Correlates of Opioid Dispensing

Vennela Thumula

Te-Chun Liu

WCRI
Workers Compensation Research Institute

ABOUT THE INSTITUTE

OUR MISSION:

To be a catalyst for significant improvements in workers' compensation systems, providing the public with objective, credible, high-quality research on important public policy issues.

THE INSTITUTE:

Founded in 1983, the Workers Compensation Research Institute (WCRI) is an independent, not-for-profit research organization which strives to help those interested in making improvements to the workers' compensation system by providing highly regarded, objective data and analysis.

The Institute does not take positions on the issues it researches; rather, it provides information obtained through studies and data collection efforts, which conform to recognized scientific methods. Objectivity is further ensured through rigorous, unbiased peer review procedures.

The Institute's work includes the following:

- Original research studies of major issues confronting workers' compensation systems (for example, outcomes for injured workers)
- Studies of individual state systems where policymakers have shown an interest in change and where there is an unmet need for objective information
- Studies of states that have undergone major legislative changes to measure the impact of those reforms and draw possible lessons for other states
- Presentations on research findings to legislators, workers' compensation administrators, industry groups, and other stakeholders

With WCRI's research, policymakers and other system stakeholders—employers, insurers, and labor unions—can monitor state systems on a regular basis and identify incremental changes to improve system performance. This results in a more enduring, efficient, and equitable system that better serves the needs of workers and employers.

For more information and to view other WCRI studies, please visit our website: www.wcrinet.org

WCRI
Workers Compensation
Research Institute

CORRELATES OF OPIOID DISPENSING

Vennela Thumula

Te-Chun Liu

WC-18-48

December 2018

WORKERS COMPENSATION RESEARCH INSTITUTE
CAMBRIDGE, MASSACHUSETTS

COPYRIGHT © 2018 WORKERS COMPENSATION RESEARCH INSTITUTE

COPYRIGHT © 2018 BY THE WORKERS COMPENSATION RESEARCH INSTITUTE
ALL RIGHTS RESERVED. NO PART OF THIS BOOK MAY BE COPIED OR
REPRODUCED IN ANY FORM OR BY ANY MEANS WITHOUT WRITTEN PERMISSION
OF THE WORKERS COMPENSATION RESEARCH INSTITUTE.

ISBN 978-1-61471-628-0

PUBLICATIONS OF THE WORKERS COMPENSATION RESEARCH INSTITUTE
DO NOT NECESSARILY REFLECT THE OPINIONS OR POLICIES
OF THE INSTITUTE'S RESEARCH SPONSORS.

COPYRIGHT © 2018 WORKERS COMPENSATION RESEARCH INSTITUTE

ACKNOWLEDGMENTS

We are grateful to the many people within and outside WCRI for their helpful contributions to this study.

WCRI received funding from the Centers for Disease Control and Prevention/National Institute for Occupational Safety and Health (NIOSH) to support this study. We would like to thank Steve Wurzelbacher and his colleagues at NIOSH for their support and helpful feedback on the draft report. Special thanks to the technical reviewers of this report, Dr. Philip Borba and Frank Neuhauser, whose thoughtful comments and suggestions helped us to tailor the key message and improve the quality of the final report. Several others provided feedback on the draft, including Corrine Bogovich, Dr. Gary Franklin, Dr. Dan Hunt, Dr. Richard Johnson, Dr. Kathryn Mueller, Scott Weiant, and Dr. Thomas Wickizer. Their comments were helpful in improving the usefulness and clarity of this report and are also valuable for our future research. We wish to thank them all. Critical to the study was the indispensable assistance provided by Milliman, Inc. and our colleagues at WCRI, Eric Harrison, Beth Heffner, Stacey O'Brien, Tom Landry, Karen Rothkin, and Roman Dolinschi. Their contributions, including data acquisition, database development, and quality assurance, made the study possible. We wish to thank Sarah Solorzano for expertly editing the report and managing the review and publication process. We also thank Andrew Kenneally, the communications director at WCRI, for his diligent efforts in disseminating the research findings. Finally, our gratitude goes to Dr. John Ruser, president and CEO of the Institute, and Ramona Tanabe, executive vice president and counsel, for their invaluable input and guidance throughout the whole process.

Any errors that remain in the report are the responsibility of the authors.

Vennela Thumula
Te-Chun Liu

Cambridge, Massachusetts
December 2018

COPYRIGHT © 2018 WORKERS COMPENSATION RESEARCH INSTITUTE

TABLE OF CONTENTS

COPYRIGHT © 2018 WORKERS COMPENSATION RESEARCH INSTITUTE

LIST OF TABLES

COPYRIGHT © 2018 WORKERS COMPENSATION RESEARCH INSTITUTE

CORRELATES OF OPIOID DISPENSING

Previous Workers Compensation Research Institute (WCRI) studies reported that opioids are widely dispensed to injured workers in the workers' compensation system, despite medical recommendations to avoid routine prescriptions and to limit the use of opioids for more severe pain or pain unresponsive to other analgesics.[1,2] Among nonsurgical claims with more than seven days of lost time, 52–85 percent of injured workers across the study states with pain medications received opioids. Workers in some states frequently received opioids on a chronic basis. Among injured workers with opioids, 29 percent of workers in Louisiana and more than one in seven workers in Kentucky, Massachusetts, Michigan, New York, North Carolina, South Carolina, and Texas (15–19 percent) received at least 60 days of opioids supply over at least one 90-day period.[3]

In this study, we examine important correlates of opioid dispensing to injured workers in the workers' compensation system using 1.4 million pain medication prescriptions filled within 18 months postinjury for injuries that occurred between October 1, 2014, and September 30, 2015, in 27 states.[4] We identify factors that demonstrate a strong statistical association with higher or lower opioid utilization. This statistical association may or may not be causal.[5] In distinguishing these correlates, we identify factors that are typically available in workers' compensation claims and payment data coupled with readily available area characteristics that may help public officials, employers, insurers, and health care providers better predict which cases are more or less likely to receive opioids. For example, if we found that workers who were employed in certain industries were more likely to receive opioid prescriptions on a chronic basis, then this information might be useful for payors looking to set priorities for targeting special interventions to reduce opioid prescriptions.

We analyzed a range of possible correlates, including worker (age and gender), injury (type of injury), industry (industry group and employer's payroll size), and location (county-level opioid dispensing rate, urban-rural classification, and health insurance coverage rate) characteristics. The analysis is based on statistical methods that allow us to isolate the effects of each factor while holding constant the other factors. The results from this analysis are presented in detail in the main body of the report. Readers interested in opioid utilization measures before controlling for other factors may refer to the Technical Appendix Table TA.1.

Some of the factors we analyzed explain significant differences in opioid dispensing rates and provide valuable predictive power independently from other variables included in the analysis. The significant correlates were:

- Industry in which the worker is employed
- Employer's payroll size
- County-level factors (for the county in which the worker resides)
- Worker's age
- Injury type

[1] The term *opioids* used in this report refers to prescription opioids for pain relief, including natural (codeine, morphine), semisynthetic (hydrocodone, oxycodone, etc.), and synthetic (methadone, fentanyl) opioids.

[2] Several guidelines address opioid prescribing for acute, sub-acute, and chronic pain. These guidelines generally recommend non-pharmacologic pain modalities and non-opioid pharmacologic treatment prior to prescribing opioids.

[3] Readers interested in learning more about the interstate variations and trends in opioids dispensed to injured workers should refer to WCRI's ongoing opioid benchmarking reports, including Thumula, Wang, and Liu (2017) and Wang (2017).

[4] Numerous legislative and regulatory changes addressing opioid prescribing and dispensing were implemented at the federal and state levels. This may result in narrowing of the variation across groups of workers to the extent that the reforms reduce unnecessary opioid utilization.

[5] A correlate may reflect a causal relationship, or it may be capturing the effect of another unobserved factor that is correlated with both opioid dispensing and the reported correlate.

COPYRIGHT © 2018 WORKERS COMPENSATION RESEARCH INSTITUTE

EMPLOYER CHARACTERISTICS

INDUSTRY/OCCUPATION

Workers employed in mining and construction industries were more likely than workers in other industries to receive opioids when receiving a prescription for pain medication, after controlling for differences in worker age, gender, the type of injury the worker sustained, the employer's payroll size, and local area characteristics (Table 1). Opioid utilization rates were fairly similar across the majority of the other industry/occupation groups, with about one in two workers with pain medications receiving at least one opioid prescription. Adjusting for differences in demographics and injury mix resulted in a narrowing of the variations across industry groups; larger variations in opioid utilization were seen in opioid utilization measures before controlling for case mix (see Table TA.1).

Table 1 Opioid Utilization across Industry Groups

	Among Injured Workers Receiving Pain Medications		Among Injured Workers Receiving Opioids		
	% That Received an Opioid Rx	% That Received 2 or More Opioid Rx	% That Received Opioids on a Longer-Term Basis	% That Had at Least 60 Days of Opioids Supply in Any 90-Day Period[a]	% That Had High-Dose Opioids (MED ≥ 50 mg for at least 60 days)[a]
Industry/occupation categories					
Mining (including oil and gas)	62%	33%	7%	14%	3%
Construction	55%	29%	7%	12%	3%
Agriculture, forestry, and fishing	52%	25%	4%	9%	1%
Public safety	51%	25%	5%	8%	2%
Wholesale and retail trade	50%	23%	5%	9%	2%
Restaurants and entertainment	50%	23%	5%	9%	2%
Health care and social assistance	49%	22%	5%	8%	2%
Manufacturing	48%	23%	5%	9%	2%
Services (except public safety)	48%	23%	5%	10%	2%
Transportation, warehousing, and utilities	48%	24%	5%	9%	2%
Clerical and professional	47%	21%	4%	8%	2%

Note: The underlying data include prescriptions filled within 1.5 years of the injury date for all medical claims that had injuries occurring between October 1, 2014, and September 30, 2015.

Case-mix adjusted measures are reported. Unadjusted measures are reported in Table TA.1. Regression estimates and significance tests are in Tables TA.3–TA.5.

[a] These two measures are based on a subset of claims with opioids that had complete days of supply.

Key: MED: morphine equivalent daily dose; Rx: prescription(s).

Mining and construction workers also had higher rates of receiving chronic and high-dose opioids and receiving opioids on a longer-term basis.[6] One in 7 mining and 1 in 8 construction workers who received an opioid prescription had at least 60 days of opioids within a 90-day period (referred to as *chronic opioids* in our study). In most other industries, less than 1 in 10 workers received chronic opioids. The proportion of injured workers in each industry group is reported in Table TA.2. Although mining jobs only account for a small percentage of all workers receiving pain medications, the dangers of chronic opioid use may put hundreds of injured workers in mining jobs at higher risk of opioid use disorders and overdose deaths.

