WCRI
Workers Compensation Research Institute

WCRI RESEARCH BRIEF:

IMPACT OF KENTUCKY OPIOID REFORMS

Research Questions:

- Did Kentucky House Bill 1 reduce opioids dispensed to injured workers?
- Which groups of injured workers were most affected by Kentucky House Bill 1?
- Did House Bill 1 impact the prescribing of non-opioid analgesics and non-pharmacologic pain management services?

In this study, we examine the impact of Kentucky's House Bill (HB) 1, a comprehensive reform addressing prescribing, dispensing, and monitoring of prescription opioids in the state. We report the initial impact of HB 1 on opioids received by newly injured workers (within the first year after the injury) using detailed transaction data for services rendered between January 1, 2011, and December 31, 2014. HB 1, which went into effect on July 1, 2012, regulated pain clinics and established standards for dispensing and prescribing of opioids, including mandating prescribers to query the state prescription drug monitoring program (PDMP) prior to prescribing opioids. As of December 2016, 20 states have adopted mandates requiring prescribers to check the state PDMP at least prior to initial prescriptions, starting with Kentucky. Findings of this study should therefore be of interest to stakeholders in Kentucky as well as those in several other states.

MAJOR FINDINGS

HB 1 IMMEDIATELY REDUCED OPIOIDS DISPENSED TO KENTUCKY INJURED WORKERS

In the first year after injury, fewer workers with pain medications received opioids, and the average amount of opioids received by Kentucky workers decreased. Fewer workers also received opioids on a chronic basis and at higher doses.

- Prior to the reforms, 54 percent of Kentucky workers injured in 2011 with pain medications received at least one opioid prescription within the first year of the injury. After the reforms, 44 percent of workers injured in 2013 with pain medications received at least one opioid prescription. By contrast, the proportion of injured workers receiving opioids changed little over the same period in neighboring states without similar reforms.
- Among those receiving opioids, the average amount of opioids decreased by 15 percent, from 1,472 morphine equivalent milligrams to 1,247 milligrams.
- The proportion of Kentucky workers with opioids who received opioids on a chronic basis over the first year (defined in this study as those receiving opioids for at least 60 days during any continuous 90-day period) changed little. One out of eight injured workers who initiated an opioid prescription received opioids on a chronic basis pre- and post-reform. But fewer Kentucky workers received opioids post-HB 1, and consequently fewer Kentucky workers received opioids on a chronic basis. The proportion of Kentucky workers with pain medications receiving opioids on a chronic basis decreased from 7.3 to 5.7 percent.

HB 1 HAD LITTLE OR NO IMPACT ON SOME GROUPS OF INJURED WORKERS

The impact of the reforms varied across different subsamples of Kentucky workers, after controlling for all other available characteristics of injured workers.

- Among Kentucky workers who had a major surgery, there was no change in the percentage of workers with pain medications who received opioids in the first year after injury (94 percent pre-HB 1 and 93 percent post-HB 1). At the same time, the claim frequency of receiving opioids decreased from 48 to 35 percent among workers who did not have a major surgery.
- Larger reductions in opioid dispensing were seen among injured workers who sustained back sprains and strains and neurologic spine pain injuries (compared with fractures), and workers 25 to 39 years old (compared with older workers).
- Opioid dispensing to injured workers was higher among those living in Eastern Kentucky compared with those living in the rest of the state, both pre- and post-HB 1. Pre-HB 1, 73 percent of injured workers with pain medications residing in Eastern Kentucky received at least one opioid prescription compared with 53 percent among those residing in other regions. This measure decreased by 10 percentage points in both groups after HB 1 came into effect. Post-HB 1, we still observed a higher rate of opioid dispensing among injured workers residing in Eastern Kentucky.

INJURED WORKERS CONTINUED TO RECEIVE PAIN MEDICATION POST-HB1

- After HB 1, Kentucky doctors appeared to have substituted at least some opioid prescriptions with non-opioid analgesics, especially nonsteroidal anti-inflammatory drugs (NSAIDs). The percentage of Kentucky workers injured in 2013 with pain medications that received only non-opioid analgesics increased by 10 percentage points, while the percentage with pain medications receiving opioid and non-opioid analgesics together and only opioids decreased by 5 percentage points each.
- There was no increase in the frequency and intensity of use of other pain management services such as physical therapy and pain management injections over the same period.

The study findings show that HB 1 immediately reduced opioids dispensed to Kentucky injured workers in the first 12 months after the injury. These findings raise questions about whether physicians had been prescribing pain medications that pose higher risks, like opioids, instead of non-opioid analgesics to a small but sizable fraction of some groups of Kentucky workers—such as those without a major surgery, workers with back sprains and strains with or without neurological involvement, and workers of ages 25 to 39 years—prior to the implementation of HB 1. The findings of this study also help readers focus on characteristics of injured workers where opioid utilization continues to be higher post-HB 1, such as workers living in the Eastern Kentucky region and workers aged 55 and older, so that future interventions, if necessary, could be targeted at these groups of workers.

DATA & METHODS

The findings are based on data comprising over 21,000 Kentucky workers' compensation claims with injuries from January 1, 2011, to December 31, 2013, and nearly 91,000 prescriptions associated with those claims. The prescription utilization of each worker was observed for 12 months following the date of injury. Injury year 2011 represents the experience of injured workers predominantly prior to the effective date of HB 1, and 2013 represents the experience immediately after the implementation of the reforms. 2012 is partially post-reform. The data included represent 44 percent of workers' compensation claims in Kentucky.

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

Vennela Thumula
Cambridge, Massachusetts
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EXECUTIVE SUMMARY

In this study, we examine the impact of the comprehensive reforms in Kentucky addressing opioid prescribing and dispensing on utilization of opioids, as well as other pharmacological and non-pharmacological pain management services. Kentucky's House Bill (HB) 1 went into effect on July 1, 2012.[1] HB 1 regulated pain clinics and established standards for dispensing and prescribing of opioids, including mandating prescribers to query the state prescription drug monitoring program (PDMP) prior to prescribing opioids. As of December 2016, 20 states had adopted prescriber use mandates requiring doctors to check the state PDMP at least prior to initial prescriptions.[2] Findings of this study should therefore be of interest to stakeholders in Kentucky as well as those in several other states.

This report presents the initial impact of Kentucky's HB 1 on opioids dispensed to newly injured workers using detailed transaction data for services rendered between January 1, 2011, and December 31, 2014.

The impact of HB 1 was observed immediately after the reform went into effect. Among the major findings of this study are the following:

- Fewer Kentucky workers with pain medications received opioids post-reform (Table A).[3] Prior to the reforms, 54 percent of Kentucky workers injured in 2011 with pain medications received at least one opioid prescription in the first 12 months following the injury. After the reforms, 44 percent of workers injured in 2013 with pain medications received at least one opioid prescription. By contrast, the proportion of injured workers receiving opioids changed little over the same period in neighboring states without similar reforms addressing prescription opioids.[4]
- The average morphine equivalent amount (MEA) of opioids received by Kentucky workers also decreased in the post-reform period.[5] With fewer injured workers receiving opioids post-reform, we expected those receiving opioids to have relatively more severe injuries, on average. Therefore we expected to see a higher average amount of opioids per claim in the post-reform period. However, among those receiving opioids, the average amount of opioids decreased from 1,472 morphine

[1] A detailed description of HB 1 and HB 217, the subsequent bill clarifying the provisions of HB 1, is provided later in this report on page 11.

[2] The 20 states are Alaska, Arizona, California, Connecticut, Kentucky, Maine, Maryland, Massachusetts, Nevada, New Hampshire, New Jersey, New Mexico, New York, Ohio, Oklahoma, Pennsylvania, Rhode Island, Tennessee, West Virginia, and Wisconsin. See Chapter 1 for more details.

[3] The term *opioids* used in this report refers to prescription opioids for pain relief, including natural (codeine, morphine), semisynthetic (hydrocodone, oxycodone, etc.), and synthetic (tramadol, methadone, and fentanyl) opioids. The study focuses on prescription opioids paid under the workers' compensation system. It does not address prescription and non-prescription opioids paid by other insurers and those obtained on a cash basis.

[4] To assess whether the changes in opioid dispensing observed in Kentucky between 2011 and 2013 were an artifact of the provisions of HB 1 or a response to the increased awareness of the opioid epidemic and federal changes, we compared changes in opioid dispensing in Kentucky with the changes in three neighboring states (Illinois, Indiana, and Missouri) without similar reforms. After adjusting for case mix, we observed a 10 percentage point decrease in Kentucky, whereas the same measure decreased by 0, -3, and 1 percentage points in Illinois, Indiana, and Missouri, respectively. See Table TA.15 and the related discussion in the technical appendix for details.

[5] The MEA of opioids is a cumulative opioid utilization measure calculated across the different opioid prescriptions received by an injured worker during the observation period, taking into account the strength in milligrams of the prescribed opioid medication, the analgesic potency ratio between the specific opioid and morphine, and the quantity of the prescription.

equivalent milligrams to 1,247 milligrams, a reduction of 15 percent.[6] This was mainly driven by Kentucky workers receiving fewer opioid prescriptions, mainly hydrocodone-acetaminophen (Vicodin®) prescriptions, in the post-reform period.

- Over the same period, the proportion of Kentucky workers with opioids who received opioids on a chronic basis (defined in this study as those receiving opioids for at least 60 days during any continuous 90-day period) changed little. One out of eight injured workers who initiated an opioid prescription received opioids on a chronic basis pre- and post-reform. But fewer Kentucky workers received opioids post-HB 1, and consequently fewer Kentucky workers received opioids on a chronic basis post-HB 1. The proportion of Kentucky workers with pain medications receiving opioids on a chronic basis decreased from 7.3 to 5.7 percent.[7]

Table A Opioid Dispensing within the First Year after Injury: Changes following Kentucky's Opioid Reforms[a]

	Pre-Reform	Partial Post-Reform	Post-Reform	Change, 2011–2013
	Injury Year 2011	Injury Year 2012	Injury Year 2013	
Frequency of claims receiving opioids				
% of claims with pain medications that had opioids	54%	50%	44%	-10 ppt***
Among claims that had opioids				
Average MEA per claim with opioids, milligrams	1,472	1,273	1,247	-15%**
% of claims with opioid Rx that had at least 60 days of opioid supply in any 90-day period[b]	14%	13%	13%	-1 ppt

Notes: The underlying data include prescriptions filled within one year of the injury date for all medical claims that had injuries occurring in calendar years 2011, 2012, and 2013. 2011 refers to injuries that occurred between January 1, 2011, and December 31, 2011, and we observed their prescriptions for one year following the injury date; similar notation is used for other years.

Case-mix adjusted measures are reported.

[a] Kentucky's House Bill 1 went into effect on July 1, 2012. 2011 represents the experience of injured workers predominantly before the effective date of House Bill 1, and 2013 represents the experience immediately after the implementation of the reforms. 2012 is partially post-reform.

[b] Days of supply information was complete for all opioid prescriptions for nearly 70 percent of Kentucky claims with opioids during the study period, and claims with complete days of supply were generally representative of all claims with opioids.

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

Key: MEA: morphine equivalent amount; ppt: percentage points; Rx: prescriptions.

[6] Chapter 3 shows the changes in the average amount of opioids received by injured workers in different subsamples. Note that the changes in this measure over time were not statistically significant despite the sizable reductions in several subsamples. This may be because of the very large variation in the MEA of opioids received by workers and the smaller sample sizes in the subsamples.

[7] Note that the change in the proportion of workers with pain medications who received chronic opioids was not statistically significant at the 0.1 level despite the sizable reduction of 22 percent between the post- and pre-reform periods.

The impact of the reforms varied across different subsamples of Kentucky workers, after controlling for all other available characteristics of injured workers.

- *Surgical versus nonsurgical cases.* Among Kentucky workers who had a major surgery,[8] we observed no change in the percentage of workers with pain medications who received opioids. Pre-HB 1, 94 percent of Kentucky workers with a major surgery who had pain medications filled at least one opioid prescription, and the figure was 93 percent post-HB 1. At the same time, the claim frequency of receiving opioids decreased significantly among workers who did not have a major surgery, from 48 percent pre-HB 1 to 35 percent post-HB 1. Similar patterns were seen in the claim frequency of receiving chronic opioids. Among surgical cases, the proportion of workers with pain medications receiving chronic opioids was 16 percent pre-reform and 15 percent post-reform (a 2 percent reduction). The figure decreased by 32 percent from 6.8 percent to 4.6 percent among nonsurgical cases. Note that a similar proportion of injured workers had a major surgery in the pre- and post-reform periods.
- *Injury type.* We observed that a fairly similar proportion of Kentucky workers who sustained fractures and neurologic spine pain with pain medications received opioids in the pre-reform period, 81 and 80 percent, respectively. However the changes in the frequency of receiving opioids after HB 1 differed across workers with these different injury types. Post-HB 1, 72 percent of Kentucky workers with fractures who had a pain medication prescription received opioids, whereas 62 percent of neurologic spine pain claims with pain medications had opioid prescriptions. Kentucky workers with back sprains and strains also had a larger reduction in the frequency of receiving opioids compared to workers with fractures. Reductions in the frequency and amount of opioids were also significantly higher among injured workers who sustained back sprains and strains compared to workers with non-back sprains and strains.[9]
- *Age.* We observed that the impact of the reforms was muted for older workers. Larger reductions in opioid dispensing rates were seen among Kentucky workers of ages 25 to 39 and workers of ages 40 to 54, compared with those 55 and older. Prior to the reforms, a similar proportion of Kentucky workers across these age groups with pain medications received at least one opioid prescription (55 to 58 percent). Post-HB 1, 41 percent of Kentucky workers of ages 25 to 39 received opioids for pain relief, and 49 percent or higher of those aged 55 and older who had pain medications received opioids.
- *Region of Kentucky.* Opioid dispensing was higher among injured workers living in Eastern Kentucky compared with those living in the rest of the state. Prior to HB 1, 73 percent of Eastern Kentucky residents with pain medications received at least one opioid prescription compared with 53 percent among those residing in other regions. We observed a similar reduction of 10 percentage points in the opioid dispensing rate among both groups of injured workers after HB 1 came into effect. Looking at workers injured in 2013, after most provisions of HB 1 were effective, we still observed a higher rate of opioid dispensing among workers residing in Eastern Kentucky.

[8] Major surgery is a WCRI-defined service group that is a subset of the surgery section of the Current Procedural Terminology (CPT®) manual. This service group includes invasive surgical procedures, as opposed to surgical treatments and pain management injections (which are also included in the surgery section of the CPT manual). The most frequent surgeries in this service group include (but are not limited to) arthroscopic surgeries of the shoulder or knee, laminectomies, laminotomies, discectomies, lumbar fusion, carpal tunnel surgeries, neuroplasty, and hernia repair. We tested the sensitivity of our results by defining major surgery as procedures identified by the Centers for Medicare & Medicaid Services as having a 90-day post-operative period for reimbursement purposes and found similar results.

[9] More than half of non-back sprains and strains were for shoulder, knee, ankle, and wrist sprains and strains.

Chapter 3 provides a more detailed description of changes in the frequency and amount of opioids among different subsamples of Kentucky injured workers. While we adjusted for differences in case mix across the different subsamples in these analyses, 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.

These findings may be useful in answering several important questions. Often, when reforms addressing opioid prescribing and dispensing are implemented, some concerns are raised that injured workers for whom opioids are medically necessary may not have access to these medications. While it is beyond the scope of this study to ascertain whether opioids are medically necessary for each of the Kentucky workers included in this study, our analyses across different subsamples of workers provide some preliminary evidence against this assertion. For example, HB 1 had no or relatively little impact on the frequency of receiving opioids among injured workers who had a major surgery (compared with those who did not have a major surgery) and workers who sustained fractures (compared with those who sustained back sprains and strains). Moreover, the large reductions in the prescribing of opioids to some injured workers (workers without a major surgery and workers with back sprains and strains), after the effectiveness of HB 1 raises concerns that opioids may not have been necessary in managing the pain for a small but sizable proportion of Kentucky workers injured prior to the implementation of HB 1.

The findings of this study also help readers focus on characteristics of injured workers where opioid dispensing continues to be higher post-HB 1, such as workers living in the Eastern Kentucky region and workers aged 55 and older, so that future interventions, if necessary, could be targeted at these groups of workers.

It is important to acknowledge that, in this study, we only examined the utilization patterns of newly injured workers who were not previously exposed to opioids for their work-related injury. We did not observe the changes in patterns of utilization among Kentucky workers who were prescribed opioids prior to HB 1, some of whom may have been receiving opioids on a chronic basis prior to HB 1. If some of these injured workers stop receiving opioids completely after HB 1 instead of having a tapered reduction over time, it may indicate potential access problems. Future studies should examine changes in opioid utilization in this group of injured workers to assess any potential unintended consequences of HB 1.

The study also looked at the impact of HB 1 on utilization of non-opioid pain medications and non-pharmacological pain management services.

- While fewer Kentucky workers received opioids, there was no change in the percentage of injured workers with a prescription that received any pain medications. Post-HB 1, Kentucky doctors appeared to have substituted at least some opioid prescriptions with non-opioid analgesics, especially nonsteroidal anti-inflammatory drugs (NSAIDs). Prior to the reforms, 24 percent of Kentucky workers with pain medications received only opioid analgesics, 46 percent received only non-opioid analgesics, and 30 percent received both opioid and non-opioid analgesics. After HB 1, the percentage of Kentucky workers injured in 2013 with pain medications who received only non-opioid analgesics increased by 10 percentage points, while the percentage with pain medications receiving opioid and non-opioid analgesics together and only opioids decreased by 5 percentage points each.
- There was no increase in the frequency and intensity of use of other pain management services such as physical therapy and pain management injections over the same period.
- These findings indicate that a similar fraction of Kentucky workers continued to get medications for pain

relief post-HB 1, but some injured workers received non-opioid pain medications, such as ibuprofen and naproxen, instead of opioids. If non-opioid pain medications were prescribed to this small but sizable fraction of Kentucky workers injured prior to HB 1 instead of opioids, they might not have been exposed to the serious risks associated with opioid prescriptions.

In sum, Kentucky's HB 1 reduced opioids dispensed to injured workers during the first 12 months after the injury. The change in frequency of receiving opioids was relatively smaller among injured workers who suffered injuries where the prescribing of opioids is expected at least for a shorter duration (workers with a major surgery compared to those without). A larger effect of the reforms was observed among injured workers with medical conditions where there is lower clinical consensus about the utilization of opioids, raising concerns that opioids may not have been necessary in this population in the first place (workers with back sprains and strains compared to those with fractures).[10] Moreover, Kentucky doctors appeared to have substituted at least some opioid prescriptions with non-opioid analgesics after the reforms, and there was no increase in the utilization of other pain management services such as physical therapy or pain management injections.

[10] Occupational medical treatment guidelines by the American College of Occupational and Environmental Medicine (ACOEM) and the Official Disability Guidelines (ODG) generally discourage the use of opioids initially, except for post-operative pain and for fractures and other conditions likely to result in significant pain. The 2014 update of the ACOEM guidelines recommends opioids for the treatment of acute, severe pain (including crush injuries, burns, fractures, etc.) and does not recommend opioids for the routine use for treatment of chronic low back pain, sprains, etc. For postoperative pain, ACOEM recommends limited use of opioids as adjunctive medications with more effective treatments (Hegmann et. al., 2014).

1

BACKGROUND

Opioid prescribing rates and overdose death rates have increased in parallel in the United States and in Kentucky, which is at the epicenter of the opioid epidemic. The Kentucky Injury Prevention and Research Center reported that the age-adjusted overdose death rate increased from 6.2 per 100,000 residents in 2000 to 24.1 per 100,000 residents in 2011. To address the growing problem in the state, the Kentucky legislature passed the comprehensive House Bill (HB) 1 in 2012 that made several changes addressing the prescribing, dispensing, and monitoring of prescription opioids. HB 217 was enacted in 2013, clarifying some of the provisions of HB 1. Coinciding with the 2012 reforms, small year-to-year decreases were seen in drug overdose deaths from 2011 to 2013. This was followed by increases over two years from 23.3 per 100,000 residents in 2013 to 28.7 per 100,000 residents in 2015.[1] In 2015, 1,248 Kentucky residents died due to drug overdoses. Pharmaceutical opioids continued to account for the majority of the overdose deaths in the state.[2] Kentucky implemented other reforms in subsequent years addressing measures to reduce overdose deaths, including Senate Bill 192 (which was passed in 2015) and House Bill 333 (signed by the governor in 2017). In this study, we examine the impact of HB 1 on prescription utilization among Kentucky workers who suffered a workplace injury and received workers' compensation benefits.

Opioid utilization is prevalent among injured workers in the Kentucky workers' compensation system. Prior to the recent reforms, Kentucky was among the states with a higher-than-typical average amount of opioids per claim, according to a recent Workers Compensation Research Institute (WCRI) study. In 2011/2013, Kentucky workers included in that study had 38 percent higher average morphine equivalent milligrams of opioids compared with the 25-state median (Thumula, Wang, and Liu, 2017).[3]

[1] Fentanyl was noted to be the primary driver of the increase in overdose deaths during this period in the study (Akkers, et al., 2016). Another study reported that the increases may be attributable to illicitly manufactured fentanyl (Gladden, Martinez, and Seth, 2016).

[2] Pharmaceutical opioid associated deaths include overdose deaths due to natural/semisynthetic opioids (e.g., morphine, codeine, hydrocodone, oxycodone, and hydromorphone), methadone, and synthetic opioids other than methadone (e.g., fentanyl and tramadol). These deaths may be associated with prescribed or illicitly obtained opioids.

[3] 2011/2013 refers to nonsurgical claims with more than seven days of lost time with injuries occurring in October 1, 2010, through September 30, 2011, with prescriptions filled through March 31, 2013, and paid for by a workers' compensation payor. See *Interstate Variations in Use of Opioids, 4th Edition* (Thumula, Wang, and Liu, 2017) for more details.

SUMMARY OF KENTUCKY'S HB 1 AND INITIAL IMPACT

HB 1 was passed by the Kentucky legislature in April 2012 and went into effect in July 2012.[4] HB 1 made several changes that address prescribing, dispensing, and monitoring of prescription opioids and other controlled substances. One of the major provisions of HB 1 required all prescribers and dispensers to register with the state prescription drug monitoring program (PDMP) called Kentucky All Schedule Prescription Electronic Reporting Program (KASPER). Effective July 2012, practitioners are required to query KASPER prior to the initial prescribing or dispensing of Schedule II controlled substances or a Schedule III controlled substance containing hydrocodone and at least every three months after that for patients who continue to receive medications, with narrow exemptions. In addition, practitioners must obtain the patient's medical history, conduct a physical examination, develop a treatment plan, discuss risks and benefits with the patient, and obtain written consent and document these records. Dispensers of controlled substances are required to report to KASPER within one day of dispensing beginning July 2013.

HB 1 also required all state licensing boards to promulgate administrative regulations for prescribers and dispensers of controlled substances by September 2012.[5] The regulations include mandatory professional standards related to controlled substances; restriction of routine physician dispensing of Schedule II or Schedule III opioids to 48 hours;[6] continuing education requirements in pain management, addiction disorders, or electronic monitoring; and procedures to enforce licensure standards, among others. The Kentucky Board of Medical Licensure issued prescribing standards for Schedule II–IV controlled substances for doctors prescribing both acute and long-term opioids.[7] These regulations expand the requirements for prescribers to query KASPER prior to initial prescriptions of Schedule II–IV controlled substances. Doctors prescribing long-term opioids to treat non-cancer pain are required to obtain a comprehensive patient history, review KASPER periodically, develop and document a treatment plan, get a baseline drug screen, administer random drug screens and pill counts when deemed appropriate, and refer to appropriate specialists when needed, among other requirements. HB 1 also set ownership and oversight requirements for pain management facilities with criminal sanctions for violation of these requirements.

There were anecdotal reports of unintended consequences of HB 1 immediately after it came into effect. There were concerns about HB 1 causing access problems for patients in need of controlled substances because fewer doctors may be willing to prescribe controlled substances post-HB 1. Consequently, HB 217 was passed to clarify and modify some provisions in HB 1 and became effective in March 2013. HB 217 made exemptions to the KASPER querying requirements for patients in hospitals, long-term care facilities, and hospice care; for patients within 14 days of surgery; and for treatment of pain associated with cancer. The bill also removed some requirements from the mandatory prescribing standards set forth by the Board of Medical Licensure. Instead of requiring doctors to conduct random urine drugs tests for all patients, HB 217 leaves the appropriateness of a random urine drug test up to the discretion of the doctor. HB 217 also modified the

[4] The full text of Kentucky's HB 1 is available at http://kbml.ky.gov/hb1/Documents/House-Bill-1.pdf. The full text of Kentucky's HB 217, a subsequent bill that clarifies and modifies certain provisions in HB 1, can be accessed at http://www.lrc.ky.gov/record/13RS/HB217/bill.doc. A summary of HB 1 is available on the Kentucky Board of Medical Licensure's website at http://kbml.ky.gov/hb1/Documents/KBML%20Summary%20of%20HB1.pdf.

[5] The licensing boards issued emergency regulations in July 2012.

[6] Physician dispensing of opioids is not prevalent in Kentucky. Pre-reform, only 7 percent of all opioid prescriptions were dispensed by physician-dispensers. This number decreased to 3 percent post-reform.

[7] A summary of regulations issued by the Kentucky Board of Medical Licensure is available at http://kbml.ky.gov/hb1/Documents/Summary%20of%20201%20KAR%209_260.pdf, and the full text of the regulation 201 KAR 9:260 is available on the Board's website.

requirement that doctors should obtain a patient's complete controlled substance use history from KASPER to obtaining 12 months of history.

The Kentucky Cabinet for Health and Family Services contracted with the University of Kentucky to evaluate the impact of HB 1. Researchers from the University of Kentucky used KASPER data, practitioner interviews, and surveys to evaluate the preliminary impact of HB 1. Comparing controlled substance utilization patterns one year before and after HB 1 took effect in July 2012, the authors reported a 7 percent decrease in the number of unique patients with controlled substances (Freeman et al., 2015). Over the same period, the total number of opioids prescribed in Kentucky decreased by 9 percent. One of the major goals of the reform was to address drug abuse and diversion; therefore, a larger impact was expected in patients receiving controlled substances from multiple prescribers and pharmacies, sometimes referred to as *doctor shoppers*. As expected, there was an immediate and large decrease in the number of doctor shoppers, from 14,455 patients in fiscal year 2012 to 6,963 patients in fiscal year 2013, a 52 percent reduction. During stakeholder interviews, prescribers and pharmacists reported initial confusion and disruptions to workflow to accommodate the HB 1 changes. The researchers concluded that the stakeholders initially expressed frustration, but 15 months after the implementation of KASPER changes, they accepted and some even appreciated the changes to prescribing and dispensing of controlled substances. The survey data provided additional information about the impact of HB 1 on Kentucky prescribers and dispensers. Doctors and pharmacists reported utilizing KASPER more often in their practices. However, a majority reported little change in their prescribing and dispensing behaviors, which may explain the moderate reductions seen in overall prescribing patterns in the University of Kentucky study as well as our study. The authors also found that the number of unique Kentucky prescribers issuing controlled substances did not decline post-HB 1. Prescribers from Kentucky issued more than 90 percent of all controlled substances in the state, with the remaining 10 percent being written by out-of-state prescribers.[8]

The above referenced study documented the impact of the Kentucky opioid reforms on the entire Kentucky population. However, the extent to which the reforms impacted opioid prescribing to injured workers is unknown. Our study examines whether the reforms changed opioid dispensing and utilization of other pain management services among injured workers in the workers' compensation system.

PRESCRIPTION DRUG MONITORING PROGRAMS AND PRESCRIBER USE MANDATES

One of the major provisions of Kentucky's HB 1 addresses the state PDMP called KASPER. PDMPs are statewide electronic databases of prescriptions dispensed for controlled substances. Information collected by PDMPs may be used to support access to legitimate medical use of controlled substances; identify or prevent drug abuse and diversion; facilitate identification of prescription drug-addicted individuals and enable intervention and treatment; outline drug use and abuse trends to inform public health initiatives; or educate individuals about prescription drug use, abuse, and diversion.[9] As of July 2017, all states but Missouri have enacted PDMP legislation. The state PDMPs vary widely with respect to what information is contained in the database, who should report to the system in what time frame, who can and should access the database for

[8] The authors found a 14 percent decrease in unique controlled substance prescribers post-HB 1. The reduction appears to be driven by out-of-state prescribers who account for two-thirds of all prescribers reporting to the KASPER data set. There was no change in the number of unique Kentucky prescribers post-HB 1.

[9] See Finklea, Sacco, and Bagalman (2014).

what purposes, and whether the information can be shared with other state PDMPs.[10]

In recent years, an increasing number of states made legislative mandates requiring prescribers to register and use the PDMP database. In 2009, Nevada was the first state to pass legislation requiring use of the PDMP with a more subjective trigger of "reasonable belief that the patient may be seeking the controlled substances." Since 2012, mandates for the use of state PDMPs have accelerated with more obligatory requirements for prescribers to check prescription history in the PDMP database at the initial and continued prescribing of opioids. Kentucky was the first state to adopt a comprehensive mandate that requires all prescribers to check a patient's prescription history before initial prescriptions and at least every three months after that for patients who continue to receive medications, with narrow exemptions. As of 2015, 12 other states adopted similar comprehensive PDMP prescriber use mandates at least for initial prescriptions.[11] A review of mandatory PDMP use conditions published by the National Alliance for Model State Drug Laws (NAMSDL) suggests that 20 states had adopted such mandates as of December 2016.[12] PDMP utilization is mandated under limited circumstances or for specific prescribers in other states, including for physicians in pain management clinics, when the practitioner believes the patient may be seeking controlled substances for non-medical reasons, or when patients are prescribed Schedule II controlled substances for chronic non-cancer pain.[13]

The PDMP Center of Excellence (COE) documented evidence on the effectiveness of mandatory PDMP use requirements on opioid prescriptions (PDMP COE, 2014). For example, Kentucky observed a 9 percent decline in the number of opioid prescriptions dispensed in the first year after requiring prescriber enrollment and use of KASPER. After Tennessee's PDMP use mandate went into effect in April 2013, opioid prescriptions in the state decreased by over 7 percent between August 2012 and July 2013. New York also observed a 9.5 percent decrease in opioid prescriptions between the fourth quarters of 2012 and 2013 after implementing the Internet System for Tracking Over-Prescribing (I-STOP) legislation in July 2013. A recently published study by Dowell et al. (2016) shows positive results of reforms mandating prescribers to review the state PDMP. The authors observed substantial reductions in the amount of opioids and prescription opioid overdose deaths in states that simultaneously implemented PDMP prescriber mandates and regulated pain clinics, unlike states without these reforms. The impact of these reforms on heroin overdose deaths is unclear. Dowell et al. noted that the heroin overdose deaths were increasing at a higher rate prior to the reforms in states that eventually implemented PDMP mandates and pain clinic laws compared to states without these reforms. Future studies should analyze whether the implementation of PDMP mandates and other policies curbing prescription opioids were effective in slowing or reversing the growing trend in heroin overdose deaths.

[10] Information is available at http://www.pdmpassist.org/pdf/PDMPProgramStatus2015_v5.pdf.

[11] See Appendix D of a 2016 report published by the Pew Charitable Trusts, *Prescription Drug Monitoring Programs: Evidence-Based Practices to Optimize Prescriber Use* for detailed information about the mandates in these 13 states.

[12] NAMSDL and Sherry L. Green & Associates, LLC compiled the key state requirements for mandatory use of PDMPs by prescribers. Summarized data (as of December 2016) is available in Excel format at http://www.namsdl.org/library/6757CFE2-E9D2-2C3E-3EED217690E6ABA3. The 20 states that adopted mandates requiring all prescribers to use the PDMP for initial prescriptions are Alaska, Arizona, California, Connecticut, Kentucky, Maine, Maryland, Massachusetts, Nevada, New Hampshire, New Jersey, New Mexico, New York, Ohio, Oklahoma, Pennsylvania, Rhode Island, Tennessee, West Virginia, and Wisconsin.

[13] Mandatory PDMP use conditions compiled by the PDMP Center of Excellence (COE) at Brandeis University (as of April 2017) are available at http://www.pdmpassist.org/pdf/Mandatory_conditions_use_2.pdf.

2

DATA, APPROACH, AND CAVEATS

This study analyzes data on the medications dispensed to injured workers covered by the Kentucky workers' compensation program. The focus of this study is on the utilization of prescriptions and other pain management services and not the associated costs. This study examines the impact of the reforms on newly injured workers; it does not include the post-reform experience of legacy claims (i.e., claims with dates of injury before the reform).

The claims represent injuries occurring in three calendar years from 2011 to 2013. The prescriptions received by each worker were observed for 12 months following the date of the injury. Injury year 2011 represents the experience of injured workers prior to the effective date of HB 1, and 2013 represents the experience immediately after the implementation of the reforms. 2012 is partially post-reform. The data include 21,739 Kentucky claims with prescriptions and 91,350 prescriptions associated with those claims.

The data include both open and closed Kentucky claims that had indemnity benefits as well as those that did not (*medical-only* claims). The analysis data were extracted from WCRI's 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 insurance carriers and workers' compensation payors whose data underlie this study represent 44 percent of workers' compensation claims in Kentucky.

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. The specific medication prescribed was identified by National Drug Code (NDC). For the purpose of this study, we grouped prescription drugs into the following therapeutic groups—opioids, nonsteroidal anti-inflammatory drugs (NSAIDs), muscle relaxants, anticonvulsants, antidepressants, dermatologicals, other pain drugs, antianxiety drugs, anti-infective agents, gastrointestinal agents, and other medications.[1] We used the classification scheme developed by Medi-Span® to assign medications to each therapeutic group.[2]

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

[1] Medications that were rarely prescribed to injured workers in the workers' compensation system were grouped into a category called *other medications.*

[2] 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).

based on morphine equivalent amount (MEA) 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 equianalgesic conversion factors developed by the Centers for Disease Control and Prevention (CDC)[3] 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. A variable was created for each individual claim to capture the cumulative MEA across different opioid medications received by the injured worker.

MEASURES INCLUDED IN THIS STUDY WERE UTILIZATION BASED

Utilization of opioids was primarily measured using the following metrics: the percentage of claims with pain medications that received at least one opioid prescription and the average MEA per claim with opioids.[4] Several other utilization metrics are also included in the analyses to help explain why the average MEA increased or decreased post-HB 1. A lower average MEA per claim could mean fewer opioid prescriptions filled per claim, fewer pills per opioid prescription, or a change in the mix of types of opioids prescribed; we include all these measures in this study. We further examined the change in the percentage of claims with pain medications that had non-opioid analgesics and the mix of drugs prescribed to Kentucky workers before and after HB 1.

We constructed a few additional measures using a subset of claims with complete days of supply information in order to highlight the changes in opioid dispensing among claims with higher rates of dispensing.[5] Measures based on days of supply include the average duration of opioids received, the average

[3] 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.

[4] Claims with a prescription or pain medication prescription paid under workers' compensation provide a robust base to measure the changes in frequency of opioid dispensing after opioid reforms because these reforms are unlikely to have an impact on whether or not an injured worker receives any prescription. One may be concerned that if fewer injured workers receive opioids post-reform and non-opioid pain medications were not substituted for opioids, then fewer claims would receive a pain medication prescription or any prescription. However, the percentage of injured workers who only received an opioid prescription and no other medications was in the single digits and changed little over time, implying that the opioid policies are less likely to result in changes in the percentage of injured workers receiving any prescription. Moreover, the proportion of Kentucky claims with a prescription may have changed over time for other reasons. For example, the Affordable Care Act's Medicaid expansion led to an increase in the Kentucky population with health insurance coverage. This may have resulted in more initial prescriptions paid for by Medicaid instead of workers' compensation. Thumula, Wang, and Liu (2017) discuss the potential reasons for the large proportion of claims without prescriptions in our data.

[5] Over the study period, 70 percent of claims with opioids had days of supply information for all opioid prescriptions. One may be concerned that claims with days of supply are different from claims without days of supply and may not represent all claims with opioid prescriptions in our sample. A review of detailed data showed that days of supply information was missing for claims with lower, typical, and higher amounts of opioids. We tested the magnitude of the potential bias introduced by using claims with complete days of supply and found that this selection was unlikely to be material for the purpose of comparing changes in days-of-supply-based metrics over the study period. To test the bias we (1) compared the average MEA across all claims in the state with the average among claims with complete days of supply and found small differences of 8 and 6 percent in the pre- and post-reform periods, and (2) we computed the chronic dispensing rate across all claims with opioids by assuming lower rates of chronic opioid dispensing among claims for which we do not have complete days of supply (we reduced the rate of chronic dispensing by a multiplier of the percentage difference in the average MEA between claims with complete days of supply and all claims), and found that the characterization of trends did not change. However, it is possible that the claim frequency of receiving chronic opioids and high-dose opioids among claims with complete days of supply may be slightly higher than the numbers across all Kentucky claims with opioids because the average amount of opioids per claim for claims with complete days of supply was 8 and 6 percent higher than the average across all claims in the pre- and post-reform periods.

morphine equivalent daily dose (MED), the percentage of injured workers receiving opioids for at least 60 days during any continuous 90-day period (referred to as receiving *chronic opioids* in this study), and the percentage of injured workers receiving an MED exceeding 50 and 90 milligrams for at least 60 days (referred to as receiving *high-dose opioids* in this study).[6,7] To compute these measures, we converted the opioid transactions into day-to-day utilization metrics based on 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.

Lastly, to assess whether HB 1 resulted in an increase in the utilization of other pain management services, we computed the percentage of Kentucky injured workers who received the following services and the average number of visits per claim for each of these services—evaluation and management, emergency services, physical medicine, pain management injections, and major surgery.

REGRESSION METHODS USED TO OBTAIN ADJUSTED UTILIZATION METRICS

We wanted the comparisons of utilization metrics before and after the reforms to be based on a similar group of injured workers, i.e., we wanted the change in opioid utilization to be a reflection of HB 1 rather than a reflection of the differences in the characteristics of injured workers. To accomplish this, we used logistic regression analyses to compare the categorical utilization measures (e.g., likelihood of an injured worker receiving opioids) before and after the reforms while controlling for differences in the demographic, employment, and injury characteristics of the workers. Ordinary least squares (OLS) linear regression analyses were used to compare continuous utilization measures (average number of prescriptions per claim, average number of pills per claim, and average MEA per claim).

The control variables included the worker's age at the time of injury, gender, urban versus rural location, marital status, the type of injury the worker sustained, type of industry in which the injured worker was employed, and comorbidities. The urban-rural classification was based on the Department of Agriculture's Urban-Rural continuum codes, which range from 1 (most urban) to 9 (most rural) based on the degree of rurality.[8] 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).[9] Note that the majority of the counties in Eastern Kentucky and the Appalachian counties fell under the very rural category. The injury classifications are primarily based on ICD-9 (International Classification of Diseases, Ninth Revision) codes.[10] 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. Type of

[6] 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.

[7] CDC guidelines for prescribing opioids for chronic pain 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] See https://www.ers.usda.gov/data-products/rural-urban-continuum-codes/.

[9] 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.

[10] The injury categories are predominantly based on primary ICD-9 codes from medical bills. The primary ICD-9 code is defined as the one that receives the most payments. In the event that ICD-9 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.

industry was determined using the four-digit industry-standard worker and governing-class codes and standard industrial classification (SIC) codes. Industry classifications include (1) clerical or professional, (2) construction, (3) high-risk services, (4) low-risk services, (5) manufacturing, (6) trade, (7) other industry, and (8) unknown.[11] Comorbidities were based on ICD-9 codes extracted from all medical bills for the injured worker. To capture the number of injured worker comorbidities, we used the commonly used Elixhauser comorbidity index that was developed to predict health care utilization and mortality.[12] For the linear and 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.

LIMITATIONS AND CAVEATS

The data used for this analysis are based on 12 months of experience, which is not necessarily sufficient to capture the full utilization of opioids and other pain management services.[13] With more mature data, one could observe the longer-term impact of the reforms and assess any potential unintended consequences of these reforms. Readers should also note that this study does not isolate the effect of the PDMP prescriber use mandate in Kentucky; the changes we observed may be associated with several provisions of HB 1 (discussed in Chapter 1) that were implemented over a short period of time between July 2012 and March 2013. Additionally, the general awareness of the extent of the opioid epidemic in the United States may have triggered organizational efforts to alter prescribing and dispensing of opioids. Other federal efforts such as up-scheduling of hydrocodone-combination products toward the end of the study period[14] may also have confounded our results. To address some of these concerns, we examined whether opioid dispensing patterns changed during the same time period in three neighboring states that did not have substantial state-level opioid reforms. Our analysis suggests that the changes in opioid dispensing patterns we observed in Kentucky are likely to be predominantly due to the state reforms. Confounding effects appear to be minimal. The technical appendix provides the results of this analysis.

[11] For more detailed information about the construction of injury and industry mix, please refer to Dolinschi and Rothkin (2016).

[12] The Elixhauser index is a total of comorbidities reported as an integer with possible values ranging from 0 to 30. It is an index of comorbidities that was validated to be used in studies using administrative claims data (Elixhauser et al., 1998).

[13] In a National Council on Compensation Insurance (NCCI) study, the authors found that the opioid share of all prescriptions increased steadily when claims became more mature until about the eighth year postinjury (Lipton, Laws, and Li, 2009). The same study also looked at the opioid share by costs per opioid prescription, where the high-cost group would presumably include more prescriptions for stronger and long-acting opioids. The study found that the high-cost opioid prescriptions grew from 9 percent of all opioid prescriptions in the first year to 45 percent in the 12th year postinjury.

[14] In October 2014, the Drug Enforcement Administration moved hydrocodone-combined products, including Vicodin® and Lortab®, to Schedule II, the category of medically accepted drugs with the highest potential for abuse, mainly because of the rise in hydrocodone abuse and trafficking in the last several years.

3

CHANGES IN DISPENSING OF OPIOIDS

This chapter presents the research results that underlie the major findings and policy implications that were discussed in the executive summary. We provide answers to the following research questions:

- Did the frequency and amount of opioids dispensed to injured workers change after the reforms?
- Did the reforms have a similar impact on all injured workers in Kentucky?
- Did the prescribing patterns of pain medications change after the reforms?
- Did the frequency and intensity of use of other pain management services (e.g., pain management injections, physical medicine, and surgery) change?

In short, the data show that Kentucky injured workers received fewer opioids after HB 1. HB 1 had a larger impact on opioid dispensing among injured workers who did not have a major surgery (compared with those with a major surgery), injured workers who sustained back sprains and strains and neurologic spine pain injuries (compared with fractures), and workers 25 to 39 years old (compared with older workers). We also observed that physicians substituted some opioid prescriptions with other pain medications. There was no change in the proportion of workers receiving pain management injections, physical medicine, or surgical interventions.

CHANGES IN DISPENSING OF OPIOID AND NON-OPIOID ANALGESICS BEFORE AND AFTER KENTUCKY'S HB 1

Table 3.1 presents the results from the regression analyses estimating the changes in opioid utilization metrics before and after HB 1. Fewer Kentucky workers with pain medications received opioids post-reform. Prior to the reforms, 54 percent of Kentucky workers injured in 2011 with pain medications received at least one opioid prescription in the first 12 months following the injury. After the reforms, 44 percent of workers injured in 2013 received at least one opioid prescription. By contrast, the proportion of injured workers receiving opioids changed little over the same period in neighboring states without similar reforms addressing prescription opioids.[1]

It is plausible that many Kentucky injured workers received only one opioid prescription for an emergent condition, while others continued to receive opioids. HB 1 decreased the proportion of Kentucky workers

[1] To assess whether the changes in opioid dispensing observed in Kentucky between 2011 and 2013 were an artifact of the provisions of HB 1 or a response to the increased awareness of the opioid epidemic and federal changes, we compared changes in opioid dispensing in Kentucky with the changes in three neighboring states (Illinois, Indiana, and Missouri) without similar reforms. After adjusting for case mix, we observed a 10 percentage point decrease in Kentucky, whereas the same measure decreased by 0, -3, and 1 percentage points in Illinois, Indiana, and Missouri, respectively. See Table TA.15 and the corresponding discussion in the technical appendix for details.

receiving only one opioid prescription and those receiving two or more opioid prescriptions.

Table 3.1 Changes in Opioid Dispensing after Kentucky's Opioid Reforms[a]

	Pre-Reform	Partial Post-Reform	Post-Reform	Change, 2011–2013
	2011	2012	2013	
Frequency of claims receiving opioids				
% of claims with prescriptions that had opioids	44%	41%	35%	-9 ppt***
% of claims with pain medications that had opioids	54%	50%	44%	-10 ppt***
% of claims with pain medications that had 2 or more opioids	28%	25%	22%	-6 ppt***
Among claims that had opioids				
Average MEA per claim with opioids, milligrams	1,472	1,273	1,247	-15%**
Average number of opioid Rx per claim with opioids	3.6	3.3	3.2	-11%***
Average number of opioid pills per claim with opioids	166	153	150	-10%**
Among claims with opioids that had days of supply populated for all opioid Rx[b]				
Average number of opioid days per claim	39	37	37	-7%
Average MED per claim with opioids, milligrams	41	40	41	1%
% of claims with opioid Rx that had at least 60 days of opioid supply in any 90-day period	14%	13%	13%	-1 ppt
% of claims with opioid Rx that had more than 50 MED of opioid supply for at least 60 days	3.0%	2.9%	2.1%	-0.9 ppt*
% of claims with opioid Rx that had more than 90 MED of opioid supply for at least 60 days	1.1%	0.9%	0.7%	-0.3 ppt

Notes: The underlying data include prescriptions filled within one year of the injury date for all medical claims that had injuries occurring in calendar years 2011, 2012, and 2013. 2011 refers to injuries that occurred between January 1, 2011, and December 31, 2011, and we observed their prescriptions for one year following the injury date; similar notation is used for other years.

Case-mix adjusted measures are reported. Unadjusted measures are reported in TA.1. Regression estimates are in Tables TA.3–TA.9.

[a] Kentucky's House Bill 1 went into effect on July 1, 2012. 2011 represents the experience of injured workers predominantly before the effective date of House Bill 1, and 2013 represents the experience immediately after the implementation of the reforms. 2012 is partially post-reform.

[b] Days of supply information was complete for all opioid prescriptions for nearly 70 percent of Kentucky claims with opioids during the study period, and claims with complete days of supply were generally representative of all claims with opioids.

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

Key: MEA: morphine equivalent amount; MED: morphine equivalent daily dose in milligrams; ppt: percentage points. Rx: prescriptions.

With fewer injured workers receiving opioids post-reform, we expected those receiving opioids to have relatively more severe injuries, on average. Therefore we expected to see a higher average amount of opioids per claim and a higher proportion of these workers receiving chronic opioids in the post-reform period. However, the average MEA of opioids received by Kentucky workers also decreased in the post-reform period.[2] Among those receiving opioids, the average amount of opioids decreased from 1,472 morphine equivalent milligrams to 1,247 milligrams, a reduction of 15 percent. This was mainly driven by Kentucky workers receiving fewer opioid prescriptions, mainly hydrocodone-acetaminophen (Vicodin®) prescriptions in the post-reform period. The proportion of Kentucky workers with opioids who received opioids on a chronic basis (defined in this study as those receiving opioids for at least 60 days during any continuous 90-

[2] The MEA of opioids is a cumulative opioid utilization measure calculated across the different opioid prescriptions received by an injured worker during the observation period, taking into account the strength in milligrams of the prescribed opioid medication, the analgesic potency ratio between the specific opioid and morphine, and the quantity of the prescription.

day period) changed little over the same period. One out of eight injured workers who initiated an opioid prescription received opioids on a chronic basis pre- and post-reform. Note that the percentage of Kentucky workers with opioids that received high-dose opioids exceeding 50 MED for at least 60 days decreased post-HB 1. It is important to note that fewer Kentucky workers received opioids post-HB 1; consequently fewer Kentucky workers received opioids on a chronic basis and at higher doses post-HB 1. For example, the proportion of Kentucky workers with pain medications receiving opioids on a chronic basis decreased from 7.3 to 5.7 percent.[3]

While fewer Kentucky workers received opioids, there was no change in the percentage of injured workers with prescriptions who received any pain medication. Post-HB 1, Kentucky doctors appeared to have substituted at least some opioid prescriptions with non-opioid analgesics, especially nonsteroidal anti-inflammatory drugs (NSAIDs). Prior to the reforms, 24 percent of Kentucky workers received only opioid analgesics, 46 percent received only non-opioid analgesics, and 30 percent received both opioid and non-opioids analgesics (Table 3.2). After HB 1, the percentage of Kentucky workers injured in 2013 with pain medications who received only non-opioid analgesics increased by 10 percentage points, while the percentage with pain medications receiving opioid and non-opioid analgesics together and only opioids decreased by 5 percentage points each. In addition, there was no increase in the frequency and intensity of use of other pain management services such as physical therapy and pain management injections over the same period, as discussed later in this chapter. These findings indicate that a similar fraction of Kentucky workers continued to get medications for pain relief post-HB 1, but some injured workers received non-opioid pain medications, such as ibuprofen and naproxen, instead of opioids.

Table 3.2 Changes in Frequency of Injured Workers Receiving Pain Medications after Kentucky's Opioid Reforms[a]

	Pre-Reform	Partial Post-Reform	Post-Reform	% Point Change, 2011–2013
	2011	2012	2013	
% of claims with prescriptions that received pain medications	82%	83%	81%	-1**
% of claims with pain medications that received				
Opioid analgesics only	24%	21%	19%	-5***
Non-opioid analgesics only	46%	50%	56%	10***
Both opioid and non-opioid analgesics	30%	29%	25%	-5***

Notes: The underlying data include prescriptions filled within one year of the injury date for all medical claims that had injuries occurring in calendar years 2011, 2012, and 2013. 2011 refers to injuries that occurred between January 1, 2011, and December 31, 2011, and we observed their prescriptions for one year following the injury date; similar notation is used for other years.

Case-mix adjusted measures are reported.

[a] Kentucky's House Bill 1 went into effect on July 1, 2012. 2011 represents the experience of injured workers predominantly before the effective date of House Bill 1, and 2013 represents the experience immediately after the implementation of the reforms. 2012 is partially post-reform.

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

[3] Note that the change in the proportion of workers with pain medications who received chronic opioids was not statistically significant at the 0.1 level despite the sizable reduction of 22 percent between the post- and pre-reform periods.

CHANGES IN OPIOID DISPENSING AMONG DIFFERENT GROUPS OF INJURED WORKERS

The impact of the reforms varied across different subsamples of Kentucky workers, after controlling for all other available characteristics of injured workers. While we adjusted for differences in case mix across the different subsamples in these analyses, 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.

KENTUCKY WORKERS WITH AND WITHOUT MAJOR SURGERY[4]

The need for prescribing of opioids for pain management is different for patients with and without surgery. Opioids are generally recommended for the treatment of post-operative pain and for severe pain associated with traumatic conditions. For example, ACOEM recommends limited use of opioids as adjunctive medications with more effective treatments for post-operative pain (Hegmann et al., 2014). Nonsurgical claims, on the other hand, are mostly claims with musculoskeletal injuries that tend to be less serious, with lower consensus regarding the need for opioids in pain management. Therefore, we expected HB 1 to impact prescriber behaviors differently when prescribing opioids to injured workers with surgery compared with those without surgery. Moreover, HB 217 makes certain exceptions for surgical cases. Effective July 2013, HB 217 exempted prescribers from querying KASPER when controlled substance prescriptions are written for patients within 14 days of surgery and if the medication is related to the procedure performed. The exemption only applies to prescriptions written for up to a 14-day supply following the procedure. Claim frequency of opioid dispensing among surgical cases did not change before and after the July 2013 effective date. Also note that HB 1 does not prohibit prescribers from prescribing opioids to those without surgeries; it requires prescribers to review the patient's medication use history in KASPER prior to prescribing.

When we compared the changes in dispensing among nonsurgical claims with claims that had a major surgery, while holding the case mix constant, we observed larger reductions among nonsurgical claims compared with surgical claims. Table 3.3 summarizes the changes in the frequency and amount of opioids received by injured workers with and without a major surgery. Among Kentucky workers who had a major surgery, we observed no change in the percentage of workers with pain medications who received opioids. Pre-HB 1, 94 percent of Kentucky workers with a major surgery who had a pain medication filled at least one opioid prescription, and the figure was 93 percent post-HB 1. At the same time, the claim frequency of receiving opioids decreased significantly among workers who did not have a major surgery, from 48 percent pre-HB 1 to 35 percent post-HB 1. Similar patterns were seen in the claim frequency of receiving chronic opioids. Among surgical cases, the proportion of workers with pain medications receiving chronic opioids was 16 percent pre-reform and 15 percent post-reform (a 2 percent reduction). The figure decreased by 32 percent from 6.8 percent to 4.6 percent among nonsurgical cases. Note that a similar proportion of injured workers had a major surgery in the pre- and post-reform periods. Among those receiving opioids, the average amount of opioids received by nonsurgical claims decreased more than the average amount received by

[4] Major surgery is a WCRI-defined service group that is a subset of the surgery section of the Current Procedural Terminology (CPT®) manual. This service group includes invasive surgical procedures, as opposed to surgical treatments and pain management injections (which are also included in the surgery section of the CPT manual). The most frequent surgeries in this service group include (but are not limited to) arthroscopic surgeries of the shoulder or knee, laminectomies, laminotomies, discectomies, lumbar fusion, carpal tunnel surgeries, neuroplasty, and hernia repair. We tested the sensitivity of our results by defining major surgery as procedures identified by the Centers for Medicare & Medicaid Services as having a 90-day post-operative period for reimbursement purposes and found similar results.

surgical claims.[5]

Table 3.3 Changes in Opioid Dispensing, among Claims with and without Major Surgery, after Kentucky's Opioid Reforms[a]

	Pre-Reform	Partial Post-Reform	Post-Reform	% Change, 2011–2013
	2011	2012	2013	
% of claims with pain medications that had opioids				
Claims with major surgery	94%	93%	93%	0%
Claims without major surgery	48%	43%	35%	-27%***
Average MEA per claim with opioids, milligrams				
Claims with major surgery	2,414	2,303	2,145	-11%*
Claims without major surgery	1,297	999	986	-24%***

Notes: The underlying data include prescriptions filled within one year of the injury date for all medical claims that had injuries occurring in calendar years 2011, 2012, and 2013. 2011 refers to injuries that occurred between January 1, 2011, and December 31, 2011, and we observed their prescriptions for one year following the injury date; similar notation is used for other years.

Case-mix adjusted measures are reported.

[a] Kentucky's House Bill 1 went into effect on July 1, 2012. 2011 represents the experience of injured workers predominantly before the effective date of House Bill 1, and 2013 represents the experience immediately after the implementation of the reforms. 2012 is partially post-reform.

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

Key: MEA: morphine equivalent amount.

TYPE OF INJURY

The changes in the frequency of opioids received by injured workers post-HB 1 varied across workers with different types of injuries.[6] As shown in Table 3.4, a fairly similar proportion of Kentucky workers who sustained fractures and neurologic spine pain received opioids for pain relief in the pre-reform period, 81 and 80 percent, respectively. However, post-HB 1, 72 percent of Kentucky workers with fractures who had pain medication prescriptions received opioids, whereas 62 percent of neurologic spine pain claims with pain medications had opioid prescriptions. Similarly, the average amount of opioids received by injured workers who sustained neurologic spine pain injuries decreased more than that received by workers with fractures. A larger decrease was also seen in the claim frequency of receiving opioids among workers with back sprains and strains compared to workers with fractures. There is lower clinical consensus about the utilization of opioids for the treatment of sprains and strains and chronic low back pain, compared with the treatment of fractures, so these results were not surprising. We also observed different trends in opioid dispensing among workers with different types of sprains and strains. Reductions in the frequency and amount of opioids were significantly higher among injured workers who sustained back sprains and strains compared to workers with non-back sprains and strains.[7]

In the post-reform period, we observed that the injured workers with fractures were the most likely to be prescribed at least one opioid prescription, followed by those sustaining neurologic spine pain injuries. Less

[5] Note that the difference in changes in the average amount of opioids among the two subsamples was not statistically significant despite the sizable differences in reductions between the two subsamples. This may be because of the very large variation in the MEA of opioids received by workers in each subsample.

[6] We highlighted comparisons where the tests of difference in changes in opioid dispensing across subsamples were statistically significant.

[7] More than half of non-back sprains and strains were for shoulder, knee, ankle, and wrist sprains and strains.

than one-third of injured workers with back sprains and strains with pain medications received an opioid prescription.

Table 3.4 Changes in Opioid Dispensing, by Injury Group, after Kentucky's Opioid Reforms[a]

	Pre-Reform	Partial Post-Reform	Post-Reform	% Change, 2011–2013
	2011	2012	2013	
% of claims with pain medications that had opioids				
Fractures	81%	80%	72%	-11%**
Lacerations and contusions	49%	43%	38%	-23%***
Back and neck sprains, strains, non-specific pain	47%	40%	31%	-34%***
Other (non-back) sprains and strains	44%	43%	38%	-15%***
Neurologic spine pain	80%	70%	62%	-22%***
Average MEA per claim with opioids, milligrams				
Fractures	1,310	1,101	1,064	-19%
Lacerations and contusions	970	538	501	-48%
Back and neck sprains, strains, non-specific pain	1,573	1,155	1,351	-14%
Other (non-back) sprains and strains	1,232	1,307	1,411	15%
Neurologic spine pain	3,189	3,136	2,392	-25%*

Notes: The underlying data include prescriptions filled within one year of the injury date for all medical claims that had injuries occurring in calendar years 2011, 2012, and 2013. 2011 refers to injuries that occurred between January 1, 2011, and December 31, 2011, and we observed their prescriptions for one year following the injury date; similar notation is used for other years.

Case-mix adjusted measures are reported.

[a] Kentucky's House Bill 1 went into effect on July 1, 2012. 2011 represents the experience of injured workers predominantly before the effective date of House Bill 1, and 2013 represents the experience immediately after the implementation of the reforms. 2012 is partially post-reform.

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

Key: MEA: morphine equivalent amount.

EASTERN KENTUCKY VERSUS OTHER REGIONS

Table 3.5 compares opioids dispensed before and after HB 1 among injured workers residing in and outside Eastern Kentucky. Figure 3.1 shows the counties categorized as Eastern Kentucky counties in blue. The majority of the Eastern Kentucky counties are in the Appalachian region, which is very rural. Davis (2009) reported that these counties differ from other regions in Kentucky in terms of education level, socioeconomic status, labor force participation, lack of health insurance coverage, and other quality of life indicators. Eastern Kentucky was also reported to have higher rates of opioid misuse, abuse, and diversion compared with other regions in Kentucky. The 2015 overdose fatality report from the Kentucky Office of Drug Control Policy reported that five of the top eight Kentucky counties in terms of overdose deaths from 2012 through 2015 are located in the Eastern Kentucky region. Similar regional differences were seen in the workers' compensation system. We found that injured workers residing in the Eastern Kentucky region were more likely to receive an opioid prescription and receive higher average amount of opioids compared with their counterparts outside Eastern Kentucky, even after adjusting for differences in case mix.[8] Table 3.5 shows that 73 percent of Eastern Kentucky injured workers with pain medications received at least one opioid prescription prior to HB 1, compared with 53 percent among those living in other regions. Freeman et al. (2015) reported that the total number of KASPER queries was higher in the eastern and southeastern counties compared with other regions

[8] We controlled for differences in the worker's age at the time of injury, gender, marital status, the type of injury the worker sustained, type of industry in which the injured worker was employed, and comorbidities.

in the state. Therefore, we expected the change in opioid prescribing and dispensing to be more prominent in Eastern Kentucky. Contrary to our expectation, we observed a similar reduction in opioid dispensing rates among both groups of injured workers after HB 1 came into effect. Looking at workers injured in 2013, after most provisions of HB 1 were effective, we still observed a higher rate of opioid dispensing among workers residing in Eastern Kentucky. Similar reductions were also seen in the average amount of opioids received by injured workers in both regions.

Figure 3.1 Eastern Kentucky versus Other Regions

Table 3.5 Changes in Opioid Dispensing, Eastern Kentucky versus Other Regions, after Kentucky's Opioid Reforms[a]

	Pre-Reform	Partial Post-Reform	Post-Reform	% Change, 2011–2013
	2011	2012	2013	
% of claims with pain medications that had opioids				
Claims from Eastern KY	73%	67%	62%	-15%***
Claims outside Eastern KY	53%	49%	43%	-19%***
Average MEA per claim with opioids, milligrams				
Claims from Eastern KY	1,916	1,937	1,573	-18%
Claims outside Eastern KY	1,407	1,128	1,212	-14%*

Notes: The underlying data include prescriptions filled within one year of the injury date for all medical claims that had injuries occurring in calendar years 2011, 2012, and 2013. 2011 refers to injuries that occurred between January 1, 2011, and December 31, 2011, and we observed their prescriptions for one year following the injury date; similar notation is used for other years.

Case-mix adjusted measures are reported.

[a] Kentucky's House Bill 1 went into effect on July 1, 2012. 2011 represents the experience of injured workers predominantly before the effective date of House Bill 1, and 2013 represents the experience immediately after the implementation of the reforms. 2012 is partially post-reform.

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

Key: MEA: morphine equivalent amount.

URBAN VERSUS RURAL AREAS

We also compared opioids dispensed before and after HB 1 based on the degree of rurality of the residential location of Kentucky injured workers. We categorized the counties into urban, rural, and very rural counties, as shown in Figure 3.2. We classified the rural counties into rural and very rural counties because of the significant variation in Kentucky's rural counties in terms of education level, socioeconomic status, labor force participation, lack of health insurance coverage, and other quality of life indicators as reported by Davis (2009). As discussed earlier, the majority of Kentucky's very rural counties are in the Eastern Kentucky region, which is reported to have higher rates of opioid misuse, abuse, and diversion compared with other regions. Consistent with the previous results, we found a higher opioid dispensing rate in very rural counties. In addition, a higher proportion of Kentucky workers in rural counties received opioids compared with those residing in urban areas. Table 3.6 shows that 71 and 68 percent of Kentucky workers in rural and very rural counties with pain medications received opioids prior to HB 1, compared with 49 percent in urban counties. After HB 1, workers residing in rural counties had a larger decrease in opioid dispensing rate compared with workers residing in urban counties. However, a smaller reduction in opioid dispensing rate was seen among workers residing in very rural regions of Kentucky compared with the change seen in rural Kentucky regions. Note that the changes in the average amount of opioids between workers residing in urban counties were not statistically significantly different from the changes in the average amount of opioids received by injured workers in rural and very rural counties.

Figure 3.2 Urban-Rural Classification of Kentucky Counties

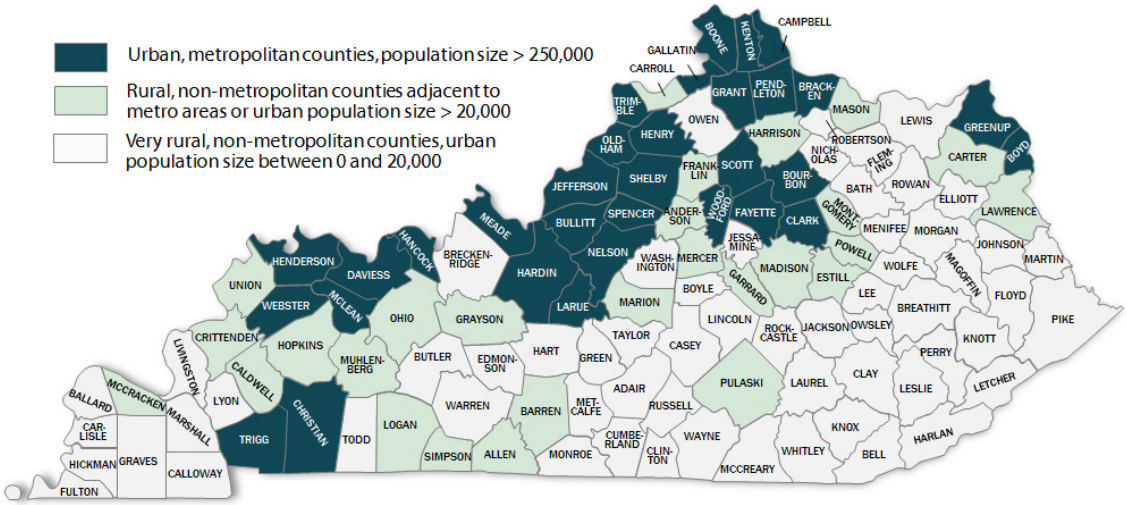

Table 3.6 Changes in Opioid Dispensing, by Urban/Rural Location, after Kentucky's Opioid Reforms[a]

	Pre-Reform	Partial Post-Reform	Post-Reform	% Change, 2011–2013
	2011	2012	2013	
% of claims with pain medications that had opioids				
Claims from urban KY	49%	46%	39%	-19%***
Claims from rural KY	71%	61%	55%	-23%***
Claims from very rural KY	68%	63%	59%	-13%***
Average MEA per claim with opioids, milligrams				
Claims from urban KY	1,448	1,070	1,193	-18%**
Claims from rural KY	1,387	1,371	1,329	-4%
Claims from very rural KY	1,488	1,427	1,253	-16%

Notes: The underlying data include prescriptions filled within one year of the injury date for all medical claims that had injuries occurring in calendar years 2011, 2012, and 2013. 2011 refers to injuries that occurred between January 1, 2011, and December 31, 2011, and we observed their prescriptions for one year following the injury date; similar notation is used for other years.

Case-mix adjusted measures are reported.

[a] Kentucky's House Bill 1 went into effect on July 1, 2012. 2011 represents the experience of injured workers predominantly before the effective date of House Bill 1, and 2013 represents the experience immediately after the implementation of the reforms. 2012 is partially post-reform.

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

Key: MEA: morphine equivalent amount.

In the post-reform period, we continued to find that a higher proportion of Kentucky workers with pain medications residing in rural and very rural counties received opioids compared with those residing in urban counties. Geographic differences in medical practice and health care delivery systems are considered to play an important role in opioid utilization. Multiple studies reported that higher concentrations of active physicians and surgeons in a region are strongly correlated with the amount of opioids prescribed (Curtis et al., 2006; Han et al., 2012; McDonald, Carlson, and Izrael, 2012). Therefore, one may expect opioid dispensing rates to be higher in urban regions with higher densities of doctors, which is contrary to our study findings. Future studies should examine the factors underlying the regional variations in opioid utilization in Kentucky.

AGE GROUPS

Table 3.7 shows that the reforms had a smaller impact for older workers. Prior to the reforms, a similar proportion of Kentucky workers over 25 years across different age groups with pain medications received at least one opioid prescription (55 to 58 percent). Post-HB 1, about 40 percent of Kentucky workers of ages 25 to 39 received opioids for pain relief, and about 50 percent of workers 55 and older who had pain medications received opioids. Significantly larger reductions in the frequency of opioid dispensing among workers of ages 25 to 39 and ages 40 to 54, compared with those 55 and older, are concerning because opioids may not have been necessary to manage the pain associated with workplace injuries for some of these workers prior to the Kentucky reforms.

A seminal publication by Case and Deaton (2015) reported 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 between 1999 and 2013, primarily accounted for by increasing rates of drug overdose deaths. Considering the potential risks of unnecessary opioid utilization, injured workers in this age group could perhaps be better monitored to assess whether opioids are medically necessary.

Table 3.7 Changes in Opioid Dispensing, by Age Group, after Kentucky's Opioid Reforms[a]

	Pre-Reform	Partial Post-Reform	Post-Reform	% Change, 2011–2013
	2011	2012	2013	
% of claims with pain medications that had opioids				
Age under 25	46%	44%	38%	-16%***
Age 25 to 39	55%	49%	41%	-25%***
Age 40 to 54	58%	54%	47%	-18%***
Age 55 to 60	56%	53%	53%	-5%
Age over 60	57%	53%	49%	-13%*
Average MEA per claim with opioids, milligrams				
Age under 25	1,162	1,041	1,039	-11%
Age 25 to 39	1,600	1,484	1,417	-11%
Age 40 to 54	1,627	1,359	1,327	-18%*
Age 55 to 60	1,304	1,097	1,136	-13%
Age over 60	1,167	796	1,063	-9%

Notes: The underlying data include prescriptions filled within one year of the injury date for all medical claims that had injuries occurring in calendar years 2011, 2012, and 2013. 2011 refers to injuries that occurred between January 1, 2011, and December 31, 2011, and we observed their prescriptions for one year following the injury date; similar notation is used for other years.

Case-mix adjusted measures are reported.

[a] Kentucky's House Bill 1 went into effect on July 1, 2012. 2011 represents the experience of injured workers predominantly before the effective date of House Bill 1, and 2013 represents the experience immediately after the implementation of the reforms. 2012 is partially post-reform.

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

Key: MEA: morphine equivalent amount.

GENDER

Table 3.8 provides the comparison of changes in opioid dispensing by gender. After adjusting for differences in other available worker, injury, and industry characteristics, we found that the changes in the frequency and amount of opioids received by injured workers were similar for male and female workers in Kentucky.

Table 3.8 Changes in Opioid Dispensing, by Gender, after Kentucky's Opioid Reforms[a]

	Pre-Reform	Partial Post-Reform	Post-Reform	% Change, 2011–2013
	2011	2012	2013	
% of claims with pain medications that had opioids				
Female	52%	48%	41%	-20%***
Male	54%	50%	45%	-18%***
Average MEA per claim with opioids, milligrams				
Female	1,218	1,099	1,033	-15%
Male	1,598	1,354	1,368	-14%*

Notes: The underlying data include prescriptions filled within 1 year of the injury date for all medical claims that had injuries occurring in calendar years 2011, 2012, and 2013. 2011 refers to injuries that occurred between January 1, 2011, and December 31, 2011, and we observed their prescriptions for one year following the injury date; similar notation is used for other years.

Case-mix adjusted measures are reported.

[a] Kentucky's House Bill 1 went into effect on July 1, 2012. 2011 represents the experience of injured workers predominantly before the effective date of House Bill 1, and 2013 represents the experience immediately after the implementation of the reforms. 2012 is partially post-reform.

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

Key: MEA: morphine equivalent amount.

CHANGE IN THE MIX OF DRUGS PRESCRIBED TO KENTUCKY WORKERS POST-HB 1

This section compares pre- and post-reform prescribing practices. Table 3.9 shows that the percentage of all prescriptions that were written for opioids decreased by 7 percentage points. The proportion of prescriptions for some other categories of medications used to manage musculoskeletal pain—such as NSAIDs, muscle relaxants, other analgesics (which include acetaminophen and corticosteroids), and dermatologicals—increased. These changes in the mix of opioids and non-opioid pain medications should not be interpreted as Kentucky doctors substituting all opioid prescriptions with other pain medications. This is because of a decrease in the number of prescriptions received by Kentucky workers over this period. The average number of prescriptions received by Kentucky workers with prescriptions decreased from 4.4 (pre-reform) to 3.9 (post-reform). One may think that if opioid prescriptions decreased post-HB 1 and opioids are not substituted with non-opioid pain medications, then the total number of prescriptions would decrease.[9] It is possible that not all opioids were substituted with other pain medications post-HB 1. Other measures presented in Table 3.2 provide evidence of doctors substituting some opioids with non-opioid pain

[9] There may be other reasons for a decrease in the total number of prescriptions. For example, post-HB 1, fewer Kentucky injured workers were prescribed opioids immediately after the injury, and other studies have shown the association between initial opioid prescriptions and longer-term opioid use and longer disability duration (Franklin et al., 2008, and Webster, Verma, and Gatchel, 2007). We saw evidence of substitution of initial opioid prescriptions with other medications, but because non-opioid medications may lead to fewer long-term prescriptions than initial opioid therapy, this may decrease the volume of prescriptions post-HB 1.

medications.[10]

Table 3.9 Prescription Share of Drugs by Therapeutic Group, before and after Kentucky's Opioid Reforms[a]

Therapeutic Group	Pre-Reform	Partial Post-Reform	Post-Reform	% Point Change, 2011–2013[b]
	2011	2012	2013	
Opioids	38%	33%	30%	-7
Nonsteroidal anti-inflammatory drugs (NSAIDs)	24%	25%	27%	4
Muscle relaxants	15%	15%	17%	1
Anticonvulsants	4%	4%	4%	0
Anti-infective agents	4%	5%	5%	1
Other analgesics	3%	3%	4%	1
Dermatologicals	2%	3%	3%	1
Antidepressants	1%	2%	2%	0
Gastrointestinal agents	1%	2%	2%	0
Other therapeutic groups	6%	6%	6%	0

Notes: The underlying data include prescriptions filled within one year of the injury date for all medical claims that had injuries occurring in calendar years 2011, 2012, and 2013. 2011 refers to injuries that occurred between January 1, 2011, and December 31, 2011, and we observed their prescriptions for one year following the injury date; similar notation is used for other years.

[a] Kentucky's House Bill 1 went into effect on July 1, 2012. 2011 represents the experience of injured workers predominantly before the effective date of House Bill 1, and 2013 represents the experience immediately after the implementation of the reforms. 2012 is partially post-reform.

[b] Percentage point changes shown may not agree with reported percentages due to rounding.

Table 3.10 shows the changes in the mix of commonly prescribed drugs prescribed to injured workers in Kentucky. These top 20 drugs accounted for 80 percent of all the prescriptions filled by Kentucky workers pre- and post-HB 1. Hydrocodone-acetaminophen, which accounted for one out of every four prescriptions filled by Kentucky injured workers prior to the reforms, had the largest reduction. HB 1 required prescribers to query KASPER prior to prescribing Schedule II controlled substances and Schedule III products containing hydrocodone. In addition, the Kentucky Board of Medical Licensure regulations require prescribers to query the PDMP prior to prescribing all controlled substances in Schedules II–IV. Therefore, we did not see any substitution of hydrocodone-acetaminophen prescriptions with tramadol in Kentucky, unlike in other states that limited prescribing of hydrocodone-combination products (Thumula, Wang, and Liu, 2017). The proportion of all prescriptions that were for NSAIDs (including naproxen, meloxicam, and diclofenac sodium), muscle relaxants (methocarbamol and metaxalone), and corticosteroids (methylprednisolone) increased.

[10] We also see evidence of substitution of some opioids with non-opioid analgesics and other medications by examining the first prescriptions (the prescription filled closest to the date of injury) received by injured workers pre- and post-HB 1. The percentage of injured workers with a prescription whose first prescription included an opioid analgesic decreased by 10 percentage points. We found 6 and 4 percentage point increases in the proportion of workers with prescriptions whose first prescription was for non-opioid analgesics (and no opioids on the same day) and non-pain medications (and no pain medications on the same day), respectively. The non-pain medications category predominantly includes muscle relaxants and antibiotics.

Table 3.10 Prescription Share of Drugs Received by Kentucky Workers, before and after Kentucky's Opioid Reforms[a]

Top 20 Commonly Prescribed Drugs	Pre-Reform	Partial Post-Reform	Post-Reform	% Point Change, 2011–2013[b]
	2011	2012	2013	
Hydrocodone-acetaminophen (Vicodin®)	25%	21%	20%	-6
Cyclobenzaprine HCL (Flexeril®)	8%	8%	8%	0
Ibuprofen (Motrin®)	8%	7%	8%	0
Oxycodone-acetaminophen (Percocet®)	6%	5%	5%	-1
Naproxen (Naprosyn®)	5%	5%	5%	1
Tramadol HCL (Ultram®)	4%	5%	4%	0
Meloxicam (Mobic®)	3%	4%	4%	1
Gabapentin (Neurontin®)	3%	3%	4%	0
Methylprednisolone (Medrol®)	2%	2%	3%	1
Methocarbamol (Robaxin®)	2%	2%	3%	1
Diclofenac sodium (Voltaren®)	2%	2%	3%	1
Cephalexin (Keflex®)	2%	2%	2%	0
Tizanidine HCL (Zanaflex®)	2%	2%	2%	0
Prednisone (Meticorten®, Deltasone®)	2%	2%	2%	0
Naproxen sodium (Aleve®)	1%	2%	1%	0
Metaxalone (Skelaxin®)	1%	2%	2%	0
Diclofenac potassium (Cataflam®)	1%	1%	2%	0
Celecoxib (Celebrex®)	1%	1%	1%	0
Diazepam (Valium®)	1%	1%	0%	0
Oxycodone HCL (OxyContin®)	1%	1%	1%	0

Notes: The underlying data include prescriptions filled within one year of the injury date for all medical claims that had injuries occurring in calendar years 2011, 2012, and 2013. 2011 refers to injuries that occurred between January 1, 2011, and December 31, 2011, and we observed their prescriptions for one year following the injury date; similar notation is used for other years.

[a] Kentucky's House Bill 1 went into effect on July 1, 2012. 2011 represents the experience of injured workers predominantly before the effective date of House Bill 1, and 2013 represents the experience immediately after the implementation of the reforms. 2012 is partially post-reform.

[b] Percentage point changes shown may not agree with reported percentages due to rounding.

CHANGE IN THE UTILIZATION OF NON-PHARMACEUTICAL MEDICAL SERVICES

Table 3.11 compares pre- and post-reform utilization of other medical services associated with management of pain among all Kentucky injured workers. Post-HB 1, Kentucky doctors appeared to have substituted some opioid prescriptions with NSAIDs. We observed a 10 percentage point increase in the percentage of Kentucky injured workers who received only non-opioid analgesics after Kentucky's opioid reforms (see Table 3.2). If NSAIDs were not sufficient to manage the pain, we would expect to see injured workers go to other doctors or emergency rooms for opioid prescriptions. However, the frequency and intensity of use of doctors' office visits and emergency services visits did not increase post-HB 1. We did not see any increase in the use of other pain management services such as physical medicine, pain management injections, and surgeries.

Table 3.11 Utilization of Other Services, before and after Kentucky's Opioid Reforms[a]

	Pre-Reform	Partial Post-Reform	Post-Reform	Change, 2011–2013[b]
	2011	2012	2013	
% of claims with services				
Evaluation and management	79%	79%	80%	0 ppt
Physical medicine	25%	25%	25%	0 ppt
Pain management injections	4%	4%	4%	0 ppt
Major surgery	7%	7%	7%	0 ppt
Emergency services	39%	39%	37%	-2 ppt***
Average number of visits per claim for each service				
Evaluation and management	3.4	3.3	3.4	0
Physical medicine	13.0	13.5	13.3	2%
Pain management injections	1.4	1.4	1.4	1%
Major surgery	1.1	1.1	1.1	-1%
Emergency services	1.1	1.1	1.1	0%

Notes: The underlying data include services received within one year of the injury date for all medical claims that had injuries occurring in calendar years 2011, 2012, and 2013. 2011 refers to injuries that occurred between January 1, 2011, and December 31, 2011, and we observed their service utilization for one year following the injury date; similar notation is used for other years.

Case-mix adjusted measures are reported.

[a] Kentucky's House Bill 1 went into effect on July 1, 2012. 2011 represents the experience of injured workers predominantly before the effective date of House Bill 1, and 2013 represents the experience immediately after the implementation of the reforms. 2012 is partially post-reform.

[b] Percentage point changes shown may not agree with reported percentages due to rounding.

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

Key: ppt: percentage points.

4

Policy Implications and Conclusions

A higher level of opioid prescribing is considered to be one of the contributing factors to the increase in opioid overdose deaths in the United States. In this study, we examine the impact of Kentucky's comprehensive reforms addressing opioid prescribing and dispensing, which are regarded as primary prevention strategies in addressing the opioid overdose epidemic. The findings of this study are based on Kentucky data, but the lessons may be useful for policymakers and stakeholders in other states who are looking for policy solutions to address the higher opioid utilization and overdose deaths in their jurisdictions, while balancing the needs of patients who may need opioids for pain management. More specifically, this study helps policymakers and other stakeholders, both in workers' compensation and the larger health care system, to understand the potential impact of Kentucky's HB 1, which mandated prescribers to query the PDMP before prescribing opioids, among other provisions. As of December 2016, 20 states had adopted comprehensive prescriber use mandates, starting with Kentucky. Some of these states adopted requirements that are similar to Kentucky's, while a few other states implemented mandates that have less rigorous requirements. Findings from our study provide initial evidence of how such reforms may impact the opioid utilization among injured workers.

In Kentucky, we observed that post-HB 1, fewer injured workers with pain medications received opioids, and the average amount of opioids received by Kentucky workers also decreased. Fewer Kentucky workers also received opioids on a chronic basis and at higher doses. Opioid dispensing did not change over the same period in neighboring states without similar reforms. Higher reductions in opioid dispensing were seen among some subsamples of Kentucky workers. For example, HB 1 had a larger impact on opioid dispensing rates among injured workers who did not have a major surgery (compared to those with a major surgery), injured workers who sustained back sprains and strains and neurologic spine pain injuries (compared with fractures), and workers 25 to 39 years old (compared with older workers). While fewer Kentucky workers received opioids, there was no change in the percentage of injured workers with a prescription that received any pain medications. Kentucky doctors appeared to have substituted some opioid prescriptions with non-opioid pain medications, such as ibuprofen and naproxen. In addition, there was no change in workers receiving pain management injections, physical medicine, or surgical interventions. These findings raise questions about whether physicians had been prescribing pain medications that pose higher risks, like opioids, instead of non-opioid analgesics to a small but sizable fraction of some groups of Kentucky workers—such as those without a major surgery, workers with back sprains and strains with or without neurological involvement, and workers of ages 25 to 39 years—prior to the implementation of HB 1.

Despite the noted reduction in opioid prescribing following HB 1 and some initial decline in opioid-related overdose deaths between 2011 and 2013, opioid-related overdose deaths increased again in Kentucky in recent years. The CDC reported that Kentucky is among the top three states in the nation in terms of drug

overdose deaths that occurred in 2015.[1] The 2015 overdose fatality report from the Kentucky Office of Drug Control Policy shows that overdose death rates are higher in some counties in the state. Five of the top eight counties in terms of overdose deaths from 2012 through 2015 are located in the Eastern Kentucky region. Our study highlights the characteristics of injured workers where opioid dispensing continues to be higher post-HB 1, so that future interventions, if necessary, could be targeted at these groups of workers. For example, we found that the percentage of injured workers with pain medications who received opioids was higher among injured workers living in Eastern Kentucky compared with those living in the rest of the state. Prior to HB 1, 73 percent of Eastern Kentucky injured workers with pain medications received at least one opioid prescription compared with 53 percent among those living in other regions. We observed a similar reduction in the opioid dispensing rate among both groups of injured workers after HB 1 came into effect. Looking at workers injured in 2013, after most provisions of HB 1 were effective, we still observed a higher rate of opioid dispensing among workers residing in Eastern Kentucky.

There are also concerns about the potential unintended consequences of public policies aimed at reducing opioid prescribing, such as HB 1, on heroin overdose deaths. The evidence is conflicting about the association between policies curbing prescription opioids and increases in drug overdose deaths related to the use of non-prescription opioids (e.g., heroin and illicit fentanyl).[2] University of Kentucky researchers evaluating the impact of HB 1 also caution that the heroin market experienced a growth in Kentucky well before the implementation of HB 1, and they observed an increase in heroin-related hospitalizations and overdose deaths prior to the decrease in opioid prescriptions resulting from HB 1 (Freeman, et al., 2015). Similar findings were reported by Dowell et al. (2016). Future studies should analyze whether HB 1 was effective in slowing or reversing the growing trend in heroin overdose deaths using more recent data.

Our study examined the impact of HB 1 on opioids dispensed to newly injured workers immediately after the implementation of HB 1. Future studies should continue to track the longer-term impact of HB 1 on Kentucky injured workers and examine how HB 1 may have impacted the access to opioids and other pain management services among injured workers who were receiving opioids on a chronic basis prior to the implementation of HB 1.

[1] Rudd et al. (2016).

[2] Finklea, Sacco, and Bagalman (2014); Dowell et al. (2016); Patrick et al. (2016).

TECHNICAL APPENDIX

In this appendix, we discuss the following: (1) changes in opioid dispensing, without adjusting for case mix; (2) empirical models used in estimating the case-mix adjusted utilization measures reported in this study; and (3) a comparison of changes in opioid dispensing in Kentucky with changes in neighboring states.

DESCRIPTIVE STATISTICS OF CHANGES IN OPIOID DISPENSING

We begin our discussion with how the measures of opioid dispensing changed over time, without adjusting for differences in the mix of cases. Table TA.1 shows that the percentage of workers with pain medications who received at least one opioid prescription decreased by 11 percentage points. Of the workers with opioid prescriptions, the claim frequency of receiving chronic opioids and high-dose opioids exceeding 50 MED decreased by 1 percentage point each. The average number of opioid prescriptions and the MEA per claim decreased by 9 and 17 percent, respectively. These findings are comparable to the case-mix adjusted differences reported in the main body of the text.

Table TA.1 Changes in Opioid Dispensing after Kentucky's Opioid Reforms[a]

	Pre-Reform	Partial Post-Reform	Post-Reform	Change, 2011–2013
	2011	2012	2013	
Frequency of claims receiving opioids				
% of claims with a prescription that had opioids	47%	42%	36%	-10 ppt
% of claims with pain medications that had opioids	54%	49%	44%	-11 ppt
% of claims with pain medications that had 2 or more opioids	28%	25%	22%	-6 ppt
Among claims that had opioids				
Average MEA per claim with opioids, milligrams	1,516	1,248	1,261	-17%
Median MEA per claim with opioids, milligrams	350	315	375	7%
Average number of opioid Rx per claim with opioids	3.6	3.3	3.3	-9%
Average number of opioid pills per claim with opioids	170	151	152	-11%
Among claims with opioids that had days of supply populated for all opioid Rx[b]				
Average number of opioid days per claim	41	37	37	-10%
Average MED per claim with opioids, milligrams	41	40	41	2%
% of claims with opioid Rx that had at least 60 days of opioid supply in any 90-day period	15%	14%	13%	-1 ppt
% of claims with opioid Rx that had more than 50 MED of opioid supply for at least 60 days	3%	3%	2%	-1 ppt
% of claims with opioid Rx that had more than 90 MED of opioid supply for at least 60 days	1%	1%	1%	0 ppt

Notes: The underlying data include prescriptions filled within one year of the injury date for all medical claims that had injuries occurring in calendar years 2011, 2012, and 2013. 2011 refers to injuries that occurred between January 1, 2011, and December 31, 2011, and we observed their prescriptions for one year following the injury date; similar notation is used for other years.

Unadjusted measures are reported in this table. Regression estimates are in Tables TA.3–11.

continued

Table TA.1 Changes in Opioid Dispensing after Kentucky's Opioid Reforms[a] (continued)

[a] Kentucky's House Bill 1 went into effect on July 1, 2012. 2011 represents the experience of injured workers predominantly before the effective date of House Bill 1, and 2013 represents the experience immediately after the implementation of the reforms. 2012 is partially post-reform.

[b] Days of supply information was complete for all opioid prescriptions for nearly 70 percent of Kentucky claims with opioids during the study period.

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

Key: MEA: morphine equivalent amount; MED: morphine equivalent daily dose in milligrams; ppt: percentage points; Rx: prescriptions.

EMPIRICAL MODELS TO ESTIMATE CHANGES IN OPIOID DISPENSING

We used OLS regressions to model continuous utilization measures in this study and used logistic regressions for binary variables. We controlled for differences in worker demographic, industry, and injury characteristics, and comorbidities.[3] Table TA.2 provides the descriptive statistics of the control variables.

An OLS regression describes a linear relationship between the utilization measures of interest (e.g., number of opioid prescriptions for the injured worker, MEA of opioids received by the injured worker, number of visits to receive pain management injections, etc.) and a set of predictors. The model can be specified as follows:

$$Y_i = \alpha + REFORM_i\gamma + WORKER_i\beta_1 + INDUSTRY_i\beta_2 + INJURY_i\beta_3 + COMORBIDITIES_i\beta_4 + \varepsilon_i \qquad \text{(TA.1)}$$

Where, Y_i stands for the utilization measure of interest; γ reflects the vector of the coefficients on the reform dummies (pre-reform, partial post-reform, and post-reform);[4] β_1, β_2, β_3, and β_4 reflect vectors of estimated coefficients on the worker, industry, and injury characteristics, and comorbidity indices. In OLS, the estimated coefficient of a continuous variable simply measures how the dependent variable changes with a one-unit increase in the continuous variable. For categorical variables, the coefficient shows how the dependent variable for the selected group compares with the base category.

For the binary utilization measures 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), we estimated predictions using a logistic regression. The probability that injured worker *i* receives an opioid prescription (i.e., Y_i) can be specified as follows:

$$\Pr(Y_i = 1) = \frac{e^{Z_i\theta}}{1+e^{Z_i\theta}} \qquad \text{(TA.2)}$$

Where $Z_i\theta$ denotes parameters and variables on the right-hand side of the equation (TA.1), and parameters θ are estimated using the maximum likelihood approach. The coefficients from this model cannot be used directly to examine the differences in predicted outcomes without necessary transformations. As a result, in most of the report we focus on discussing the differences in predictions based on these models (as discussed later in this section) rather than on discussing the coefficients. Furthermore, we present transformations of the logit coefficients, odds ratios that are more easily interpretable, in the next section.

[3] 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 and setting the missing values to zero.

[4] In this study, Kentucky workers with injuries in 2011 are referred to as the pre-reform group, those with injuries in 2012 are referred to as the partial post-reform group, and those injured in 2013 are referred to as the post-reform group.

They measure the multiplicative effect of the variable of interest. For instance, if the odds ratio is 1.15, then a one-unit increase in the variable of interest increases the relative probability $\Pr(Y_i = 1)$ by 15 percent.

Table TA.2 Descriptive Characteristics of Control Variables

	Pre-Reform	Partial Post-Reform	Post-Reform
	2011	2012	2013
Total number of claims with prescriptions	7,231	7,685	6,824
Age group			
Age under 25	16%	16%	14%
Age 25 to 39	33%	32%	33%
Age 40 to 54	37%	37%	37%
Age 55 to 60	9%	10%	11%
Age over 60	4%	4%	5%
Gender			
Female	42%	43%	45%
Male (base)	58%	57%	55%
Gender is missing	0%	0%	0%
Marital status			
Married	42%	38%	36%
Single, separated, divorced	51%	56%	56%
Marital status is missing	8%	6%	8%
Location type			
Urban area	68%	69%	70%
Rural area (base)	13%	12%	13%
Very rural area	15%	14%	13%
Location is missing	5%	5%	4%
Industry type			
Construction	4%	4%	4%
Manufacturing	21%	25%	23%
Clerical and professional	6%	5%	5%
Trade	17%	16%	17%
High-risk services	28%	28%	28%
Low-risk services	10%	9%	10%
Other industries	13%	13%	12%
Industry is missing	1%	1%	0%
Injury type			
Neurologic spine pain	5%	5%	5%
Back and neck sprains, strains, and non-specific pain	22%	21%	22%
Fractures	5%	5%	5%
Lacerations and contusions	18%	19%	16%
Inflammations	5%	6%	6%
Other sprains and strains	26%	27%	27%
Upper extremity neurologic (carpal tunnel)	1%	1%	1%
Other injuries	12%	12%	12%
Comorbidities			
Number of Elixhauser comorbidities, mean	0.25	0.26	0.26

Notes: The data underlying this table comprise Kentucky workers injured in calendar years 2011, 2012, and 2013 with at least one prescription. The distribution of claims was generally similar to the reported numbers among all Kentucky claims, claims with pain medications, and claims with opioids, with some minor exceptions.

The pre-reform period includes Kentucky workers injured in 2011, the partial post-reform period includes workers injured in 2012, and the post-reform period includes workers injured in 2013. We observed the prescriptions of each patient for one year following the date of injury.

REGRESSION ESTIMATES

This section documents results from the regression analyses adjusting for case mix, location, comorbidity indices, and industry type that were used to create the case-mix adjusted measures reported in this study.

Table TA.3 presents estimated odds ratios from the logistic regressions for the likelihood of injured workers receiving opioids and chronic opioids. 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 post-reform from the logistic regressions for the likelihood of injured workers receiving opioids in TA.3 is 0.615, i.e., a worker who was injured in the post-reform period was less likely to receive an opioid compared with a worker who was injured during the pre-reform period.

Table TA.4 presents coefficient estimates from OLS linear regressions for the continuous opioid utilization measure, MEA per claim. We tested the sensitivity to extreme outliers by using a natural logarithm of MEA of opioids and found that the estimates from the specification without logged opioid amounts were generally similar to the results reported based on logged opioid amounts. We chose the specification without logged amounts because of the ease of interpretation of the estimates. For continuous variables, the coefficients in the tables show how the utilization measure changes when the control variable increases by one unit. For categorical variables, the coefficient shows how the average amount of opioids for the selected group compares with the average for the base category. For example, the coefficient estimate for neurologic spine pain in Table TA.4, showing the coefficient estimates for MEA per claim, was 1,923. Workers with neurologic spine pain received 1,923 more milligrams of opioids, on average, compared to workers with fractures. The coefficients show the changes in utilization measures while keeping each of the other variables in the analysis constant.

For brevity, we do not report the full model results for the other utilization measures in this study. We report the estimates for the reform dummies from logistic and OLS regressions for the remaining measures discussed in Chapter 3 in Tables TA.5–TA.9. A full set of estimates is available upon request.

Opioid utilization varies across different groups of claims, perhaps because the pain severity varies across these claim groups, and consequently the medical necessity may vary. Therefore, we expected to see the impact of the reforms vary across different subsamples of claims.[5] Tables TA.10 and TA.11 report estimates for the reform dummies from regressions for the subsamples grouped by injury group, age group, location, gender, and whether or not the injured worker had a surgery. Odds ratios from the logistic regressions for estimating the likelihood of a worker in each subsample receiving opioids are reported in Table TA.10, and the estimates from OLS regressions for the MEA of opioids per claim are reported in Table TA.11. As evidenced from these tables, changes in the frequency of receiving opioids is significant across almost all groups of injured workers, whereas the estimated changes in the average MEA per claim are rarely statistically significant despite the sizable reductions in the average MEA between 2011 and 2013.[6] The latter may have

[5] For example, one may expect that injured workers with a major surgery might continue to receive opioids even after the reforms, at least during the perioperative period, and there might be larger reductions among those without a major surgery. Table TA.10 shows that the change in frequency of receiving opioids was not significant for workers that had a major surgery, while the change was significant for nonsurgical claims.

[6] