physical medicine types, indicating that injured workers were getting earlier physical medicine treatment overall (Figure 9). Chiropractic care and PT, in particular, were rendered within three weeks of the injury approximately one-half of the time. Since chiropractors are included as primary treating physicians in the California workers' compensation system and patients do not need referrals to seek care, median time to first chiropractic treatment is significantly lower than for other physical medicine treatments. As most physical medicine treatments are for PT, the time to first physical medicine tracks closely the time-to-PT trend. Access to PT was found to be fastest in LA County (median time: 16 days), while it takes the shortest time to access chiropractic care in Sacramento and the Central Valley (median time for both: 11 days).

Physical Medicine Treatments and Their Impact on Opioid Use and Lost Time in California Workers' Compensation

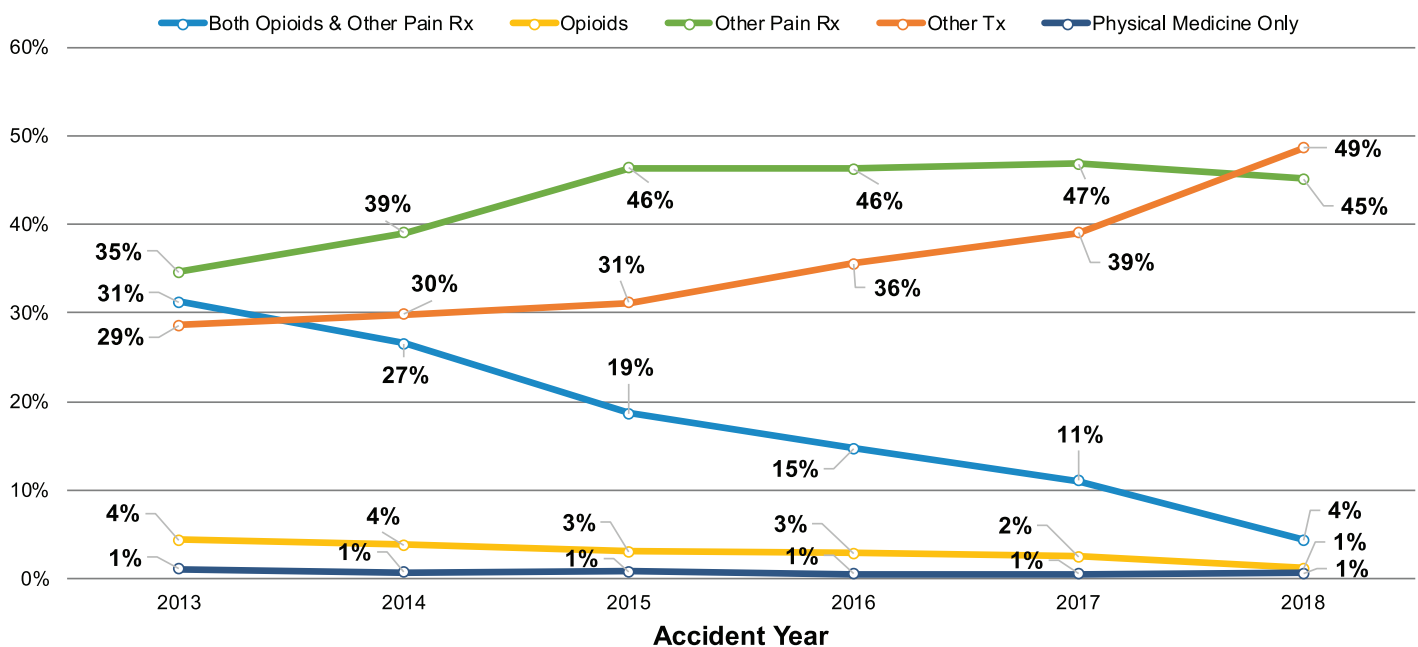
Figure 9. Median Days to First Physical Medicine Treatment by Treatment Type (6-Month Experience)



Note. Cumulative trauma claims were excluded from the analysis.

Figure 10 shows the patterns of other medical treatments on claims involving physical medicine. Between 2013 and 2018, there was a sharp decline (86%) in the utilization of both opioids and other pain medications in conjunction with physical medicine, largely driven by the declines in the use of opioids. Concurrent use of opioids and physical medicine decreased by 72% during this time period. On the other hand, there was a rapid increase (70%) in concurrent medical treatments other than pain medications between 2013 and 2018. In particular, complex evaluation and management procedures during office visits were among the leading concurrent treatments among other medical treatments increasing during the period. The surge in the use of physical medicine and office visits is suggestive of potential substitution for opioid use, which is discussed in greater detail in the next section.

Figure 10. Other Types of Medical Treatments Used on Claims Involving Physical Medicine (6-Month Experience)



Note. Non-medical treatment services such as medical legal, liens, copy services and interpreter services were not included in the graph.

Early Use of Physical Medicine and Opioid Use among Claims with Soft Tissue Injuries

Soft tissue injuries are typical in the worker's compensation system, and they are more likely to involve musculoskeletal pain and medical treatment to control pain. PT is recommended by the CDC as an alternative treatment to opioids for controlling chronic pain. Early use of PT appears to reduce opioid use among injured workers with musculoskeletal pain and was shown to reduce downstream health care utilization and costs.²⁹ The evidence, however, has been limited to patients in group health or other health care systems.³⁰

In this analysis, the WCIRB assessed the association between early use of physical medicine and opioid use among California injured workers with soft tissue injuries to shoulder, back, neck or knee. The study analyzed whether soft tissue injury claims that involved early use of physical medicine may have a lower likelihood of opioid use than claims without early physical medicine treatments, controlling for demographics and other injury characteristics, concurrent medical treatments and access to care characteristics. Also, among soft tissue injury claims that involved use of opioids, the analysis assessed whether early PT may have helped them reduce the doses of opioids needed.

Association between Early Physical Medicine and Any Opioid Use

Overall, more than 170,000 claims had a soft tissue injury to shoulder, back, neck or knee between 2013 and 2017 in the WCIRB medical transaction database. More than 50% involved at least one physical medicine service, mostly PT (Table 1). More than 54,000 claims (32%) received at least one opioid prescription within 12 months of the injury. These claims were significantly more likely to involve physical medicine, overall and by different types (except for acupuncture), within the first 30 days. This may not be surprising and likely indicates that the claims are more complex.

Table 1. Unadjusted Association between Physical Medicine and Any Opioid Use among Claims with Soft Tissue Injuries

	All Soft Tissue Injury Claims (N=171,230)		Soft Tissue Injury Claims w/o Opioid Use (N=116,705)		Soft Tissue Injury Claims Involving Any Opioid Use (N= 54,525)		P-value*
	N	%	N	%	N	%	
Early Use of Physical Medicine							
Physical Therapy	89,911	52.5	57,779	49.5	32,132	58.9	< 0.001
Chiropractic Care	14,963	8.7	10,014	8.6	4,949	9.1	< 0.001
Acupuncture	2,704	1.6	1,948	1.7	756	1.4	< 0.001
Total Soft Tissue Injury Claims with Physical Medicine	90,349	52.8	58,127	49.8	32,222	59.1	< 0.001

Note. Chi-square test was conducted to analyze the difference in the share of claims involving early physical medicine comparing claims with opioid use to claims with no opioid use. N is sample size.

Also, these injured workers more frequently worked in manufacturing (14%) and retail (13%). Around two-thirds had one or more non-opioid pain medications, and a similar share had at least one type of pain (acute, chronic or both), yet only 1% had any major surgery. About 70% of them had seen two medical providers or more, and almost half sought care in LA County. See Appendices (Table A1) for more information on the characteristics of the soft tissue injury claims included in the analysis.

29 Childs, John D., Julie M. Fritz, Samuel S. Wu, Timothy W. Flynn, Robert S. Wainner, Eric K. Robertson, Forest S. Kim, and Steven Z. George. "Implications of early and guideline adherent physical therapy for low back pain on utilization and costs." *BMC Health Services Research*, 15, no. 1 (2015): 150.

30 Eccleston, Christopher, Emma Fisher, Kyla H. Thomas, Leslie Hearn, Sheena Derry, Cathy Stannard, Roger Knaggs, and R. Andrew Moore. "Interventions for the reduction of prescribed opioid use in chronic non-cancer pain." *Cochrane Database Syst Rev*, 11 (2017): Nov 13;11:CD010323.
Pivec, Robert, Michael E. Minshall, J. B. Mistry, M. Chughtai, R. K. Elmallah, and M. A. Mont. "Decreased opioid utilization and cost at one year in chronic low back pain patients treated with transcutaneous electric nerve stimulation (TENS)." *Surg Technol Int*, 27 (2015): 268-274.
Sun, Eric, Jasmin Moshfegh, Chris A. Rishel, Chad E. Cook, Adam P. Goode, and Steven Z. George. "Association of early physical therapy with long-term opioid use among opioid-naïve patients with musculoskeletal pain." *JAMA Network Open*, 1, no. 8 (2018): e185909-e185909.
Thackeray, Anne, Rachel Hess, Josette Dorius, Darrel Brodke, and Julie Fritz. "Relationship of opioid prescriptions to physical therapy referral and participation for Medicaid patients with new-onset low back pain." *The Journal of the American Board of Family Medicine*, 30, no. 6 (2017): 784-794.

Physical Medicine Treatments and Their Impact on Opioid Use and Lost Time in California Workers' Compensation

After controlling for potential confounding factors (listed in Table A1), soft tissue injury claims with early PT were 4% (95% confidence interval [CI]: 1 to 7%) less likely to initiate opioid use within one year of the injury (Table 2). While the overall impact of early PT was statistically significant, likely due to the large sample size, the magnitude of the impact is not strong. The marginal effect, in fact, is consistent with other studies on the same topic from other systems. For example, a study on privately insured patients found that early use of PT reduced incidence of opioid use among shoulder, neck, knee or low back pain patients, by about 7%.³¹

The analysis also indicates that chiropractic care within the first 30 days was associated with 16% (95% CI: 12 to 20%) lower odds of opioid use, controlling for potential confounding factors (Table 2). While claims with early chiropractic care are about 9% of claims with soft tissue injuries, the result is consistent with existing studies from other systems. For example, a 2019 systematic review of published studies on the association between chiropractic use and opioid use among patients with spinal pain showed that the proportion of patients receiving an opioid prescription was lower for chiropractic users than non-users by about 10%.³²

Table 2. Adjusted Association between Physical Medicine and Opioid Use among Claims with Soft Tissue Injuries (N=171,230)

Type of Physical Medicine	Adjusted Odds Ratio of Any Opioid Use within 12 Months of the Injury	95% Confidence Interval
Has Early PT	0.96 **	0.93, 0.99
Has Early Chiropractic Care	0.84 ***	0.80, 0.88
Has Early Acupuncture	0.93	0.84, 1.04

Note. **** < 0.001 *** < 0.01 ** < 0.05

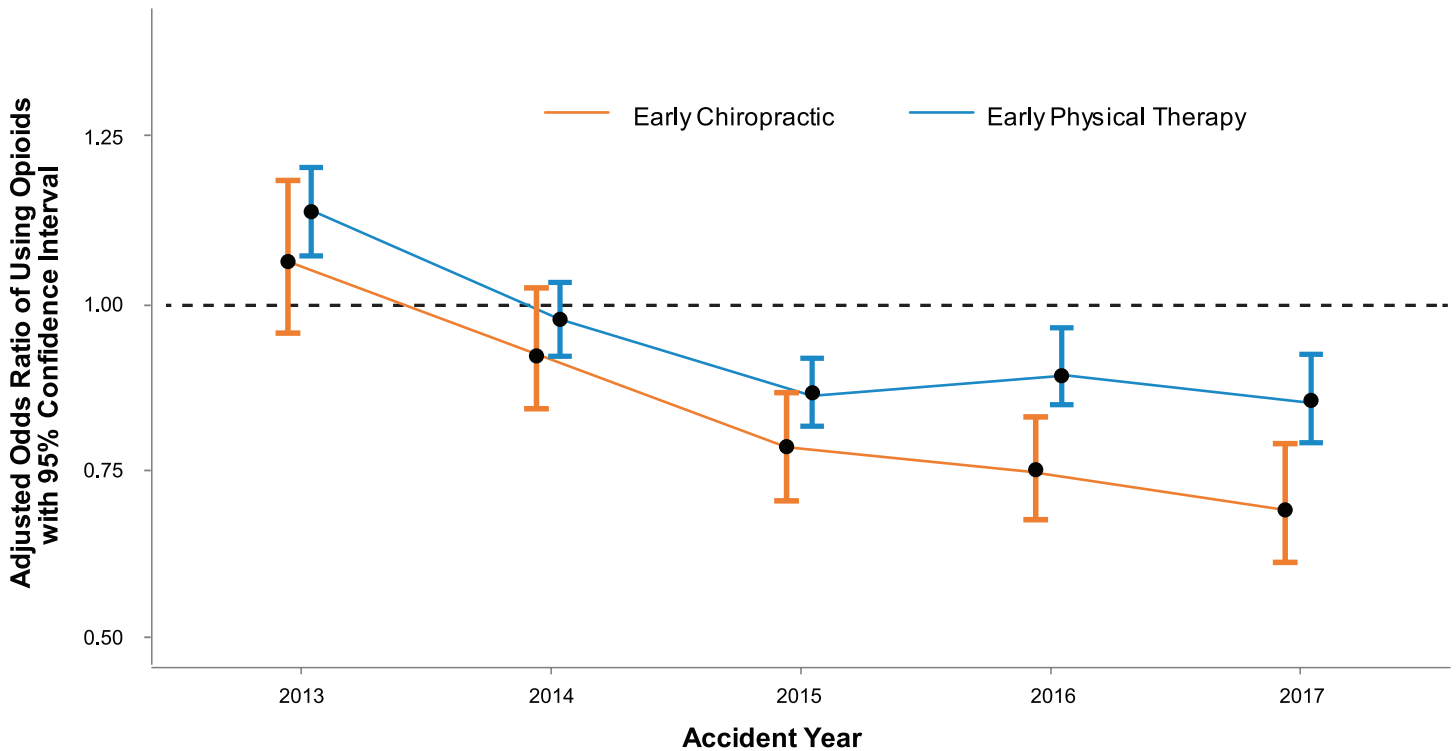
Multivariate logistic regression was used to estimate the association between early use of physical medicine and the likelihood of opioid use within 12 months of the injury. See the coefficients of the controlled variables in the model in Appendices (Table A2). C-statistic of the final regression shows that the model has a good fit.

Interestingly, the magnitude and direction of the impact of early PT on initiation of opioid use on soft tissue injury claims vary over time (Figure 11). Specifically, before 2015, soft tissue injury claims involving early PT did not have, on average, lower odds of opioid use within one year of the injury; between 2015 and 2017, however, early PT started to significantly lower the odds of opioid use, by about 13% on average (AY2015 claims: 14% [95% CI: 8 to 19%]; AY 2016: 11% [95% CI: 4 to 17%]; and AY2017: 15% [95% CI: 8 to 21%]). This indicates a more pronounced substitution between early PT and opioid use experienced by the more recent claims.

31 Sun, Eric, Jasmin Moshfegh, Chris A. Rishel, Chad E. Cook, Adam P. Goode, and Steven Z. George. "Association of early physical therapy with long-term opioid use among opioid-naïve patients with musculoskeletal pain." *JAMA Network Open*, 1, no. 8 (2018): e185909-e185909.

32 Corcoran, Kelsey L., Lori A. Bastian, Craig G. Gunderson, Catherine Steffens, Alexandria Brackett, and Anthony J. Lisi. "Association between chiropractic use and opioid receipt among patients with spinal pain: a systematic review and meta-analysis." *Pain Medicine* (2019).

Figure 11. Time-Varying Effect of Early Physical Medicine on Initiation of Opioid Use among Claims with Soft Tissue Injuries



Association between Early Physical Medicine and Doses of Opioids Prescribed

Compared to soft tissue claims that did not involve opioids, those that involved opioids were more likely to have an injury before 2015 and worked in retail, and over 90% of these claims had one or more non-opioid pain medications (Appendices: Table A3). These injured workers had a shorter time to access care (11 days vs. 20 days for all workers with soft tissue injuries). Also, a significantly larger share of these claims involved at least two different medical providers (87% vs. 68% for all soft tissue claims).

PT was the leading type of physical medicine treatments rendered (Table 3). Chiropractic care and acupuncture were used on 9% and 1% of the soft tissue claims with any opioid prescription, respectively. Overall, the average doses of opioids prescribed for these injured workers were 1,044 MME over 12 months after the injury. Even without controlling for injury mix or other factors, those claims that used PT within the first 30 days tended to have a significantly lower average MME at the claim level than those that did not use PT during the same timeframe. A similar pattern was observed for claims involving early chiropractic care, but not for those involving early acupuncture.

Table 3. Unadjusted Association between Physical Medicine and Doses of Opioids Prescribed among Claims with Soft Tissue Injuries

	# of Soft Tissue Claims Involving Opioid Use		Soft Tissue Claim MME		P-value*
	N	%	Mean	SD	
Early Use of Physical Therapy					
Yes	17,766	58.4	964	1,929	< 0.001
No	12,676	41.6	1,156	2,326	
Early Use of Chiropractic Care					
Yes	2,758	9.1	840	1,750	< 0.001
No	27,684	90.9	1,064	2,137	
Early Use of Acupuncture					
Yes	359	1.2	1,046	2,110	0.98
No	30,083	98.8	888	1,691	
Total	30,442	100.0	1,044	2,106	< 0.001

*Wilcoxon rank sum test was performed to compare the difference between the groups with early physical medicine and those without.
SD stands for standard deviation. N is sample size.

After controlling for potential confounding factors (listed in Table A3), soft tissue claims involving early PT were associated with, on average, lower doses of opioids by 23% (95% CI: 20 to 25%) (Table 4). The result is consistent with existing studies from other systems, one of which showed that for patients who used opioids, early PT was associated with an approximately 10% reduction in the quantity of opioids (MME) used for pain control.³³ Another study of patients after hip surgery in a military health system showed that using PT first resulted in significantly fewer opioid prescriptions than patients initiating opioid use first.³⁴

Table 4. Adjusted Association between Physical Medicine and Doses of Opioids Prescribed on Claims with Soft Tissue Injuries (N = 30,442)

	% Change in Average MME	95% Confidence Interval
Type of Physical Medicine		
Has Early PT	0.77 ***	0.75, 0.80
Has Early Chiropractic Care	0.73 ***	0.69, 0.78
Has Early Acupuncture	1.05	0.91, 1.21

Note. **** < 0.001 *** < 0.01 ** < 0.05

Multivariate log-linear regression was used to estimate the association between early use of physical medicine and the amount of opioid doses prescribed to the injured worker within 12 months of the injury. See the coefficients of the controlled variables in the model in Appendices (Table A4).

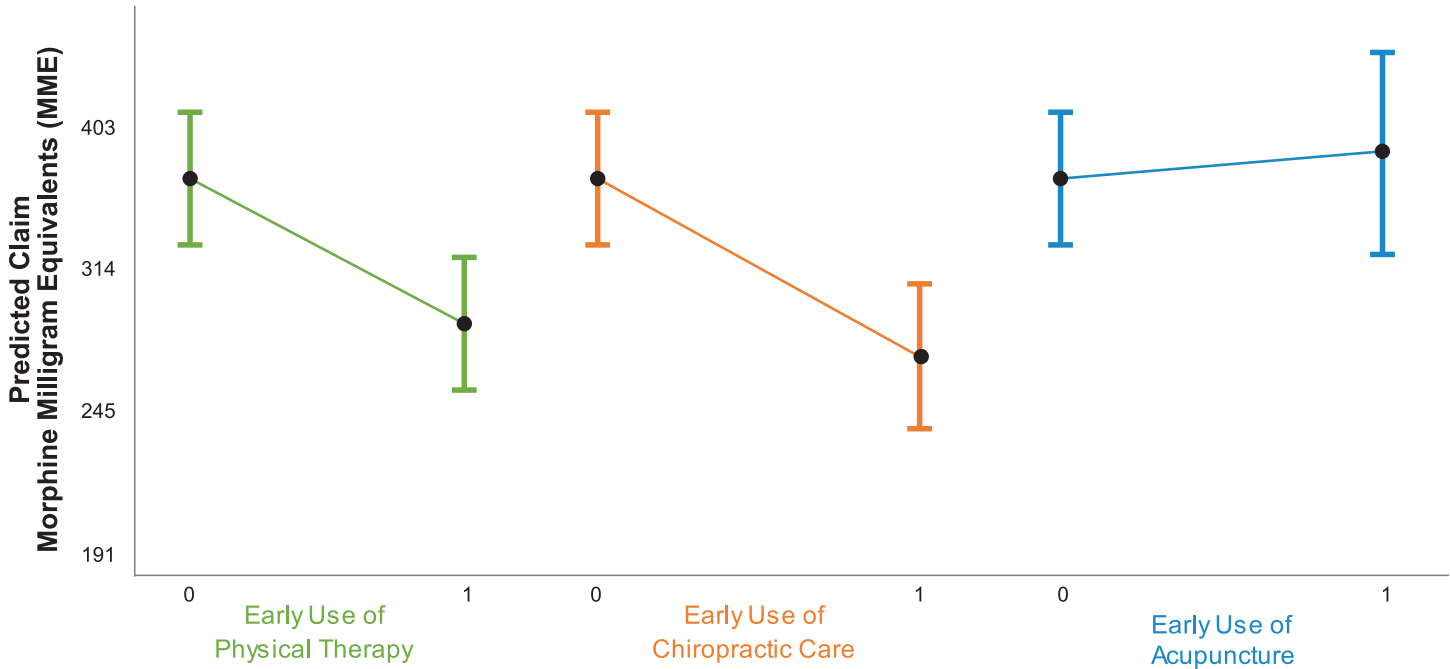
Figure 12 shows the difference in the predicted claim MME between AY2013 soft tissue claims³⁵ involving early use of PT and similar claims that did not involve early PT, based on the regression model. Specifically, soft tissue claims involving early PT have, on average, a significantly lower average dose of opioids, by 84 MME, than similar claims without early PT. This analysis also suggests that early use of chiropractic care had similar effects on the average MME on claims; however, the small sample size does not warrant robust inferences.

33 Sun, Eric, Jasmin Moshfegh, Chris A. Rishel, Chad E. Cook, Adam P. Goode, and Steven Z. George. "Association of early physical therapy with long-term opioid use among opioid-naïve patients with musculoskeletal pain." *JAMA Network Open*, 1, no. 8 (2018): e185909-e185909.

34 Rhon, Daniel I., Suzanne J. Snodgrass, Joshua A. Cleland, Tina A. Greenlee, Charles D. Sissel, and Chad E. Cook. "Comparison of downstream health care utilization, costs, and long-term opioid use: physical therapist management versus opioid therapy management after arthroscopic hip surgery." *Physical Therapy*, 98, no. 5 (2018): 348-356.

35 AY2013 claims were selected for the predicted MME because they tended to involve higher doses of opioids than more recent claims and could better highlight the effect of early PT.

Figure 12. Difference in the Predicted Morphine Milligram Equivalents (MME) for Accident Year 2013 Claims³⁶ Comparing Soft Tissue Injury Claims with Early Use of Physical Medicine and Similar Claims without Early Physical Medicine



Early Use of Physical Medicine and Lost Time

Workers involving a longer time away from work due to a workplace injury often incur significantly higher medical and indemnity costs in the workers' compensation system. A 2008 study showed that early use of active PT was associated with reduced time lost from work, claim duration and chronic pain among patients with work-related acute musculoskeletal pain.³⁷ However, limited research is available on the association between early physical medicine and losing time from work. This analysis used the database that the WCIRB has been developing on indemnity transaction information to test this association.

Information on the last date worked in the WCIRB indemnity transaction data was available for 10,147 claims that were matched to the WCIRB medical transaction data and USR data at the time of this study, and about 60% of these involved lost time (Table 5). About 80% of these matched claims had an injury in 2017 or the first half of 2018 given the timing of the WCIRB's collection of this data (Appendices: Table A5). These indemnity claims also tended to have fewer concurrent non-opioid pain medication compared to claims in the WCIRB medical transaction data and USR data. Nonetheless, these injured workers more frequently seek care in Southern California and have similar distributions of diagnostic groups and pain type compared to all claims in the matched WCIRB's medical transaction and USR data.

³⁶ Predicted claim MME was calculated for each claim by varying the PT value (0/1) and using the mean values of all other variables in the model (Table A5).

³⁷ Bernacki, Edward J., and Xuguang Grant Tao. "The relationship between attorney involvement, claim duration, and workers' compensation costs." *Journal of Occupational and Environment Medicine*, 50, no. 9 (2008): 1013-1018.

Physical Medicine Treatments and Their Impact on Opioid Use and Lost Time in California Workers' Compensation

Table 5. Unadjusted Association between Physical Medicine and Lost Time for Claims in the Medical Transaction Data Linked to the Indemnity Transaction Data and the Unit Statistical Report Data

	All Linked Claims (N=10,147)		Linked Claims w/ Lost Time (N= 6,177)		Linked Claims w/o Lost Time (N=3,970)		P-value*
	N	%	N	%	N	%	
Early Use of Physical Medicine							
Physical Therapy	3,110	30.6	1,889	30.9	1,221	30.8	0.87
Chiropractic Care	376	3.7	217	3.5	159	4.0	0.22
Acupuncture	101	1.0	59	1.0	42	1.1	0.68
Total Claims with Physical Medicine	3,116	30.7	1,891	30.9	1,225	30.9	<0.001

*Chi-squared test was performed to compare the difference between claims with lost time and those without lost time.

About 30% of all claims had PT, and the share was very similar for claims with and without lost time (Table 5). Chiropractic care and acupuncture were utilized much less frequently. As shown in Table 6, of the claims with lost time information, it was found that those with early PT were 12% (95% CI: 2 to 22%) less likely to have any lost time, after controlling for all other controlled variables (listed in Table A5). No statistically significant effects of chiropractic care or acupuncture were found on the probability of lost time.

Table 6. Adjusted Association between Physical Medicine and Lost Time (N=10,147)³⁸

	Adjusted Odds Ratio of Having Lost Time from Work	95% Confidence Interval
Type of Physical Medicine		
Has Early PT	0.88 *	0.78, 0.98
Has Early Chiropractic Care	1.01	0.76, 1.35
Has Early Acupuncture	0.97	0.60, 1.56

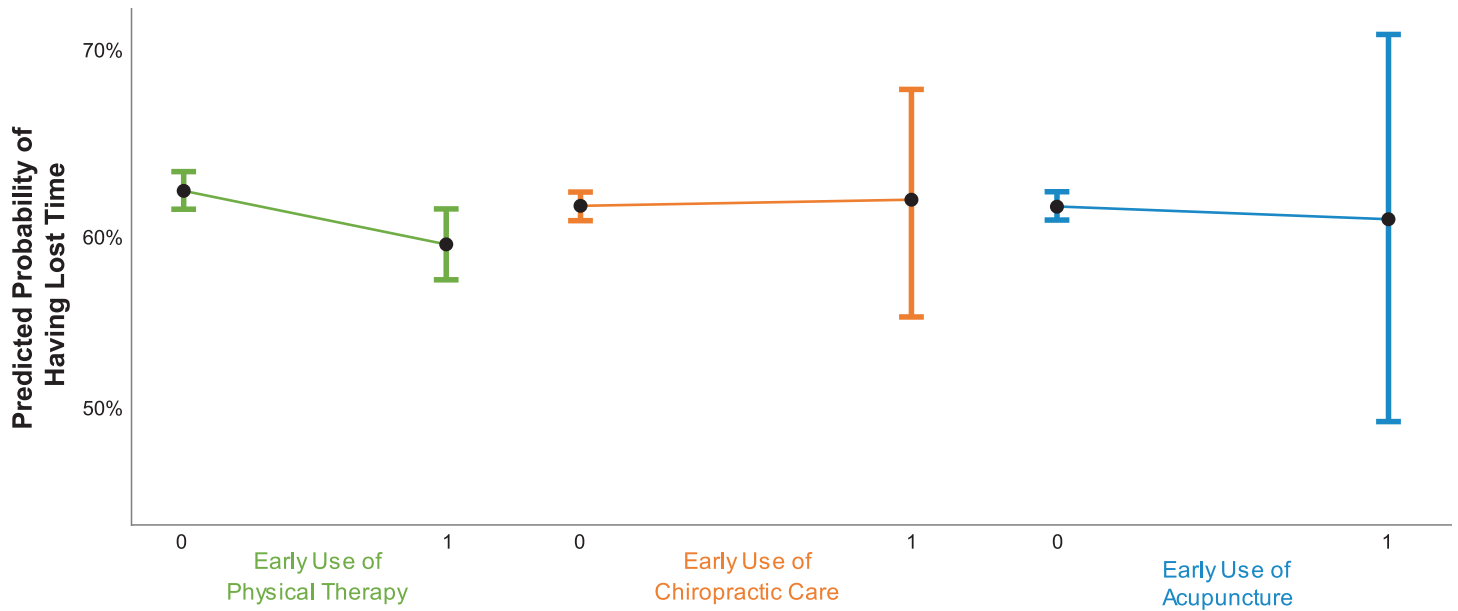
Note. **** < 0.001 *** < 0.01 * < 0.05

Multivariate logistic regression was used to estimate the association between early use of physical medicine and the likelihood of losing time from work. See the coefficients of the controlled variables in the model in Appendices (Table A6). C-statistic of the final regression shows that the model has a good fit.

Figure 13 shows the difference in the predicted probability of having lost time between claims involving early use of physical medicine and similar claims that did not involve early physical medicine, within one year of the injury. The prediction was based on the regression model shown in Table 6 and Table A6. Specifically, claims using PT within the first 30 days are estimated to have a much lower probability of having lost time than similar claims without early PT. Early acupuncture and chiropractic care do not seem to affect the probability of lost time.

³⁸ For the logistic regression, claims with early physical medicine treatments were identified if the treatment is earlier than 30 days within the first date of treatment or the date the injured worker has returned to work. Identification of claims with at least one early opioid prescription used the same process. Also, claims that had an injury before 2018 in the new indemnity transaction data were more likely to have lost time than claims in 2018, which is more representative of typical claims in the indemnity transaction data. Even when the regression model controlled for injury mix and accident year, the estimated impact of early physical medicine may be slightly underestimated.

Figure 13. Difference in the Predicted Probability of Having Lost Time Comparing Claims with Early Use of Physical Medicine and Similar Claims without Early Physical Medicine



Conclusions

The medical payments for opioids per claim have plummeted by more than 90% in the California workers' compensation system since 2012. In contrast, medical payments for physical medicine per claim have continued to grow by about 60%. Given these starkly different trends in the medical payments for opioid and physical medicine, the WCIRB undertook an in-depth analysis of physical medicine treatments in the California workers' compensation system and how their increasing prevalence could be related to the steep declines in opioid use.

This study found that overall, the number of physical medical services per claim declined moderately between 2013 and 2018 despite a significant increase in the paid per claim. The average number of physical medicine visits, however, remained stable, indicating a flat frequency of physical medicine treatments for injured workers in the system. It was also observed that the median time to access PT and chiropractic care was within three weeks of the injury, and injured workers started to get earlier physical medicine beginning in 2014, suggestive of improved access to care. Injured workers who received physical medicine treatment appeared to work across different industrial sectors and were more likely to have soft tissue injuries or CTS; the sector and injury mix of these workers, however, remained unchanged over time. The share of claims involving physical medicine treatment remained stable across regions in California, although the Central Coast had a slight decrease and San Diego County had a slight increase in the share of claims with physical medicine treatment.

For claims with soft tissue injuries, the study found that claims with PT services within the first 30 days of the first doctor's visit tended to have a lower likelihood of initiating opioid use during one year of the injury than similar claims without early PT. While the magnitude of the overall impact of early PT is small, early PT has a more significant effect on reduced incidence of opioid use among soft tissue claims that had an injury between 2015 and 2017. Also, while chiropractic care was less frequently used by soft tissue claims, it was found that those involving early chiropractic care had a significantly lower probability of opioid use.

Early PT was found to have a strong and positive impact on reduced opioid doses among soft tissue injury claims that had at least one opioid prescription 12 months of the injury. These workers, on average, had significantly lower average doses of opioids prescribed if they utilized any PT within the first 30 days.

The study also found strong quantitative evidence on the positive impact of early use of PT on reducing the likelihood of lost time, shedding light on this rarely addressed research question. Specifically, compared to claims with similar characteristics but different timing of using PT, claims with early PT had a significantly lower likelihood of involving lost time within one year of the injury.

Conditions and Limitations

The WCIRB completed this study of physical medicine treatments and their impact on opioid use and lost time using data from reported medical transactions, the USR data, as well as indemnity transactions for workplace injuries occurring between 2013 and 2018. Our medical data reflects approximately 92% of the pure premium in the insured market in California, and the new indemnity transaction data reflects about one-quarter of the pure premium. In reviewing this information, the following should be noted:

1. This report reflects a compilation of individual insurer submissions of medical transaction data to the WCIRB. While the individual insurer data submissions are regularly checked for consistency and comparability with other data submitted by the insurer as well as with data submitted by other insurers, the source information underlying each insurer's data submission is not verified by the WCIRB.
2. The study is based solely on the experience of insured employers. No self-insured employer experience is reflected in the study.
3. The WCIRB's medical transaction data does not have information on injury severity. However, this analysis included in all regression models claim information on diagnostic group based on the ICD codes, pain type based on the ICD codes and major surgery, all of which partially account for injury severity.
4. The WCIRB's indemnity transaction data includes only a subset of all claims in the California workers' compensation system, and these claims tend to have more recent injuries. While some characteristics of these indemnity claims differ from the claims in the medical transaction data, using the regression modeling approach ensures comparing claims with similar characteristics, such as same accident year, and thus ensures robust inferences.
5. The study used claims and medical billing data (i.e., medical transaction data, indemnity transaction data, USR data), thus the results of the study do not imply causality. In addition, information on injured workers' pain tolerance, their preference for non-pharmacological or pharmacological treatments and other qualitative aspects related to initiation of opioid use was not available to include in the analysis.

Appendices

Table A1. Demographics, Injury Characteristics and Early Medical Treatments of the Claim Population in Model (1) on Association between Early Physical Medicine and Any Opioid Use (N=171,230)

Demographic Characteristics and Injury Mix		
Age at the Time of Injury (Years)	Mean	SD
	43.5	12.7
Accident Year	N	%
2013	33,368	19.5
2014	34,894	20.4
2015	35,730	20.9
2016	34,205	20.0
2017	33,033	19.3
Gender	N	%
Male	106,638	62.3
Diagnostic Group	N	%
Soft tissue disorders (excl. low back pain [LBP])	99,383	58.0
Multiple injuries - Soft tissue disorders & dislocation and sprain	56,111	32.8
Multiple injuries - Soft tissue disorders & diseases of the nervous system (incl. CTS)	7,565	4.4
LBP	5,543	3.2
Multiple injuries - Soft tissue disorders & fracture	2,628	1.5
Pain Type (based on ICD Codes)	N	%
None	68,088	39.8
Acute & Chronic	60,550	35.4
Acute	25,699	15.0
Chronic	16,893	9.9
Surgery	N	%
Has surgery	2,081	1.2
Industrial Sector	N	%
Manufacturing	24,353	14.2
Retail	22,049	12.9
Hospitality	16,222	9.5
Health	15,358	9.0
Utilities and Construction	14,510	8.5
Transportation and Warehousing	13,452	7.9
Agriculture and Mining	10,334	6.0
Administrative	8,939	5.2
Others	46,013	26.9
Concurrent Medical Treatments		
Number of Non-Opioid Pain Rx	N	%
0	57,782	33.7
1	48,013	28.0
2 or more	65,435	38.2

Primary Provider Type	N	%
Healthcare Facility	37,609	22.0
Physical Therapist	31,719	18.5
MD General Practice	24,774	14.5
MD Preventive Medicine	12,137	7.1
MD Family Medicine	9,977	5.8
Chiropractor	7,318	4.3
Physician Assistant or Nurse Practitioner	6,228	3.6
MD Internal Medicine	5,695	3.3
MD Physical Medicine & Rehabilitation	4,614	2.7
Pharmacy Service Providers	4,222	2.5
MD Orthopedic Surgery	3,516	2.1
MD Emergency Medicine	3,341	2.0
MD Radiology	2,224	1.3
MD Neuromusculoskeletal Medicine	1,435	0.8
Acupuncturist	694	0.4
MD Surgery	382	0.2
MD-Other Specialty	2,559	1.5
Non-MD Others	12,786	7.5
Number of Providers Seen	N	%
1	54,244	31.7
2	52,098	30.4
3	33,749	19.7
4 or more	31,139	18.2
Access to Care		
Time between Accident and First Medical Service (Days)	Mean	SD
	19.8	35.4
Primary Region of Service Provision	N	%
Los Angeles County	74,137	43.3
Remainder of LA Basin	23,872	13.9
Bay Area	20,936	12.2
Central Valley	16,203	9.5
Central Coast	10,138	5.9
San Diego County	10,074	5.9
Remaining California Zip Regions	8,130	4.7
Sacramento	7,740	4.5

SD stands for standard deviation. N is sample size.

Table A2. Coefficients of the Controlled Variables in Model (1) on Association between Early Physical Medicine and Any Opioid Use (N= 171,230).

Demographic Characteristics and Injury Mix		
	Adjusted Odds Ratio of Having Any Opioids	95% Confidence Interval
Accident Year		
2013	1 (Ref)	
2014	0.77 ***	0.74, 0.80
2015	0.50 ***	0.48, 0.51
2016	0.39 ***	0.38, 0.41
2017	0.27 ***	0.26, 0.28
Age at the Time of Injury (every 5 Years)	1.06 ***	1.05, 1.06
Gender		
Female	1 (Ref)	
Male	1.12 ***	1.09, 1.15
Diagnostic Group		
Soft tissue disorders (excl. LBP)	1 (Ref)	
Low back pain (LBP)	0.44 ***	0.39, 0.49
Multiple injuries - Soft tissue disorders & diseases of the nervous system (incl. CTS)	1.56 ***	1.48, 1.65
Multiple injuries - Soft tissue disorders & dislocation and sprain	0.99	0.97, 1.02
Multiple injuries - Soft tissue disorders & Fracture	1.76 ***	1.61, 1.94
Pain Type (based on ICD Codes)		
None	1 (Ref)	
Acute	0.74 ***	0.71, 0.76
Acute & Chronic	0.66 ***	0.64, 0.68
Chronic	1.00	0.96, 1.05
Surgery		
No surgery	1 (Ref)	
Has surgery	1.19 **	1.07, 1.32
Industrial Sector		
Utilities and Construction	1 (Ref)	
Administrative	0.89 ***	0.84, 0.95
Agriculture and Mining	0.86 ***	0.81, 0.92
Health	0.81 ***	0.76, 0.86
Hospitality	0.80 ***	0.76, 0.85
Manufacturing	0.74 ***	0.71, 0.78
Retail	0.85 ***	0.80, 0.89
Transportation and Warehousing	0.81 ***	0.77, 0.86
Others	0.75 ***	0.71, 0.78

Concurrent Medical Treatments		
Number of Non-Opioid Pain Rx		
0		1 (Ref)
1	5.52 ***	5.31, 5.74
2 or more	10.44 ***	10.05, 10.84
Primary Provider Type		
MD Physical Medicine & Rehabilitation		1 (Ref)
Acupuncturist	0.60 ***	0.47, 0.77
Chiropractor	0.78 ***	0.71, 0.86
Healthcare Facility	0.90 **	0.84, 0.97
MD Emergency Medicine	0.77 ***	0.69, 0.87
MD Family Medicine	0.92	0.85, 1.01
MD General Practice	0.89 **	0.83, 0.96
MD Internal Medicine	0.97	0.88, 1.07
MD Neuromusculoskeletal Medicine	0.94	0.81, 1.09
MD Orthopedic Surgery	1.26 ***	1.13, 1.41
MD Preventive Medicine	0.86 ***	0.80, 0.94
MD Radiology	0.68 ***	0.59, 0.79
MD Surgery	1.17	0.90, 1.51
Physician Assistant or Nurse Practitioner	0.85 ***	0.77, 0.93
Pharmacy Service Providers	1.92 ***	1.74, 2.12
Physical Therapist	0.77 ***	0.71, 0.83
MD-Other Specialty	0.71 ***	0.63, 0.80
Non-MD Others	0.94	0.86, 1.01
Number of Different Providers Seen		
1		1 (Ref)
2	1.45 ***	1.40, 1.50
3	2.05 ***	1.98, 2.12
4 or more	3.32 ***	3.20, 3.45
Access to Care		
Time between Accident and First Medical Service (per two weeks)		
	0.95 ***	0.95, 0.96
Primary Region of Service Provision		
LA County		1 (Ref)
Bay Area	0.80 ***	0.77, 0.83
Central Coast	0.94 *	0.89, 1.00
Central Valley	1.38 ***	1.32, 1.44
Sacramento	1.13 ***	1.07, 1.20
San Diego County	1.05	1.00, 1.11
Remainder of LA Basin	1.12 ***	1.08, 1.16
Remaining California Zip Regions	1.17 ***	1.10, 1.25

Note. *** < 0.001 ** < 0.01 * < 0.05

Multivariate logistic regression was used to estimate the association between early use of physical medicine and the likelihood of opioid use within 12 months of the injury. C-statistic of the final regression shows that the model has a good fit.

Table A3. Demographics, Injury Characteristics and Early Medical Treatments of the Claim Population in Model (2) on Association between Early Physical Medicine and Doses of Opioids Prescribed (N=30,442)

Demographic Characteristics and Injury Mix		
Quantity of Prescription Drugs Prescribed	Mean	SD
	158	94.6
Age at the Time of Injury (Years)	Mean	SD
	44	12.2
Accident Year	N	%
2013	8,704	28.6
2014	8,436	27.7
2015	5,880	19.3
2016	4,296	14.1
2017	3,126	10.3
Gender	N	%
Male	19,683	64.7
Diagnostic Group	N	%
Soft tissue disorders (excl. low back pain [LBP])	16,741	55.0
Multiple injuries - Soft tissue disorders & dislocation and sprain	10,877	35.7
Multiple injuries - Soft tissue disorders & diseases of the nervous system (incl. CTS)	1,675	5.5
Multiple injuries - Soft tissue disorders & fracture	767	2.5
LBP	382	1.3
Pain Type (based on ICD Codes)	N	%
None	13,745	45.2
Acute & Chronic	10,054	33.0
Acute	3,598	11.8
Chronic	3,045	10.0
Surgery	N	%
Has surgery	410	1.3
Industrial Sector	N	%
Retail	4,274	14.0
Manufacturing	3,924	12.9
Utilities and Construction	3,003	9.9
Health	2,862	9.4
Transportation and Warehousing	2,621	8.6
Hospitality	2,595	8.5
Agriculture and Mining	2,135	7.0
Administrative	1,650	5.4
Others	7,378	24.2

Concurrent Medical Treatments		
Number of Non-Opioid Pain Rx	N	%
0	2,175	7.1
1	9,699	31.9
2 or more	18,568	61.0
Specialty of First Provider Seen	N	%
Healthcare Facility	6,651	21.8
Physical Therapist	5,207	17.1
MD General Practice	5,030	16.5
Non-MD Others	2,231	7.3
MD Preventive Medicine	2,076	6.8
Pharmacy Service Providers	2,038	6.7
MD Family Medicine	1,587	5.2
Physician Assistant or Nurse Practitioner	1,066	3.5
MD Internal Medicine	996	3.3
Chiropractor	982	3.2
MD Physical Medicine & Rehabilitation	979	3.2
MD Orthopedic Surgery	425	1.4
MD-Other Specialty	334	1.1
MD Emergency Medicine	324	1.1
MD Neuromusculoskeletal Medicine	248	0.8
MD Radiology	130	0.4
MD Surgery	88	0.3
Acupuncturist	50	0.2
Number of Different Providers Seen	N	%
1	4,098	13.5
2	7,799	25.6
3	7,804	25.6
4	5,009	16.5
5	2,896	9.5
6 or more	2,836	9.3
Access to Care		
Time between Accident and First Medical Service (days)	Mean	SD
	11	33.4
Primary Region	N	%
LA County	13,139	43.2
Remainder of LA Basin	4,354	14.3
Central Valley	3,731	12.3
Bay Area	3,180	10.4
San Diego County	1,738	5.7
Central Coast	1,632	5.4
Sacramento	1,547	5.1
Remaining California Zip Regions	1,121	3.7

SD stands for standard deviation. N is sample size.

Table A4. Coefficients of the Controlled Variables in Model (2) on Association between Early Physical Medicine and Doses of Opioids Prescribed (N=30,442).

Demographic Characteristics and Injury Mix		
	% Change in Average MME	95% Confidence Interval
Age at the Time of Injury (per five years)		
	1.04 ***	1.04, 1.05
Accident Year		
2013	1 (Ref)	
2014	0.92 ***	0.89, 0.96
2015	0.86 ***	0.83, 0.90
2016	0.72 ***	0.69, 0.76
2017	0.61 ***	0.58, 0.64
Quantity of Opioids Prescribed		
Quantity Amount (log)	1.89 ***	1.84, 1.93
Gender		
Female	1 (Ref)	
Male	1.14 ***	1.10, 1.18
Pain Type		
None	1 (Ref)	
Acute	0.84 ***	0.80, 0.88
Acute & Chronic	0.78 ***	0.75, 0.80
Chronic	0.99	0.94, 1.04
Industry		
Utilities and Construction	1 (Ref)	
Administrative	0.86 ***	0.80, 0.93
Agriculture and Mining	0.88 ***	0.82, 0.95
Health	0.90 **	0.84, 0.97
Hospitality	0.91 **	0.85, 0.98
Manufacturing	0.83 ***	0.78, 0.88
Others	0.84 ***	0.80, 0.89
Retail	0.93 *	0.88, 0.99
Transportation and Warehousing	0.83 ***	0.78, 0.89
Diagnostic Group (based on ICD Codes)		
Soft tissue disorders (excl. low back pain [LBP])	1 (Ref)	
LBP	0.58 ***	0.51, 0.66
Multiple injuries - Soft tissue disorders & diseases of the nervous system (incl. CTS)	1.54 ***	1.45, 1.64
Multiple injuries - Soft tissue disorders & dislocation and sprain	0.91 ***	0.89, 0.94
Multiple injuries - Soft tissue disorders & fracture	1.08	0.99, 1.19
Surgery		
No surgery	1 (Ref)	
Has surgery	0.9	0.79, 1.02

Concurrent Medical Treatments		
Number of Non-Opioid Pain Rx		
0		1 (Ref)
1	0.89 ***	0.84, 0.94
2 or more	1.23 ***	1.16, 1.31
Primary Provider Type		
MD Physical Medicine & Rehabilitation		1 (Ref)
Acupuncturist	0.83	0.57, 1.21
Chiropractor	0.85 **	0.75, 0.96
MD-Other Specialty	0.89	0.76, 1.04
MD Emergency Medicine	1.05	0.89, 1.23
MD Family Medicine	1.02	0.92, 1.13
MD General Practice	0.82 ***	0.75, 0.89
MD Internal Medicine	0.91	0.81, 1.02
MD Neuromusculoskeletal Medicine	1.04	0.87, 1.24
MD Orthopedic Surgery	1.35 ***	1.17, 1.56
MD Preventive Medicine	0.85 ***	0.77, 0.93
MD Radiology	0.91	0.73, 1.15
MD Surgery	0.73 *	0.55, 0.96
Non-MD Others	0.96	0.87, 1.05
Physician Assistant or Nurse Practitioner	0.66 ***	0.59, 0.74
Pharmacy Service Providers	1.02	0.93, 1.13
Physical Therapist	0.82 ***	0.75, 0.89
Number of Providers Seen		
1		1 (Ref)
2	1.29 ***	1.23, 1.36
3	1.59 ***	1.51, 1.67
4	1.77 ***	1.68, 1.87
5	1.80 ***	1.69, 1.91
6 or more	2.06 ***	1.93, 2.20
Access to Care		
Time between Injury and First Medical Service (per 2 weeks)		
	1.02 ***	1.02, 1.03
First Physician's Region of Practice		
LA County		1 (Ref)
Bay Area	1.23 ***	1.18, 1.30
Central Coast	1.14 ***	1.06, 1.21
Central Valley	1.43 ***	1.36, 1.50
Remainder of LA Basin	1.23 ***	1.18, 1.29
Sacramento	1.45 ***	1.35, 1.55
San Diego County	1.13 ***	1.06, 1.20
Remaining California Zip Regions	1.78 ***	1.65, 1.93

Note. *** < 0.001 ** < 0.01 * < 0.05

Multivariate log-linear regression was used to estimate the association between early use of physical medicine and the amount of opioid doses prescribed to the injured worker within 12 months of the injury.

Table A5. Demographics, Injury Characteristics and Early Medical Treatments of the Claim Population in Model (3) on Association between Early Physical Medicine and Having Lost Time (N=10,147)

Demographic Characteristics and Injury Mix		
Accident Year	N	%
Pre-2017	1,938	19.1
2017	3,147	31.0
2018	5,062	49.9
Age at the Time of Injury (Years)	Mean	SD
	43	13.1
Gender	N	%
Male	7,034	69.3
Diagnostic Group	N	%
Soft tissue (single injury)	2,501	24.6
Soft tissue (multiple injuries)	2,299	22.7
Other	1,843	18.2
Dislocation and sprain	1,453	14.3
Minor wounds	1,104	10.9
Other multiple injuries	947	9.3
Pain Type (based on ICD Codes)	N	%
Acute	1,172	11.6
Acute & Chronic	2,088	20.6
Chronic	521	5.1
None	6,366	62.7
Surgery	N	%
Has surgery	665	6.6
Industrial Sector	N	%
Agriculture and Mining	2,156	21.2
Manufacturing	1,388	13.7
Utilities and Construction	1,349	13.3
Hospitality	952	9.4
Health	938	9.2
Transportation and Warehousing	925	9.1
Retail	510	5.0
Administrative	507	5.0
Other Services	381	3.8
Other Remaining Industries [†]	1,041	10.3
Concurrent Medical Treatments		
Early Opioid Prescription	N	%
Has early opioid prescription	1,027	10.1

Primary Provider Type	N	%
Healthcare Facility	1,779	17.5
Physical Therapist	1,609	15.9
Physician Assistant or Nurse Practitioner	722	7.1
MD General Practice	717	7.1
MD Family Medicine	692	6.8
MD Internal Medicine	632	6.2
Non-MD Others	476	4.7
Chiropractor	383	3.8
MD Neuromusculoskeletal Medicine	374	3.7
MD Physical Medicine & Rehabilitation	287	2.8
MD Emergency Medicine	286	2.8
MD Radiology	254	2.5
MD Orthopedic Surgery	253	2.5
MD-Other Specialty	170	1.7
Pharmacy Service Providers	140	1.4
MD Surgery	66	0.7
Acupuncturist	31	0.3
Number of Non-opioid Pain Rx	N	%
0	4,984	49.1
1	3,257	32.1
2 or more	1,906	18.8
Number of Providers Seen	N	%
1	1,957	19.3
2	1,620	16.0
3	1,256	12.4
4	1,038	10.2
5	881	8.7
6 or more	3,395	33.5
Access to Care		
Time between Accident and First Medical Service (Days)	Mean	SD
	8	29.6
Primary Region of Service Provision	N	%
Los Angeles County	3,221	31.7
Central Valley	1,563	15.4
Bay Area	1,561	15.4
Remainder of LA Basin	1,474	14.5
San Diego County	709	7.0
Central Coast	673	6.6
Sacramento	447	4.4
Remaining California Zip Regions	499	4.9

† Other Remaining Industries comprised of the following industries identified in the indemnity transaction data: Education, Real Estate, Clerical & Public Administration, Arts & Entertainment, Outside Sales Professional Services, Finance, and Information.
SD stands for standard deviation. N is sample size.

Table A6. Coefficients of the Controlled Variables in Model (3) on Association between Early Physical Medicine and Having Lost Time (N=10,147).

Demographic Characteristics and Injury Mix		
	Adjusted Odds Ratio of Having Lost Time	95% Confidence Interval
Accident Year		
Pre-2017	1 (Ref)	
2017	0.66 ***	0.58, 0.75
2018	0.60 ***	0.52, 0.68
Age at the Time of Injury (per five years)	1.00	0.995, 1.001
Gender		
Female	1 (Ref)	
Male	1.08	0.97, 1.19
Diagnostic Group		
Soft tissue (single injury)	1 (Ref)	
Dislocation and sprain	0.99	0.85, 1.14
Minor wounds	1.03	0.87, 1.21
Other	0.95	0.82, 1.09
Other multiple injuries	1.00	0.84, 1.17
Soft tissue (multiple injuries)	0.81 ***	0.72, 0.92
Pain Type (based on ICD Codes)		
None	1 (Ref)	
Acute	0.99	0.87, 1.14
Acute & Chronic	1.01	0.90, 1.13
Chronic	1.34 **	1.10, 1.64
Surgery		
Has surgery	0.68 ***	0.57, 0.82
Industrial Sector		
Utilities and Construction	1 (Ref)	
Administrative Services	1.03	0.83, 1.27
Agriculture & Mining	0.91	0.78, 1.06
Health Care	1.19	0.98, 1.45
Hospitality	1.35 **	1.12, 1.63
Manufacturing	1.08	0.92, 1.27
Other Services	1.13	0.89, 1.44
Retail	1.24	1.00, 1.54
Transportation and Warehousing	0.86	0.72, 1.02
Other Remaining Industries†	1.12	0.94, 1.34
Concurrent Medical Treatments		
Early Opioid Prescription		
Has early opioid prescription	0.86 *	0.75, 1.00

Number of Non-Opioid Pain Rx		
0		1 (Ref)
1	1.18 ***	1.07, 1.30
2 or more	1.33 ***	1.17, 1.51
Primary Provider Type		
MD Physical Medicine & Rehabilitation		1 (Ref)
Acupuncturist	1.14	0.47, 2.78
Chiropractor	0.74	0.51, 1.07
Healthcare Facility	0.93	0.71, 1.22
MD-Other Specialty	0.64 *	0.43, 0.95
MD Emergency Medicine	0.82	0.58, 1.15
MD Family Medicine	0.86	0.64, 1.15
MD General Practice	0.89	0.66, 1.19
MD Internal Medicine	1.13	0.83, 1.54
MD Neuromusculoskeletal Medicine	1.03	0.74, 1.42
MD Orthopedic Surgery	0.61 **	0.43, 0.88
MD Preventive Medicine	0.89	0.68, 1.17
MD Radiology	0.68 *	0.48, 0.97
MD Surgery	0.53 *	0.30, 0.92
Non-MD Others	0.65 **	0.48, 0.89
Physician Assistant or Nurse Practitioner	0.76	0.57, 1.01
Pharmacy Service Providers	0.62 *	0.41, 0.95
Physical Therapist	0.94	0.71, 1.25
Number of Providers Seen		
1		1 (Ref)
2	1.05	0.91, 1.21
3	1.17 *	1.00, 1.36
4	0.98	0.83, 1.15
5	1.18	0.99, 1.42
6 or more	1.15	0.99, 1.33
Access to care		
Time between Accident and First Medical Service (per two weeks)		
	0.95 ***	0.94, 0.97
Primary Region of Service Provision		
LA County		1 (Ref)
Bay Area	1.60 ***	1.40, 1.83
Central Coast	1.42 ***	1.18, 1.70
Central Valley	1.11	0.96, 1.27
Remainder of LA Basin	1.00	0.88, 1.14
Remaining California Zip Regions	1.38 **	1.13, 1.69
Sacramento	1.35 **	1.10, 1.67
San Diego County	1.36 ***	1.15, 1.62

Note. **** < 0.001 *** < 0.01 ** < 0.05

Multivariate logistic regression was used to estimate the association between early use of physical medicine and the likelihood of losing time from work within 12 month of the injury. C-statistic of the final regression shows that the model has a good fit.

† Other Remaining Industries comprised of the following industries identified in the indemnity transaction data: Education, Real Estate, Clerical & Public Administration, Arts & Entertainment, Outside Sales Professional Services, Finance, and Information.

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