Multiple studies have reported higher rates of opioid overdose deaths for construction and mining workers. A 2018 Centers for Disease Control and Prevention (CDC) report using data from 21 states documented that the highest prescription opioid related mortality rates across all occupational groups were for construction, mining, oil

[6] We defined claims receiving longer-term opioids as those that had opioids within the first three months after the injury and had three or more visits to fill opioid prescriptions between the 7th and 12th months after the injury.

COPYRIGHT © 2018 WORKERS COMPENSATION RESEARCH INSTITUTE

and gas extraction, and health care practitioners (Morano, Steege, and Luckhaupt, 2018). Heroin related overdose deaths were also reported to be higher among construction workers. Construction workers were also shown to have the highest opioid overdose death rates in other state-specific studies.[7] The findings of higher opioid dispensing rates among injured workers in construction and mining occupations, combined with the reports of higher overdose deaths in this population, are concerning. Employers and other stakeholders in mining and construction industries might investigate whether there is evidence of unnecessary opioid prescriptions, opioid use disorders, or diversion, and evaluate approaches to reduce opioid prescriptions, especially receipt of opioids on a chronic basis.

Several studies found that higher levels of opioid use in patients with occupational injuries may lead to opioid use disorders, increased disability duration, and overdose deaths.[8] Therefore, chronic opioid dispensing in all other industries might also warrant closer attention, especially in larger industries such as manufacturing and trade, which translates to a higher absolute number of injured workers at risk of delayed return to work and unintentional deaths from drug overdoses.[9] We describe the uses of this information in cautious terms because we are highlighting correlations in this study, and the readers might want to combine the information in this study with their experiences to infer the need for intervention.

There may be several reasons for variation in opioid dispensing rates for workers in the different industries. Workers in mining and construction may be more prone to more severe injuries, which might contribute to the higher opioid dispensing rates. While we controlled for the injury types and other case-mix factors, we acknowledge that there may still be some residual differences in injury severity across the groups of injured workers that may explain some of the differences reported here. Workers in different industries may also differ on other sociodemographic and lifestyle factors that were not observed, such as education levels, comorbidities, substance use disorders, alcohol consumption, etc., which may in turn impact opioid utilization. Construction and mining workers reported higher past month heavy alcohol use rates and construction workers reported higher past year substance use disorder rates—factors associated with more frequent absenteeism and job changes.[10] Other factors pertaining to occupations may also explain higher or lower opioid utilization rates. For instance, job insecurity was shown to be associated with higher rates of opioid overdose deaths in a recent study.[11] To the extent that job insecurity is widespread in some industries, workers may utilize opioids to facilitate faster return to work before the pain naturally subsides. Further investigations are needed to better understand the reasons underlying these variations in opioid dispensing rates across the different industry groups.

EMPLOYER'S PAYROLL SIZE

Table 2 shows that workers receiving pain medication prescriptions who were employed in *very small* size firms were more likely to be dispensed opioid prescriptions compared with workers employed in relatively larger firms. Of the workers receiving opioids, those employed in very small firms were also more likely to receive opioids on a chronic basis compared with workers in large firms.

As discussed above, workers employed in very small firms may have different unobserved characteristics compared with workers employed in larger firms. Very small size employers might also be relatively less equipped to monitor and respond to problematic opioid utilization compared with larger firms. Results from a 2017 National

[7] Massachusetts Department of Public Health, Occupational Health Surveillance Program (2018); Bunn, Bush, and Slavova (2014).

[8] Savych, Neumark, and Lea (2018); Kidner, Mayer, and Gatchel (2009); Franklin et al., (2005); Volinn, Fargo, and Fine (2009).

[9] The proportion of injured workers in each industry group and the number of claims in the study sample are reported in Table TA.2.

[10] Bush and Lipari (2015).

[11] Massachusetts Department of Public Health, Occupational Health Surveillance Program (2018).

COPYRIGHT © 2018 WORKERS COMPENSATION RESEARCH INSTITUTE

Safety Council survey of employers showed that one in three organizations with less than 1,000 employees reported that they were not very well prepared or extremely unprepared to handle misuse or abuse of prescription medications, as opposed to one in five organizations with more than 1,000 employees. Smaller employers may not have workplace policies such as drug testing and employee assistance programs. Moreover, larger employers may have resources to be more engaged in tracking whether insurers and managed care organizations that they contract with are providing benefits to deal with issues related to opioids. Considering the potential risks of unnecessary opioid utilization, pain management of injured workers employed in very small firms could perhaps be closely monitored to assess whether opioids are medically necessary.

Table 2 Opioid Utilization and Payroll Size of Worker's Employer

	Among Injured Workers Receiving Pain Medications		Among Injured Workers Receiving Opioids		
	% That Received an Opioid Rx	% That Received 2 or More Opioid Rx	% That Received Opioids on a Longer-Term Basis	% That Had at Least 60 Days of Opioids Supply in Any 90-Day Period[a]	% That Had High-Dose Opioids (MED ≥ 50 mg for at least 60 days)[a]
Firm's payroll size categories					
$1 to $4 million (very small size)	54%	27%	6%	11%	3%
> $4 million to $20 million (small size)	48%	24%	6%	10%	2%
> $20 million to $80 million (medium size)	47%	23%	5%	10%	2%
> $80 million (large size)	48%	23%	5%	9%	2%

Note: The underlying data include prescriptions filled within 1.5 years of the injury date for all medical claims that had injuries occurring between October 1, 2014, and September 30, 2015.

Case-mix adjusted measures are reported. Unadjusted measures are reported in Table TA.1. Regression estimates and significance tests are in Tables TA.3–TA.5.

[a] These two measures are based on a subset of claims with opioids that had complete days of supply.

Key: MED: morphine equivalent daily dose; Rx: prescription(s).

LOCAL AREA CHARACTERISTICS

The likelihood of injured workers receiving opioid prescriptions could be driven by a number of local area factors—factors associated with medical delivery (for example, number, specialty, and education of medical doctors in the area), targeted marketing efforts by pharmaceutical companies to doctors in the region, or local population and economic factors. In our analysis, we include county-level opioid dispensing rate, urban/rural classification, and health insurance coverage rate to control for local prescribing and local socioeconomic factors.

LOCAL OPIOID DISPENSING RATE

Several studies have demonstrated that the likelihood of injured workers receiving opioids is associated with the location of the injured worker.[12] As discussed in past WCRI studies, workers in some states are more likely to receive opioids and receive opioids on a longer-term basis. Among nonsurgical claims with more than seven days of lost time, approximately one in six Louisiana workers with opioids were identified as receiving longer-term opioids. The frequency of longer-term opioid use was also higher in California, Georgia, North Carolina, Pennsylvania, South Carolina, and Texas, where 1 in 10 to 1 in 12 injured workers with opioids were identified as receiving longer-term opioids. By contrast, about 1 in 25 injured workers received opioids on a longer-term basis in Indiana, Kansas,

[12] Thumula, Wang, and Liu (2017); Wang (2017); Savych, Neumark, and Lea (2018).

COPYRIGHT © 2018 WORKERS COMPENSATION RESEARCH INSTITUTE

Missouri, Nevada, New Jersey, and Wisconsin (Wang, 2017). Significant variations were reported even within a state. In a 2018 WCRI study based on low back pain cases, Savych et al. reported that hospital referral regions with the highest rates of longer-term opioid prescriptions within each state had, on average, 30 percentage point higher rates of longer-term opioids than areas with the lowest prescribing rates. Guy et al. (2017) found that the highest quartile counties in the country had six times the morphine milligram equivalent amount of opioids per resident on average compared with the lowest quartile counties. We used the county-level opioid dispensing rates among the general population from Guy et al. to capture local dispensing patterns. If the local dispensing rates in an area indicate that opioids are dispensed more frequently in that region because of local practice patterns, we might expect injured workers to be dispensed more opioid prescriptions in those areas relative to areas where overall opioid dispensing is less frequent.

After adjusting for differences in other available worker, injury, and industry characteristics, we found that injured workers residing in counties with higher opioid dispensing rates were more likely to receive opioids and chronic opioids. Thirty-nine percent of injured workers residing in the lowest prescribing quartile counties (bottom 25 percent counties in terms of the morphine milligram equivalent amount of opioids per capita) received an opioid prescription and 18 percent received two or more opioid prescriptions (Table 3). Whereas 1 in 2 injured workers residing in the highest prescribing quartile counties (top 25 percent counties in terms of the amount of opioids per capita) received at least one opioid prescription and 1 in 4 received two or more opioid prescriptions. These wide area variations might suggest a lack of consensus about treating pain with opioids.

Table 3 Opioid Utilization by Local Dispensing Rate Quartiles

	Among Injured Workers Receiving Pain Medications		Among Injured Workers Receiving Opioids		
	% That Received an Opioid Rx	% That Received 2 or More Opioid Rx	% That Received Opioids on a Longer-Term Basis	% That Had at Least 60 Days of Opioids Supply in Any 90-Day Period[a]	% That Had High-Dose Opioids (MED ≥ 50 mg for at least 60 days)[a]
MME prescribed per capita by county in 2015					
1st quartile (lowest quartile)	39%	18%	5%	10%	2%
2nd quartile	45%	22%	6%	11%	2%
3rd quartile	47%	23%	6%	12%	3%
4th quartile (highest quartile)	51%	25%	6%	12%	3%

Note: The underlying data include prescriptions filled within 1.5 years of the injury date for all medical claims that had injuries occurring between October 1, 2014, and September 30, 2015.

Case-mix adjusted measures are reported. Unadjusted measures are reported in Table TA.1. Regression estimates and significance tests are in Tables TA.3–TA.5.

[a] These two measures are based on a subset of claims with opioids that had complete days of supply.

Key: MED: morphine equivalent daily dose; MME: morphine milligram equivalents; Rx: prescription(s).

Geographic differences in medical practice and health care delivery systems may play an important role in shaping area variations in opioid dispensing rates. Multiple studies have reported that higher concentrations of practicing physicians and surgeons in a region are strongly correlated with the amount of opioids prescribed (Curtis et al., 2006; Han et al., 2012; McDonald et al., 2012). Some regions may also have a higher concentration of pain clinics and doctors who specialize in pain treatment than others. In areas where patients have easier access to clinics specializing in the treatment of pain, the prescribing patterns may differ from areas where there are few pain clinics. For example, some occupational medicine clinics are affiliated with academic medical centers that also have pain clinics. This arrangement facilitates referrals of patients to providers who specialize in pain treatment. As the rate of opioid prescribing is higher among pain specialists compared with non-specialists, this could increase the use of opioids in these regions (Levy et al., 2015). On the other hand, a higher level of involvement with chiropractic care

COPYRIGHT © 2018 WORKERS COMPENSATION RESEARCH INSTITUTE

may contribute to a lower rate of opioid use in the region at the aggregate level because chiropractors cannot prescribe medications (Whedon et al., 2018). Similarly, higher availability of physical therapists and other practitioners with restricted prescribing authority in the region may result in fewer opioids. In areas where more workers' compensation medical care is provided by hospital-affiliated clinics, the prescribing patterns may be influenced indirectly by certain requirements of the Joint Commission on Accreditation of Healthcare Organizations,[13] which regulates hospital accreditation. Doctors who practice in hospital-based or hospital-affiliated programs may be more likely influenced by these requirements compared with doctors who are in private practice or those who work for commercial occupational medicine networks.

URBAN VERSUS RURAL AREAS

We also compared opioid dispensing rates based on the degree of rurality of the residential location of injured workers. We categorized the counties into urban, rural, and very rural counties based on Urban-Rural Continuum Codes.[14] Controlling for local dispensing patterns and other factors, workers residing in urban counties were less likely to receive opioid prescriptions compared with those residing in rural and very rural counties (Table 4). Similar findings were reported in earlier studies (Guy et al., 2017; Thumula, 2017). Urban-rural classification may be capturing area variations in socioeconomic factors as these regions differ in terms of education level, socioeconomic status, labor force participation, and other quality of life indicators, as discussed in other studies (e.g., Davis, 2009).

Table 4 Opioid Utilization in Urban and Rural Areas

	Among Injured Workers Receiving Pain Medications		Among Injured Workers Receiving Opioids		
	% That Received an Opioid Rx	% That Received 2 or More Opioid Rx	% That Received Opioids on a Longer-Term Basis	% That Had at Least 60 Days of Opioids Supply in Any 90-Day Period[a]	% That Had High-Dose Opioids (MED ≥ 50 mg for at least 60 days)[a]
Rurality of residence					
Urban area	54%	27%	5%	9%	2%
Rural area	63%	31%	6%	10%	2%
Very rural area	68%	33%	6%	10%	2%

Note: The underlying data include prescriptions filled within 1.5 years of the injury date for all medical claims that had injuries occurring between October 1, 2014, and September 30, 2015.

Case-mix adjusted measures are reported. Unadjusted measures are reported in Table TA.1. Regression estimates and significance tests are in Tables TA.3–TA.5.

[a] These two measures are based on a subset of claims with opioids that had complete days of supply.

Key: MED: morphine equivalent daily dose; Rx: prescription(s).

[13] The Joint Commission is an independent not-for-profit organization that accredits and certifies more than 20,000 health care organizations and programs in the United States. More information can be found at www.jointcommission.org.

[14] Urban areas include metropolitan counties with population size exceeding 250,000. Rural areas include non-metropolitan counties adjacent to metro areas or counties where population size was greater than 20,000. All other non-metropolitan counties where population size was less than 20,000 were categorized as very rural areas. See https://www.ers.usda.gov/data-products/rural-urban-continuum-codes/.

COPYRIGHT © 2018 WORKERS COMPENSATION RESEARCH INSTITUTE

HEALTH INSURANCE COVERAGE[15]

In counties where the majority of the population is covered by health insurance (uninsured rate of 0 to 9 percent), 57 percent of injured workers received at least one opioid prescription, whereas 48 to 51 percent of injured workers residing in counties with relatively higher uninsured rates received an opioid prescription. Significant variations were not seen in all other opioid utilization measures across these counties (Table 5).

Table 5 Opioid Utilization and Non-Workers' Compensation Health Insurance Rate

	Among Injured Workers Receiving Pain Medications		Among Injured Workers Receiving Opioids		
	% That Received an Opioid Rx	% That Received 2 or More Opioid Rx	% That Received Opioids on a Longer-Term Basis	% That Had at Least 60 Days of Opioids Supply in Any 90-Day Period[a]	% That Had High-Dose Opioids (MED ≥ 50 mg for at least 60 days)[a]
Health insurance coverage by county					
Uninsured rate, 0 to 9 percent	57%	27%	5%	9%	2%
Uninsured rate, 10 to 19 percent	51%	25%	5%	10%	3%
Uninsured rate, 20 to 29 percent	50%	24%	5%	9%	3%
Uninsured rate 30 percent and over	48%	25%	5%	11%	2%

Note: The underlying data include prescriptions filled within 1.5 years of the injury date for all medical claims that had injuries occurring between October 1, 2014, and September 30, 2015.

Case-mix adjusted measures are reported. Unadjusted measures are reported in Table TA.1. Regression estimates and significance tests are in Tables TA.3–TA.5.

[a] These two measures are based on a subset of claims with opioids that had complete days of supply.

Key: MED: morphine equivalent daily dose; Rx: prescription(s).

INJURY CHARACTERISTICS

TYPE OF INJURY

Whether or not an injured worker receives an opioid prescription may be strongly associated with the type of injury the worker sustained. As shown in Table 6, a higher proportion of workers who sustained fractures (79 percent), carpal tunnel (70 percent), and neurologic spine pain (66 percent) received at least one opioid prescription for pain relief. Among workers receiving opioids, the likelihood of receiving chronic opioids, high-dose opioids, and longer-term opioids was higher for injured workers who sustained neurologic spine pain injuries. Workers with fractures and carpal tunnel syndrome, who received opioids, did not frequently receive them on a chronic basis or at high doses.

Injured workers with sprains and strains (in back and neck or other body parts) and those with lacerations and contusions were less likely to be prescribed opioids for pain relief (38–43 percent). There is lower clinical consensus

[15] We controlled for health insurance coverage rates in this study because of concerns that we may be missing some pain medication prescriptions prescribed for the work-related injury that were paid for by non-workers' compensation payors. If the worker resides in an area with a lower uninsured rate, they likely have health insurance and there may be a higher likelihood that some prescriptions may be paid for by non-workers' compensation payors. At the same time, a higher uninsured rate may increase the likelihood that a worker receives pain medication prescriptions paid under workers' compensation. This could potentially lead to a different mix of claims with pain medications in the presence of health insurance.

COPYRIGHT © 2018 WORKERS COMPENSATION RESEARCH INSTITUTE

about the utilization of opioids for the treatment of sprains and strains, compared with the treatment of fractures, so these results might not be surprising.[16]

Table 6 Opioid Utilization across Injury Groups

	Among Injured Workers Receiving Pain Medications		Among Injured Workers Receiving Opioids		
	% That Received an Opioid Rx	% That Received 2 or More Opioid Rx	% That Received Opioids on a Longer-Term Basis	% That Had at Least 60 Days of Opioids Supply in Any 90-Day Period[a]	% That Had High-Dose Opioids (MED ≥ 50 mg for at least 60 days)[a]
Injury type categories					
Fractures	79%	42%	4%	7%	2%
Upper extremity neurologic (carpal tunnel)	70%	38%	3%	4%	0%
Neurologic spine pain	66%	46%	11%	21%	5%
Inflammations	56%	38%	7%	10%	2%
Other injuries	55%	30%	4%	7%	2%
Other sprains and strains	43%	27%	4%	8%	1%
Lacerations and contusions	39%	14%	0%	1%	0%
Back and neck sprains, strains, and non-specific pain	38%	22%	5%	13%	2%

Note: The underlying data include prescriptions filled within 1.5 years of the injury date for all medical claims that had injuries occurring between October 1, 2014, and September 30, 2015.

Case-mix adjusted measures are reported. Unadjusted measures are reported in Table TA.1. Regression estimates and significance tests are in Tables TA.3–TA.5.

[a] These two measures are based on a subset of claims with opioids that had complete days of supply.

Key: MED: morphine equivalent daily dose; Rx: prescription(s).

WORKER CHARACTERISTICS

The likelihood of receiving opioids and chronic opioids may be associated with the characteristics of the injured worker. In our analysis, we included the injured worker's age and gender at the time of injury. Other worker characteristics that may matter include the worker's education level, race/ethnicity compositions, wages, and comorbidities, but these data fields were not available for some or all workers in our sample.[17]

AGE

Table 7 shows the prevalence of opioid dispensing across workers in different age groups. Workers aged 25 and over were more likely to receive opioids compared with workers aged below 25. Workers of age 25 to 39 were also less likely to receive at least one, or two or more, opioid prescriptions than workers aged 40 and over. The youngest workers were much less likely to receive opioids on a longer-term or chronic basis or to receive high-dose opioids.

Older patients may require one or more opioid prescriptions after an injury because they may take longer to recover than younger patients and may be more susceptible to higher pain intensity due to comorbid conditions. One might want to closely monitor this group of injured workers as recent evidence points to a marked increase in the all-cause mortality of middle aged (ages 45 to 54) white non-Hispanic men and women in the United States

[16] Several workers' compensation jurisdictions adopted the Official Disability Guideline (ODG) or American College of Environmental Medicine (ACOEM) guidelines. These guidelines generally discourage the use of opioids initially, except for post-operative pain and for fractures and other conditions likely to result in significant pain. If opioids are prescribed, prescriptions are usually for two weeks, according to ACOEM.

[17] In a sensitivity analysis based on workers with more than seven days of lost time, we also controlled for workers' wages, and the major findings did not change.

COPYRIGHT © 2018 WORKERS COMPENSATION RESEARCH INSTITUTE

between 1999 and 2013, primarily accounted for by increasing rates of drug overdose deaths (Case and Deaton, 2015).

Table 7 Opioid Utilization across Age Groups

	Among Injured Workers Receiving Pain Medications		Among Injured Workers Receiving Opioids		
	% That Received an Opioid Rx	% That Received 2 or More Opioid Rx	% That Received Opioids on a Longer-Term Basis	% That Had at Least 60 Days of Opioids Supply in Any 90-Day Period[a]	% That Had High-Dose Opioids (MED ≥ 50 mg for at least 60 days)[a]
Age group categories					
Age 15 to 24	36%	11%	1%	4%	0%
Age 25 to 39	42%	19%	5%	10%	2%
Age 40 to 54	47%	23%	6%	11%	3%
Age 55 to 60	49%	24%	6%	11%	2%
Age over 60	49%	24%	5%	10%	1%

Note: The underlying data include prescriptions filled within 1.5 years of the injury date for all medical claims that had injuries occurring between October 1, 2014, and September 30, 2015.

Case-mix adjusted measures are reported. Unadjusted measures are reported in Table TA.1. Regression estimates and significance tests are in Tables TA.3–TA.5.

[a] These two measures are based on a subset of claims with opioids that had complete days of supply.

Key: MED: morphine equivalent daily dose; Rx: prescription(s).

GENDER

Table 8 provides a comparison of opioid dispensing rates by gender. After adjusting for differences in other available worker, location, injury, and industry characteristics, we found that the frequency of receiving at least one, and two or more, opioid prescriptions was somewhat higher for male workers than female workers. Among those receiving opioids, a similar proportion of men and women received chronic, high-dose, and longer-term opioids.

Table 8 Opioid Utilization Measures by Gender

	Among Injured Workers Receiving Pain Medications		Among Injured Workers Receiving Opioids		
	% That Received an Opioid Rx	% That Received 2 or More Opioid Rx	% That Received Opioids on a Longer-Term Basis	% That Had at Least 60 Days of Opioids Supply in Any 90-Day Period[a]	% That Had High-Dose Opioids (MED ≥ 50 mg for at least 60 days)[a]
Gender					
Female	42%	19%	5%	9%	2%
Male	46%	22%	5%	10%	2%

Note: The underlying data include prescriptions filled within 1.5 years of the injury date for all medical claims that had injuries occurring between October 1, 2014, and September 30, 2015.

Case-mix adjusted measures are reported. Unadjusted measures are reported in Table TA.1. Regression estimates and significance tests are in Tables TA.3–TA.5.

[a] These two measures are based on a subset of claims with opioids that had complete days of supply.

Key: MED: morphine equivalent daily dose; Rx: prescription(s).

COPYRIGHT © 2018 WORKERS COMPENSATION RESEARCH INSTITUTE

CONCLUDING REMARKS

This study highlights considerably higher rates of opioid dispensing and chronic opioid dispensing among some groups of injured workers, which may put them at risk for potential harm. We observed that workers employed in mining and construction industries were more likely than workers in other industries to receive opioids when receiving a prescription for pain medication and more likely to receive opioids on a longer-term basis and at higher doses. Workers employed in very small firms were also more likely to be dispensed opioid prescriptions compared with workers employed in relatively larger firms. We also found that injured workers residing in counties with higher opioid dispensing rates and those residing in rural and very rural counties were more likely to receive opioids. In terms of the type of injuries sustained, a higher proportion of workers who sustained fractures, carpal tunnel, and neurologic spine pain received at least one opioid prescription for pain relief. Workers with neurologic spine pain injuries also had a higher likelihood of receiving chronic opioids, high-dose opioids, and longer-term opioids whereas workers with fractures and carpal tunnel syndrome, who received opioids, did not frequently receive them on a chronic basis or at high doses. Finally, workers aged 40 and over were more likely to receive opioids compared with younger workers. This information may be useful for policymakers, payors, employers, and health practitioners to target efforts to better manage possible overuse of opioids while providing appropriate care to injured workers and reducing unnecessary risks to patients and unnecessary costs to employers.

COPYRIGHT © 2018 WORKERS COMPENSATION RESEARCH INSTITUTE

DATA AND APPROACH

In this study, we include 391,054 claims that received at least one prescription for pain medications paid under workers' compensation and more than 1.4 million paid pain medication prescriptions associated with those claims.[1] Those claims are from 27 states: Arkansas, California, Connecticut, Delaware, Florida, Georgia, Illinois, Indiana, Iowa, Kansas, Kentucky, Louisiana, Maryland, Massachusetts, Michigan, Minnesota, Missouri, Nevada, New Jersey, New York, North Carolina, Pennsylvania, South Carolina, Tennessee, Texas, Virginia, and Wisconsin. The claims had injuries from October 1, 2014, to September 30, 2015, and we included prescriptions filled by these claims for 18 months following the date of the injury.

The analysis data were extracted from the WCRI Detailed Benchmark/Evaluation (DBE) database and consist of detailed prescription transaction data that were collected from workers' compensation payors and their medical bill review and pharmacy benefit management vendors. The data sources underlying this study represent 36–69 percent of workers' compensation claims in each state. For this report, we included transactions for prescription strength and over-the-counter strength medications, and compound drugs (referred to as *prescriptions* throughout the report). These prescriptions could be filled or refilled by the injured worker at a pharmacy or physician's office and were paid for under workers' compensation. We excluded prescription medications that were dispensed at a hospital, those administered in a physician's office (e.g., injections/infusions administered at a physician's office), and medical supplies or devices that were billed using National Drug Codes (NDCs).[2] The data available for each prescription identify the specific medication prescribed, the date on which the prescription was filled, amounts charged and paid, the number of pills (for orally-administered opioids), the number of days for which the prescription was written (days of supply), and the strength of the medication in milligrams.[3] The specific medication prescribed was identified by NDC.

We identified opioid prescriptions based on the therapeutic classification scheme developed by Medi-Span®.[4] Opioid medications vary in their effectiveness for relieving pain (i.e., *analgesic potency* in medical terms). The same number of milligrams for different opioids may indicate different strengths. For example, 1 milligram of hydrocodone (Vicodin®) is equivalent to 1 milligram of morphine, while 1 milligram of hydromorphone (Exalgo®) is equivalent to 4 milligrams of morphine. We measured the amount of opioids based on morphine milligram equivalent (MME) amount for specific opioid medications, which takes into account the differences in strength as well as the quantity of opioid medications received by injured workers. We applied the morphine equivalent

[1] We do not capture prescriptions paid by other payors or cash-only prescriptions. Note that we controlled for county-level health insurance rates in this study, which might capture the likelihood of injured workers receiving prescription drugs from other payors.

[2] To identify injectables and medical supplies/equipment for exclusions, we mainly used Medi-Span® indicators that specified the types of products with NDCs as well as the route of administration.

[3] We have seen improvement in the data for the days of supply over the years, especially for pharmacy transactions. Days of supply is a key element based on which one can measure the duration of opioid prescriptions and derive the morphine equivalent daily dose (in conjunction with the quantity and strength of opioid medications). In our data, 71 percent of claims with opioids have days of supply information, and these claims with complete days of supply have opioid utilization patterns that are comparable to all claims with opioids irrespective of completeness of days of supply. We continue to see that a higher rate of physician-dispensed opioid prescriptions were missing the days of supply field, but physician dispensing of opioids has decreased considerably in recent years; only six of the study states have frequent physician dispensing where more than 10 percent of opioid prescriptions were physician-dispensed.

[4] According to Medi-Span®'s Therapeutic Classification System, a hierarchical classification scheme, the first two digits of the 10-digit Generic Product Identifier classifies general drug products. We identified opioid prescriptions based on drug group 65 for opioid analgesics. See Medi-Span® (2005).

COPYRIGHT © 2018 WORKERS COMPENSATION RESEARCH INSTITUTE

equianalgesic conversion factors developed by the CDC[5] at the prescription level to compute the morphine equivalent dose in milligrams for individual prescriptions. The morphine equivalent dose for each opioid prescription was calculated as a product of the strength in milligrams of the prescribed opioid medication and the analgesic potency ratio between the specific opioid and morphine, multiplied by the number of pills (or quantity) of the prescription.

OPIOID UTILIZATION MEASURES

We measure the frequency of claims receiving opioids as the percentage of claims with pain medications that received at least one opioid prescription. By doing this, we focus on injured workers who received opioids and/or non-opioid pain medications for pain relief.[6] We also report the percentage of claims with pain medications receiving two or more opioid prescriptions. We constructed three additional measures to examine chronic opioid therapy and management, including the percentage of claims with opioids that received chronic opioids, high-dose opioids (i.e., use exceeding guideline-recommended doses), and longer-term opioids.

To examine workers with chronic opioids and high-dose opioids, we converted the opioid transactions into day-to-day utilization metrics based on the opioid fill date and days of supply of each opioid prescription. We counted each day the injured worker had an opioid supply and computed the morphine equivalent dose received on each day by adjusting for overlapping opioid prescriptions. In this study, we define chronic opioid dispensing as injured workers receiving opioids for at least 60 days during any continuous 90-day period over the 18-month observation period.[7] Our definition allows for small time gaps between two subsequent fills during the 90-day episode because injured workers may be taking the opioid medication less frequently than prescribed. We defined injured workers with high-dose opioids as those receiving a morphine equivalent daily dose (MED) exceeding 50 milligrams for at least 60 days during the 18-month observation period. The CDC guidelines for prescribing opioids for chronic pain published in 2016 caution prescribers to reassess the risks and benefits to the patient when prescribing an MED exceeding 50 milligrams and to avoid an MED exceeding 90 milligrams; they recommend tapering if the dose exceeds 90 milligrams MED.[8]

We identified claims receiving longer-term opioids as those that had opioids within the first three months after the injury and had three or more visits[9] to fill opioid prescriptions between the 7th and 12th months after the injury. This subset of claims was identified based on the detailed transaction data for opioid prescriptions filled over the specified period of time. With the assumption that one opioid prescription likely represents at least a 30-day supply

[5] The conversion factors compiled by the CDC for analytical purposes are available at https://www.cms.gov/Medicare/Prescription-Drug-Coverage/PrescriptionDrugCovContra/Downloads/Opioid-Morphine-EQ-Conversion-Factors-April-2017.pdf.

[6] Claims with a prescription or pain medication prescription paid under workers' compensation provide a robust base to measure frequency of opioid use because a variable percentage of injured workers across states did not have a prescription paid under workers' compensation. Several reasons may explain the large proportion of claims without prescriptions across states. For example, some initial prescriptions may be paid for by non-workers' compensation payors, and some patients may be using over-the-counter medications that they already have for treating their work injury. This is consistent with a study of workers' compensation cases of New York state employees, all of whom were covered by group health insurance that included prescription coverage (Stapleton et al., 2001). By combing the records of the state fund and group health insurer's interviews with workers, the study found that 21 percent of all drug expenditures for those injured workers were paid by the state fund, 69 percent by group health insurance, and 9 percent by the worker without reimbursement. See a more detailed discussion in Wang and Liu (2011). We controlled for county-level health insurance rates in this study, which might capture the likelihood of injured workers receiving prescription drugs from other payors.

[7] The metrics used to characterize *chronic opioid dispensing* and *high-dose opioid dispensing* are consistent with the measures proposed by the Washington State Dr. Robert Bree Collaborative and the Washington State Agency Medical Directors' Group.

[8] The *CDC Guideline for Prescribing Opioids for Chronic Pain* is available at https://www.cdc.gov/drugoverdose/prescribing/guideline.html.

[9] The number of visits here is the number of unique dates on which at least one opioid prescription was filled.

COPYRIGHT © 2018 WORKERS COMPENSATION RESEARCH INSTITUTE

of opioids, this empirical definition is largely consistent with a widely-agreed on definition for long-term opioid use that is based on morphine equivalent daily dose and duration of opioid prescriptions.

CORRELATES

The control variables include the worker's age at the time of injury, gender, the type of injury the worker sustained, type of industry in which the injured worker was employed, the employer's payroll size, and county-level factors described below. The worker's age at injury was classified into one of five categories; the categories were then used to create five dummy variables. The categories include (1) age 15 to 24, (2) age 25 to 39, (3) age 40 to 54, (4) age 55 to 60, and (5) age over 60. "Age 25 to 39" is the reference category. The injury classifications are primarily based on International Classification of Diseases (ICD-9 and ICD-10) codes. Injuries were classified into eight groups—(1) back and neck sprains, strains, and non-specific pain; (2) upper extremity neurologic (carpal tunnel); (3) fractures; (4) inflammations; (5) lacerations and contusions; (6) neurologic spine pain; (7) other sprains and strains; and (8) other injuries.[10] We did not attempt to control for severity of injury within these broader injury groups using the administrative data because even if we group the ICD codes at a more detailed level, we may not be able to adequately characterize the medical severity due to coding and issues inherent in the diagnosis codes.

We created industry groups to provide a homogenous mix of industries in terms of injury risk. We categorized each worker into 11 industry groups based on four-digit, industry-standard worker and governing-class codes and standard industrial classification (SIC) codes.[11] Industry classifications include (1) agriculture, forestry, and fishing; (2) clerical and professional; (3) construction; (4) health care and social assistance; (5) manufacturing; (6) mining (including oil and gas); (7) public safety; (8) restaurants and entertainment; (9) services (except public safety); (10) transportation, warehousing, and utilities; and (11) wholesale and retail trade. Certain occupations, such as clerical jobs, may bear similar risk factors across industries and may have different risk factors compared with other occupations within the same industry. Therefore, we categorized clerical jobs across all industries and educational professionals into the clerical and professional category. Each of the other industries reflects non-clerical occupations within those industries. For the employer's payroll size, claims were classified into one of four company-size categories based on the payroll size at the time of injury, including (1) $1 to $4 million (very small size), (2) more than $4 million to $20 million (small size), (3) more than $20 million to $80 million (medium size), and (4) over $80 million (large size).

We also included characteristics of the county in which the worker resides, including urban versus rural location type, overall opioid prescribing per capita, and the proportion of the population that is insured. County-level opioid dispensing rates per capita in the general population were obtained from Guy et al. (2017), and counties in which workers resided were grouped into quartiles based on the MME of opioids dispensed in the county in 2015 per resident.[12,13,14] The urban-rural classification is based on the Department of Agriculture's Urban-Rural Continuum

[10] The injury categories are predominantly based on primary ICD-9 and ICD-10 codes from medical bills. The primary diagnosis code is defined as the one that receives the most payments. In the event that ICD-9 or ICD-10 codes were not populated or ambiguous about the medical condition or part of body, the nature of injury and part of body were used instead. For more detailed information about the construction of injury classifications and the description of each injury group, please refer to Dolinschi and Rothkin (2018).

[11] A workers' compensation claim is assigned a classification code based on the injured worker's occupation and the payroll exposure reports of the employer. Classification codes in most states are defined using a common set of basic classifications published by the National Council on Compensation Insurance subject to individual state exceptions, although some states use independently established sets of basic classifications. In Pennsylvania, for example, classification codes are set out in the Pennsylvania Compensation Rating Bureau's *Pennsylvania Basic Manual*. To convert the Pennsylvania codes to industry-standard codes, we used a classification comparison provided to us by the rating bureau.

[12] The numerator was opioid prescriptions dispensed in the United States obtained from the QuintilesIMS Data Warehouse, and the denominator is based on U.S. census population estimates. See "Vital Signs: Changes in Opioid Prescribing in the United States, 2006–2015" (https://www.cdc.gov/mmwr/volumes/66/wr/mm6626a4.htm).

COPYRIGHT © 2018 WORKERS COMPENSATION RESEARCH INSTITUTE

Codes, which range from 1 (most urban) to 9 (most rural) based on the degree of rurality.[15] We grouped the injured worker's residential location into one of three categories: urban (Urban-Rural Continuum Codes from 1 to 3), rural (codes 4 to 6), and very rural (codes 7 to 9).[16] County-level uninsured rates for 2015 were categorized into four groups, (1) uninsured rate 0 to 9 percent, (2) 10 to 19 percent, (3) 20 to 29 percent, and (4) uninsured rate 30 percent and over.

REGRESSION METHODS USED TO OBTAIN ADJUSTED UTILIZATION METRICS

We wanted the comparisons of utilization metrics to be based on a similar group of injured workers. To accomplish this, we used logistic regression analyses to compare the categorical opioid utilization measures in our study across the different groups of workers while controlling for all other differences in the demographic, employment, and injury characteristics of the workers, as well as state dummies.[17] For the logistic regression analyses, we used α-level of 0.10 to test statistical significance. A detailed explanation of the statistical models used for this analysis, descriptive statistics of prescription utilization metrics and control variables, and the regression estimates are included in the technical appendix.

[13] We used county-level dispensing rates across the general population from Guy et al. (2017) to capture local dispensing patterns in this study, and the rates were not adjusted for variations in patient case-mix across regions. If the variation in local dispensing rates is explained by the differences in patient characteristics across the regions, then this measure may not be appropriate for characterizing local dispensing norms. But the authors of the study concluded that the differences in patient conditions likely explain only a fraction of the variation across local areas. If the fraction is significant, then this measure is capturing both variation in local practice norms and patient characteristics. We could alternately measure local practice patterns using past utilization rates from our workers' compensation data so that we have opioid utilization rates for similar injuries. But opioid utilization decreased substantially in recent years across the country, as reported in previous WCRI studies, and the magnitude of reductions varied across regions (Thumula, Wang, and Liu, 2017).

[14] The county-level dispensing rates are based on pharmacy transactions and do not account for physician-dispensed opioids, which might represent an insignificant proportion of opioid prescriptions paid by non-workers' compensation payors. Therefore, in states where physician dispensing of opioids is frequent in workers' compensation, local dispensing rates may be understated. But physician dispensing of opioids has been less frequent in recent years; less than 1 in 10 opioid prescriptions are physician-dispensed in our data, with the exception of six states (California, Connecticut, Florida, Georgia, Illinois, and Maryland). Our major findings did not change qualitatively when we excluded these states and reran the analysis on states where physician dispensing is infrequent.

[15] See https://www.ers.usda.gov/data-products/rural-urban-continuum-codes/.

[16] Urban areas include metropolitan counties with population size exceeding 250,000. Rural areas include non-metropolitan counties adjacent to metro areas or counties where population size was greater than 20,000. All other non-metropolitan counties where population size was less than 20,000 were categorized as very rural areas.

[17] State dummies mainly reflect differences across states in workers' compensation system features, state laws and regulations addressing opioids, as well as other state-specific variables that we did not control for in the regression.

COPYRIGHT © 2018 WORKERS COMPENSATION RESEARCH INSTITUTE

TECHNICAL APPENDIX

In this appendix, we provide opioid utilization measures without adjusting for case mix and discuss the empirical models used in estimating the case-mix adjusted utilization measures reported in this study.

DESCRIPTIVE STATISTICS OF OPIOID DISPENSING

Table TA.1 shows how the measures of opioid dispensing across the full sample of workers and by various worker, location, employer, and injury characteristics, without adjusting for differences in the mix of cases. These findings are qualitatively similar to the case-mix adjusted variations reported in the main body of the text.

Table TA.1 Opioid Utilization Measures Not Adjusted for Case Mix

	Among Injured Workers Receiving Pain Medications		Among Injured Workers Receiving Opioids		
	% That Received an Opioid Rx	% That Received 2 or More Opioid Rx	% That Received Opioids on a Longer-Term Basis	% That Had at Least 60 Days of Opioids Supply in Any 90-Day Period[a]	% That Had High-Dose Opioids (MED ≥ 50 mg for at least 60 days)[a]
All claims	46%	22%	5%	10%	2%
Worker characteristics					
Age group categories					
Age 15 to 24	34%	11%	2%	4%	1%
Age 25 to 39	42%	19%	5%	10%	2%
Age 40 to 54	48%	25%	6%	11%	3%
Age 55 to 60	51%	26%	6%	10%	2%
Age over 60	51%	25%	5%	9%	1%
Age is missing	36%	15%	2%	7%	1%
Gender					
Female	42%	19%	5%	9%	2%
Male	48%	23%	5%	10%	3%
Gender is missing	43%	18%	2%	7%	1%
Location characteristics					
Location is missing	51%	26%	6%	11%	3%
Rurality of residence					
Urban area	44%	21%	5%	10%	2%
Rural area	63%	31%	6%	10%	2%
Very rural area	68%	34%	6%	10%	2%
MME prescribed per capita by county in 2015					
1st quartile (lowest quartile)	39%	18%	5%	10%	2%
2nd quartile	47%	22%	5%	10%	2%
3rd quartile	50%	24%	5%	10%	3%
4th quartile (highest quartile)	55%	27%	5%	10%	3%
Health insurance coverage by county					
Uninsured rate, 0 to 9 percent	57%	27%	5%	9%	2%
Uninsured rate, 10 to 19 percent	42%	20%	5%	10%	2%
Uninsured rate, 20 to 29 percent	48%	23%	5%	9%	2%
Uninsured rate 30 percent and over	52%	24%	6%	10%	1%

continued

COPYRIGHT © 2018 WORKERS COMPENSATION RESEARCH INSTITUTE

Table TA.1 Opioid Utilization Measures Not Adjusted for Case Mix (continued)

	Among Injured Workers Receiving Pain Medications		Among Injured Workers Receiving Opioids		
	% That Received an Opioid Rx	% That Received 2 or More Opioid Rx	% That Received Opioids on a Longer-Term Basis	% That Had at Least 60 Days of Opioids Supply in Any 90-Day Period[a]	% That Had High-Dose Opioids (MED ≥ 50 mg for at least 60 days)[a]
Job characteristics					
Industry/occupation categories					
Agriculture, forestry, and fishing	50%	24%	4%	10%	1%
Clerical and professional	42%	19%	4%	9%	2%
Construction	58%	32%	7%	13%	4%
Health care and social assistance	44%	20%	5%	10%	2%
Manufacturing	48%	23%	5%	9%	2%
Mining (including oil and gas)	72%	44%	10%	19%	4%
Public safety	50%	24%	5%	8%	2%
Restaurants and entertainment	41%	17%	4%	8%	1%
Services (except public safety)	43%	21%	5%	11%	2%
Transportation, warehousing, and utilities	44%	23%	6%	11%	3%
Wholesale and retail trade	44%	20%	5%	10%	2%
Industry is missing	54%	28%	5%	11%	2%
Firm's payroll size categories					
$1 to $4 million (very small size)	54%	27%	6%	11%	3%
> $4 million to $20 million (small size)	45%	22%	6%	10%	2%
> $20 million to $80 million (medium size)	44%	21%	5%	9%	2%
> $80 million (large size)	44%	21%	5%	9%	2%
Payroll values missing	44%	21%	5%	10%	2%
Injury characteristics					
Injury type categories					
Neurologic spine pain	66%	47%	15%	29%	7%
Back and neck sprains, strains, and non-specific pain	34%	15%	5%	13%	2%
Fractures	79%	42%	4%	7%	2%
Lacerations and contusions	34%	9%	1%	3%	1%
Inflammations	55%	33%	7%	10%	2%
Other sprains and strains	40%	19%	4%	8%	1%
Upper extremity neurologic (carpal tunnel)	68%	34%	3%	5%	1%
Other injuries	55%	24%	4%	7%	2%

Note: The underlying data include prescriptions filled within 1.5 years of the injury date for all medical claims that had injuries occurring between October 1, 2014, and September 30, 2015.

[a] These two measures are based on a subset of claims with opioids that had complete days of supply.

Key: MED: morphine equivalent daily dose; MME: morphine milligram equivalents; Rx: prescription(s).

COPYRIGHT © 2018 WORKERS COMPENSATION RESEARCH INSTITUTE

EMPIRICAL MODELS TO ESTIMATE CHANGES IN OPIOID DISPENSING

All the opioid utilization measures included in this report are binary variables that take only two values (e.g., probability of an injured worker receiving an opioid prescription—"1" if the worker filled at least one opioid prescription, and "0" otherwise). For these binary utilization measures, we estimated predictions using logistic regressions. We controlled for differences in worker demographics, location, industry, and injury characteristics, as well as state dummies.[18] Table TA.2 provides the descriptive statistics of the control variables.

Table TA.2 Descriptive Characteristics of Control Variables

	Among Claims with Pain Medications	Among Claims with Opioid Rx	Among Claims with Opioid Rx and Complete Days of Supply
Total number of claims	391,054	177,994	127,133
Worker characteristics			
Age group categories			
Age 15 to 24	10.1%	7.6%	6.9%
Age 25 to 39	32.1%	29.8%	29.1%
Age 40 to 54	37.9%	40.3%	40.9%
Age 55 to 60	10.8%	12.2%	12.7%
Age over 60	8.8%	9.9%	10.3%
Age is missing	0.2%	0.1%	0.2%
Gender			
Female	39.7%	36.5%	35.8%
Male	59.7%	62.9%	63.6%
Gender is missing	0.6%	0.5%	0.6%
Location characteristics			
Location is missing	3.9%	4.4%	5.0%
Rurality of residence			
Urban area	88.0%	84.3%	82.5%
Rural area	6.3%	8.7%	9.6%
Very rural area	1.8%	2.6%	2.9%
MME prescribed per capita by county in 2015			
1st quartile (lowest quartile)	35.7%	30.4%	28.3%
2nd quartile	28.6%	29.4%	29.1%
3rd quartile	20.5%	22.3%	23.2%
4th quartile (highest quartile)	11.2%	13.5%	14.3%
Health insurance coverage by county			
Uninsured rate, 0 to 9 percent	8.9%	11.1%	12.2%
Uninsured rate, 10 to 19 percent	57.1%	52.3%	49.8%
Uninsured rate, 20 to 29 percent	24.7%	26.1%	26.6%
Uninsured rate 30 percent and over	5.3%	6.1%	6.5%

continued

[18] Some of the case-mix adjustment variables were missing for some workers. We included these claims in the regressions by including corresponding dummy variables indicating missing information.

COPYRIGHT © 2018 WORKERS COMPENSATION RESEARCH INSTITUTE

Table TA.2 Descriptive Characteristics of Control Variables (continued)

	Among Claims with Pain Medications	Among Claims with Opioid Rx	Among Claims with Opioid Rx and Complete Days of Supply
Job characteristics			
Industry/occupation categories			
Agriculture, forestry, and fishing	1.3%	1.4%	1.5%
Clerical and professional	12.0%	11.0%	11.2%
Construction	6.9%	8.7%	9.2%
Health care and social assistance	9.1%	8.7%	9.4%
Manufacturing	18.4%	19.4%	20.9%
Mining (including oil and gas)	0.4%	0.7%	0.9%
Public safety	1.2%	1.3%	1.2%
Restaurants and entertainment	5.3%	4.8%	4.5%
Services (except public safety)	14.8%	14.1%	13.9%
Transportation, warehousing, and utilities	11.5%	11.2%	10.6%
Wholesale and retail trade	18.8%	18.1%	16.1%
Industry is missing	0.4%	0.4%	0.5%
Firm's payroll size categories			
$1 to $4 million (very small size)	12.5%	14.7%	17.5%
> $4 million to $20 million (small size)	11.9%	11.8%	14.1%
> $20 million to $80 million (medium size)	9.6%	9.3%	10.7%
> $80 million (large size)	11.6%	11.1%	12.1%
Payroll values missing	54.4%	53.0%	45.6%
Injury characteristics			
Injury type categories			
Neurologic spine pain	6.3%	9.2%	9.7%
Back and neck sprains, strains, and non-specific pain	21.1%	16.0%	15.0%
Fractures	5.5%	9.5%	10.0%
Lacerations and contusions	16.6%	12.4%	11.2%
Inflammations	8.0%	9.7%	10.2%
Other sprains and strains	26.3%	23.2%	22.8%
Upper extremity neurologic (carpal tunnel)	1.2%	1.8%	1.9%
Other injuries	15.0%	18.2%	19.2%

Note: The data underlying this table are composed of workers in 27 states injured between October 1, 2014, and September 30, 2015, with Rx utilization observed within 1.5 years following the injury. The distribution of claims with Rx was generally similar to the numbers reported for claims with pain medications, with some minor exceptions.

Key: MED: morphine equivalent daily dose; MME: morphine milligram equivalents; Rx: prescription(s).

Table TA.3 presents estimated odds ratios from the logistic regressions for the likelihood of injured workers with pain medications receiving at least one opioid prescription and those receiving two or more opioid prescriptions. Since the coefficient estimates from the logistic regressions are not intuitively easy to explain, odds ratios, which present the multiplicative effect of the variable of interest, are reported. The odds ratios that are greater than 1 reveal a positive correlation between the control and the likelihood of receiving a medication compared with the base category. The odds ratios that are less than 1 reveal a negative correlation between the control and the likelihood of receiving a medication. For instance, the odds ratio for construction from the logistic regressions for the likelihood of injured workers receiving opioids in Table TA.3 is 1.410, i.e., a construction worker was more likely to receive an opioid compared with workers employed in manufacturing (base category). We report predicted probabilities from this regression model in the main body of the report for ease of interpretation.

COPYRIGHT © 2018 WORKERS COMPENSATION RESEARCH INSTITUTE

Table TA.3 Odds Ratios from Logistic Regressions Estimating the Likelihood of an Injured Worker Receiving Opioids within 1.5 Years of Injury

	% of Injured Workers with Pain Medications Who Received an Opioid Rx		% of Injured Workers with Pain Medications Who Received 2 or More Opioid Rx	
	Odds Ratio	**Standard Error**	**Odds Ratio**	**Standard Error**
Worker characteristics				
Age group categories				
Age 15 to 24	0.747***	(0.010)	0.586***	(0.011)
Age 25 to 39 (base)				
Age 40 to 54	1.242***	(0.010)	1.329***	(0.013)
Age 55 to 60	1.358***	(0.017)	1.401***	(0.020)
Age over 60	1.368***	(0.018)	1.371***	(0.021)
Age is missing	0.789***	(0.067)	0.803**	(0.086)
Gender				
Female (base)				
Male	1.210***	(0.010)	1.160***	(0.011)
Gender is missing	0.977	(0.046)	0.887**	(0.052)
Location characteristics				
Location is missing	0.490***	(0.071)	0.84	(0.125)
Rurality of residence				
Urban area	0.673***	(0.010)	0.785***	(0.013)
Rural area (base)				
Very rural area	1.282***	(0.041)	1.164***	(0.037)
MME prescribed per capita by county in 2015				
1st quartile (lowest quartile) (base)				
2nd quartile	1.350***	(0.013)	1.278***	(0.015)
3rd quartile	1.498***	(0.018)	1.391***	(0.020)
4th quartile (highest quartile)	1.751***	(0.025)	1.543***	(0.026)
Health insurance coverage by county				
Uninsured rate, 0 to 9 percent (base)				
Uninsured rate, 10 to 19 percent	0.781***	(0.012)	0.894***	(0.016)
Uninsured rate, 20 to 29 percent	0.722***	(0.015)	0.836***	(0.020)
Uninsured rate 30 percent and over	0.684***	(0.019)	0.883***	(0.029)
Job characteristics				
Industry/occupation categories				
Agriculture, forestry, and fishing	1.202***	(0.035)	1.181***	(0.040)
Clerical and professional	0.945***	(0.013)	0.903***	(0.015)
Construction	1.410***	(0.022)	1.504***	(0.026)
Health care and social assistance	1.040**	(0.016)	0.962**	(0.017)
Manufacturing (base)				
Mining (including oil and gas)	1.890***	(0.109)	1.914***	(0.102)
Public safety	1.144***	(0.037)	1.122***	(0.042)
Restaurants and entertainment	1.070***	(0.019)	1.004	(0.022)
Services (except public safety)	1.007	(0.012)	1.024	(0.015)
Transportation, warehousing, and utilities	1.002	(0.013)	1.091***	(0.017)
Wholesale and retail trade	1.081***	(0.013)	1.023	(0.015)
Industry is missing	1.206***	(0.068)	1.270***	(0.079)
Firm's payroll size categories				
$1 to $4 million (very small size) (base)				
> $4 million to $20 million (small size)	0.753***	(0.010)	0.800***	(0.013)
> $20 million to $80 million (medium size)	0.750***	(0.011)	0.778***	(0.014)
> $80 million (large size)	0.771***	(0.011)	0.768***	(0.013)
Payroll values missing	0.810***	(0.009)	0.801***	(0.010)

continued

COPYRIGHT © 2018 WORKERS COMPENSATION RESEARCH INSTITUTE

Table TA.3 Odds Ratios from Logistic Regressions Estimating the Likelihood of an Injured Worker Receiving Opioids within 1.5 Years of Injury (continued)

	% of Injured Workers with Pain Medications Who Received an Opioid Rx		% of Injured Workers with Pain Medications Who Received 2 or More Opioid Rx	
	Odds Ratio	**Standard Error**	**Odds Ratio**	**Standard Error**
Injury characteristics				
Injury type categories				
Neurologic spine pain	0.539***	(0.012)	1.313***	(0.026)
Back and neck sprains, strains, and non-specific pain	0.149***	(0.003)	0.266***	(0.005)
Fractures (base)				
Lacerations and contusions	0.153***	(0.003)	0.161***	(0.003)
Inflammations	0.346***	(0.007)	0.741***	(0.014)
Other sprains and strains	0.187***	(0.003)	0.364***	(0.006)
Upper extremity neurologic (carpal tunnel)	0.639***	(0.024)	0.763***	(0.028)
Other injuries	0.325***	(0.006)	0.453***	(0.008)
Dummy variables for each state				
Arkansas	1.624***	(0.083)	1.215***	(0.067)
California	0.651***	(0.015)	0.765***	(0.021)
Connecticut	0.661***	(0.021)	0.813***	(0.031)
Delaware	0.511***	(0.033)	0.747***	(0.057)
Florida	0.674***	(0.016)	0.793***	(0.023)
Georgia	1.120***	(0.031)	1.215***	(0.039)
Illinois	0.821***	(0.022)	1.126***	(0.035)
Indiana	0.787***	(0.023)	0.963	(0.032)
Iowa	1.054	(0.042)	1.053	(0.047)
Kansas	1.117***	(0.042)	1.068	(0.046)
Kentucky	0.499***	(0.018)	0.710***	(0.031)
Louisiana	1.939***	(0.081)	2.107***	(0.091)
Maryland	0.712***	(0.025)	0.812***	(0.034)
Massachusetts	1.507***	(0.063)	1.295***	(0.059)
Michigan	0.515***	(0.014)	0.684***	(0.023)
Minnesota	1.711***	(0.068)	1.328***	(0.058)
Missouri	0.981	(0.030)	1.062*	(0.038)
Nevada	1.041	(0.040)	1.101**	(0.048)
New Jersey	0.548***	(0.015)	0.699***	(0.023)
New York	1.084***	(0.032)	0.987	(0.033)
North Carolina	1.666***	(0.049)	1.486***	(0.048)
Pennsylvania	0.918***	(0.024)	1.044	(0.032)
South Carolina	1.567***	(0.054)	1.460***	(0.055)
Tennessee (base)				
Texas	1.766***	(0.046)	1.463***	(0.043)
Virginia	1.407***	(0.043)	1.071*	(0.038)
Wisconsin	1.306***	(0.044)	1.146***	(0.044)

Note: The underlying data include prescriptions filled within 1.5 years of the injury date for all medical claims that had injuries occurring between October 1, 2014, and September 30, 2015.

* Statistically significant at the 0.1 level; ** statistically significant at the 0.05 level; *** statistically significant at the 0.01 level.

Key: MME: morphine milligram equivalents; Rx: prescription(s).

COPYRIGHT © 2018 WORKERS COMPENSATION RESEARCH INSTITUTE

Table TA.4 presents estimated odds ratios from the logistic regressions for the likelihood of injured workers with opioids receiving them on a longer-term basis, and Table TA.5 presents the odds ratios for workers receiving chronic and high-dose opioids.

Table TA.4 Odds Ratios from Logistic Regressions Estimating the Likelihood of an Injured Worker with Opioids Receiving Opioids on a Longer-Term Basis

	% of Injured Workers with Opioid Rx Who Received Opioids on a Longer-Term Basis	
	Odds Ratio	**Standard Error**
Worker demographics		
Age group categories		
Age 15 to 24	0.413***	(0.030)
Age 25 to 39 (base)		
Age 40 to 54	1.230***	(0.033)
Age 55 to 60	1.206***	(0.045)
Age over 60	1.027	(0.044)
Age is missing	0.447*	(0.206)
Gender		
Female (base)		
Male	1.082***	(0.028)
Gender is missing	0.500***	(0.106)
Location characteristics		
Location is missing	1.071	(0.343)
Rurality of residence		
Urban area	0.905**	(0.036)
Rural area (base)		
Very rural area	1.108	(0.083)
MME prescribed per capita by county in 2015		
1st quartile (lowest quartile) (base)		
2nd quartile	1.239***	(0.039)
3rd quartile	1.320***	(0.048)
4th quartile (highest quartile)	1.371***	(0.059)
Health insurance coverage by county		
Uninsured rate, 0 to 9 percent (base)		
Uninsured rate, 10 to 19 percent	1.06	(0.050)
Uninsured rate, 20 to 29 percent	1.047	(0.064)
Uninsured rate 30 percent and over	1.192**	(0.096)
Job characteristics		
Industry/occupation categories		
Agriculture, forestry, and fishing	0.842*	(0.081)
Clerical and professional	0.904**	(0.042)
Construction	1.508***	(0.065)
Health care and social assistance	1.051	(0.052)
Manufacturing (base)		
Mining (including oil and gas)	1.778***	(0.178)
Public safety	1.132	(0.110)
Restaurants and entertainment	1.064	(0.067)
Services (except public safety)	1.116***	(0.045)
Transportation, warehousing, and utilities	1.161***	(0.049)
Wholesale and retail trade	1.052	(0.041)
Industry is missing	1.039	(0.172)

continued

COPYRIGHT © 2018 WORKERS COMPENSATION RESEARCH INSTITUTE

Table TA.4 Odds Ratios from Logistic Regressions Estimating the Likelihood of an Injured Worker with Opioids Receiving Opioids on a Longer-Term Basis (continued)

	% of Injured Workers with Opioid Rx Who Received Opioids on a Longer-Term Basis	
	Odds Ratio	**Standard Error**
Firm's payroll size categories		
$1 to $4 million (very small size) (base)		
> $4 million to $20 million (small size)	0.965	(0.039)
> $20 million to $80 million (medium size)	0.922*	(0.041)
> $80 million (large size)	0.879***	(0.038)
Payroll values missing	0.854***	(0.027)
Injury characteristics		
Injury type categories		
Neurologic spine pain	4.259***	(0.199)
Back and neck sprains, strains, and non-specific pain	1.285***	(0.064)
Fractures (base)		
Lacerations and contusions	0.357***	(0.025)
Inflammations	1.935***	(0.098)
Other sprains and strains	1.113**	(0.053)
Upper extremity neurologic (carpal tunnel)	0.777**	(0.091)
Other injuries	1.076	(0.053)
Dummy variables for each state		
Arkansas	0.808	(0.130)
California	1.396***	(0.101)
Connecticut	1.144	(0.116)
Delaware	0.871	(0.208)
Florida	1.042	(0.085)
Georgia	1.512***	(0.132)
Illinois	1.709***	(0.140)
Indiana	1.005	(0.099)
Iowa	0.815	(0.109)
Kansas	0.958	(0.118)
Kentucky	1.230*	(0.144)
Louisiana	3.178***	(0.293)
Maryland	1.192	(0.138)
Massachusetts	1.174	(0.136)
Michigan	1.128	(0.109)
Minnesota	0.917	(0.115)
Missouri	0.916	(0.097)
Nevada	1.321**	(0.158)
New Jersey (base)		
New York	1.071	(0.092)
North Carolina	1.670***	(0.143)
Pennsylvania	1.545***	(0.123)
South Carolina	1.601***	(0.152)
Tennessee	1.022	(0.096)
Texas	1.714***	(0.138)
Virginia	1.198*	(0.116)
Wisconsin	0.836	(0.093)

Note: The underlying data include prescriptions filled within 1.5 years of the injury date for all medical claims that had injuries occurring between October 1, 2014, and September 30, 2015.

* Statistically significant at the 0.1 level; ** statistically significant at the 0.05 level; *** statistically significant at the 0.01 level.

Key: MME: morphine milligram equivalents; Rx: prescription(s).

COPYRIGHT © 2018 WORKERS COMPENSATION RESEARCH INSTITUTE

Table TA.5 Odds Ratios from Logistic Regressions Estimating the Likelihood of an Injured Worker with Opioids Receiving Chronic and High-Dose Opioids within 1.5 Years of Injury

	% of Injured Workers with Opioid Rx Who Had at Least 60 Days of Opioids Supply in Any 90-Day Period[a]		% of Claims with Opioids That Had High-Dose Opioids (MED ≥ 50 mg for at least 60 days)[a]	
	Odds Ratio	**Standard Error**	**Odds Ratio**	**Standard Error**
Worker demographics				
Age group categories				
Age 15 to 24	0.488***	(0.028)	0.386***	(0.051)
Age 25 to 39 (base)				
Age 40 to 54	1.198***	(0.028)	1.150***	(0.053)
Age 55 to 60	1.151***	(0.038)	0.873**	(0.060)
Age over 60	1.045	(0.039)	0.697***	(0.058)
Age is missing	0.777	(0.221)	0.614	(0.368)
Gender				
Female (base)				
Male	1.080***	(0.025)	1.479***	(0.075)
Gender is missing	0.720**	(0.108)	0.538	(0.208)
Location characteristics				
Location is missing	1.994**	(0.693)	1.599	(0.981)
Rurality of residence				
Urban area	0.926**	(0.033)	1.066	(0.075)
Rural area (base)				
Very rural area	1.049	(0.070)	1.147	(0.151)
MME prescribed per capita by county in 2015				
1st quartile (lowest quartile) (base)				
2nd quartile	1.107***	(0.031)	1.334***	(0.080)
3rd quartile	1.260***	(0.040)	1.717***	(0.111)
4th quartile (highest quartile)	1.369***	(0.051)	1.760***	(0.135)
Health insurance coverage by county				
Uninsured rate, 0 to 9 percent (base)				
Uninsured rate, 10 to 19 percent	1.096**	(0.043)	1.257***	(0.092)
Uninsured rate, 20 to 29 percent	0.986	(0.052)	1.322***	(0.136)
Uninsured rate 30 percent and over	1.149**	(0.081)	1.102	(0.167)
Job characteristics				
Industry/occupation categories				
Agriculture, forestry, and fishing	0.999	(0.076)	0.735	(0.143)
Clerical and professional	0.915**	(0.037)	0.959	(0.081)
Construction	1.431***	(0.054)	1.797***	(0.127)
Health care and social assistance	0.968	(0.041)	1.028	(0.092)
Manufacturing (base)				
Mining (including oil and gas)	1.886***	(0.160)	1.742***	(0.294)
Public safety	0.889	(0.086)	1.138	(0.210)
Restaurants and entertainment	0.995	(0.056)	0.951	(0.116)
Services (except public safety)	1.118***	(0.039)	1.09	(0.078)
Transportation, warehousing, and utilities	1.039	(0.040)	1.147*	(0.086)
Wholesale and retail trade	0.983	(0.034)	1.07	(0.075)
Industry is missing	1.161	(0.155)	1.013	(0.293)

continued

COPYRIGHT © 2018 WORKERS COMPENSATION RESEARCH INSTITUTE

Table TA.5 Odds Ratios from Logistic Regressions Estimating the Likelihood of an Injured Worker with Opioids Receiving Chronic and High-Dose Opioids within 1.5 Years of Injury (continued)

	% of Injured Workers with Opioid Rx Who Had at Least 60 Days of Opioids Supply in Any 90-Day Period[a]		% of Claims with Opioids That Had High-Dose Opioids (MED ≥ 50 mg for at least 60 days)[a]	
	Odds Ratio	**Standard Error**	**Odds Ratio**	**Standard Error**
Firm's payroll size categories				
$1 to $4 million (very small size) (base)				
> $4 million to $20 million (small size)	0.917***	(0.031)	0.96	(0.063)
> $20 million to $80 million (medium size)	0.831***	(0.032)	0.863*	(0.066)
> $80 million (large size)	0.762***	(0.028)	0.786***	(0.059)
Payroll values missing	0.851***	(0.024)	0.867**	(0.048)
Injury characteristics				
Injury type categories				
Neurologic spine pain	5.533***	(0.228)	3.867***	(0.295)
Back and neck sprains, strains, and non-specific pain	1.969***	(0.083)	1.103	(0.094)
Fractures (base)				
Lacerations and contusions	0.508***	(0.029)	0.430***	(0.051)
Inflammations	1.452***	(0.068)	1.168*	(0.106)
Other sprains and strains	1.109**	(0.047)	0.693***	(0.059)
Upper extremity neurologic (carpal tunnel)	0.710***	(0.074)	0.472***	(0.115)
Other injuries	1.055	(0.045)	1.063	(0.085)
Dummy variables for each state				
Arkansas	0.506***	(0.077)	0.956	(0.248)
California	1.371***	(0.097)	0.932	(0.139)
Connecticut	0.731***	(0.073)	1.083	(0.207)
Delaware	1.350*	(0.221)	3.352***	(0.821)
Florida	1.009	(0.074)	0.708**	(0.110)
Georgia	0.914	(0.075)	1.091	(0.178)
Illinois	1.242***	(0.099)	1.986***	(0.311)
Indiana	0.775***	(0.069)	0.806	(0.148)
Iowa	0.531***	(0.067)	0.987	(0.230)
Kansas	0.584***	(0.066)	1.135	(0.223)
Kentucky	1.268**	(0.126)	1.059	(0.231)
Louisiana	2.522***	(0.211)	1.869***	(0.313)
Maryland	1.174	(0.121)	1.553**	(0.306)
Massachusetts	0.974	(0.098)	1.499**	(0.288)
Michigan	1.09	(0.093)	1.455**	(0.243)
Minnesota	0.588***	(0.067)	0.968	(0.216)
Missouri	0.549***	(0.055)	0.792	(0.153)
Nevada	0.953	(0.105)	1.138	(0.237)
New Jersey	0.566***	(0.051)	0.936	(0.160)
New York	1.264***	(0.097)	1.861***	(0.279)
North Carolina	1.014	(0.081)	1.264	(0.198)
Pennsylvania	1.031	(0.079)	1.706***	(0.255)
South Carolina (base)				
Tennessee	0.651***	(0.058)	0.696**	(0.126)
Texas	1.227***	(0.089)	1.04	(0.155)
Virginia	0.810**	(0.073)	1.142	(0.202)
Wisconsin	0.583***	(0.058)	1.242	(0.226)

Note: The underlying data include prescriptions filled within 1.5 years of the injury date for all medical claims that had injuries occurring between October 1, 2014, and September 30, 2015.

* Statistically significant at the 0.1 level; ** statistically significant at the 0.05 level; *** statistically significant at the 0.01 level.

[a] These two measures are based on a subset of claims with opioids that had complete days of supply.

Key: MED: morphine equivalent daily dose; MME: morphine milligram equivalents; Rx: prescription(s).

COPYRIGHT © 2018 WORKERS COMPENSATION RESEARCH INSTITUTE

Throughout the report, we compare opioid utilization metrics across the different claim groups by comparing predictions from the regression models outlined above. Case-mix adjusted measures allow us to make meaningful comparisons across groups while holding all available relevant factors constant. To estimate predicted values, we first constructed a sample of claims covering all workers across the 27 states underlying each measure. The prediction sample for estimating predictions for the percentage of injured workers with pain medications who received opioids includes all workers with pain medications across the 27 states; the prediction sample for estimating predictions for the percentage of injured workers with opioids who received opioids on a longer-term basis includes all workers with opioids across the 27 states; and the prediction sample for estimating predictions for the percentage of injured workers with opioids who received chronic and high-dose opioids includes all workers with opioids and complete days of supply across the 27 states. Then, we estimated the predicted value of the measure based on the regression results while assuming that all workers share the same worker characteristic of interest. As an example, to estimate the likelihood that construction workers received an opioid prescription, the predicted value was computed using coefficients from Table TA.3 for the full sample of claims while assuming that all claims were from the construction industry. This exercise was repeated for each industry group in our analysis by varying the values of the industry identifiers that are turned on and off for different predictions. As a result, we have predicted utilization metrics for an identical set of claims, and any differences in predicted values are not due to the characteristics we adjusted for.

COPYRIGHT © 2018 WORKERS COMPENSATION RESEARCH INSTITUTE

REFERENCES

Bunn, T., A. Bush, and S. Slavova. 2014. Drug overdose deaths by specific employment industry, occupation, and drug type. *Journal of the Kentucky Medical Association* 112: 201–211.

Bush, D., and R. Lipari. 2015. *The CBHSQ report: Substance use and substance use disorder, by industry*. Substance Abuse and Mental Health Services Administration, Center for Behavioral Health Statistics and Quality. Rockville, MD.

Case, A., and A. Deaton. 2015. Rising morbidity and mortality in midlife among white non-Hispanic Americans in the 21st century. *Proceedings of the National Academy of Sciences* 112 (49): 15,078–15,083.

Curtis, L., J. Stoddard, J. Radeva, S. Hutchison, P. Dans, A. Wright, R. Woosley, and K. Schulman. 2006. Geographic variations in the prescription of Schedule II opioid analgesics among outpatients in the United States. *Health Services Research* 41: 837–855.

Davis, A. 2009. Kentucky's urban/rural landscape: What is driving the differences in wealth across Kentucky? *Kentucky Annual Economic Report 2009*: 25–34.

Dolinschi, R., and K. Rothkin. 2018. *CompScope™ benchmarks: Technical appendix, 18th edition.* Cambridge, MA: Workers Compensation Research Institute.

Franklin, G., J. Mai, T. Wickizer, J. Turner, D. Fulton-Kehoe, and L. Grant. 2005. Opioid dosing trends and mortality in Washington state workers' compensation, 1996–2002. *American Journal of Industrial Medicine* 48: 91–99.

Guy, G., K. Zhang, M. Bohm, J. Losby, B. Lewis, R. Young, L. Murphy, and D. Dowell. 2017. Vital signs: Changes in opioid prescribing in the United States, 2006–2015. *Morbidity and Mortality Weekly Report* 66 (26): 697–704.

Han, H., P. Kass, B. Wilsey, and C. Li. 2012. Individual and county level factors associated with use of multiple prescribers and multiple pharmacies to obtain prescriptions in California. *PLoS ONE* 7(9): e46246.

Kidner, C., T. Mayer, and R. Gatchel. 2009. Higher opioid doses predict poorer functional outcome in patients with chronic disabling occupational musculoskeletal disorders. *The Journal of Bone and Joint Surgery* 91: 919–927.

Levy, B., L. Paulozzi, K. Mack., and C. Jones. 2015. Trends in opioid analgesic-prescribing rates by specialty, U.S., 2007–2012. *American Journal of Preventative Medicine* 49(3): 409–413.

Massachusetts Department of Public Health, Occupational Health Surveillance Program. 2018. *Opioid-related overdose deaths in Massachusetts by industry and occupation, 2011–2015.* Boston, MA.

McDonald, D., K. Carlson, and D. Izrael. 2012. Geographic variation in opioid prescribing in the U.S. *The Journal of Pain* 13 (10): 988–996.

Medi-Span®. 2005. *Master drug data base (MDDB®) v2.5: Documentation manual.* Indianapolis, IN: Wolters Kluwer Health, Inc.

Morano, L., A. Steege, and S. Luckhaupt. 2018. Occupational patterns in unintentional and undetermined drug-involved and opioid-involved overdose deaths — United States, 2007–2012. *Morbidity and Mortality Weekly Report* 67 (33): 925–930.

Savych, B., D. Neumark, and R. Lea. 2018. *The impact of opioid prescriptions on duration of temporary disability.* Cambridge, MA: Workers Compensation Research Institute.

Stapleton, D., G. Livermore, J. Cores, M. Nowak, and E. Eiseman. 2001. *Evaluation of the New York State ONECARD*

COPYRIGHT © 2018 WORKERS COMPENSATION RESEARCH INSTITUTE

Rx workers' compensation benefit: Final report. Prepared for State of New York, Department of Civil Service. Project Officer: Stephanie Washington. Prepared by the Lewin Group, Inc. and Cornell University.

Thumula, V. 2017. *Impact of Kentucky opioid reforms.* Cambridge, MA: Workers Compensation Research Institute.

Thumula, V., D. Wang, and T. Liu. 2017. *Interstate variations in use of opioids, 4th edition.* Cambridge, MA: Workers Compensation Research Institute.

Volinn, E., J. Fargo, and P. Fine. 2009. Opioid therapy for nonspecific low back pain and the outcome of chronic work loss. *Pain* 142: 194–201.

Wang, D. 2017. *Longer-term dispensing of opioids, 4th edition.* Cambridge, MA: Workers Compensation Research Institute.

Wang, D., and T. Liu. 2011. *Prescription benchmarks, 2nd edition: Trends and interstate comparisons.* Cambridge, MA: Workers Compensation Research Institute.

Whedon, J., A. Toler, J. Goehl, and L. Kazal. 2018. Association between utilization of chiropractic services for treatment of low-back pain and use of prescription opioids. *The Journal of Alternative and Complementary Medicine* February 2018, ahead of print. https://doi.org/10.1089/acm.2017.0131.

OTHER WCRI REPORTS

For a list of all of WCRI's reports, please click here.

COPYRIGHT © 2018 WORKERS COMPENSATION RESEARCH INSTITUTE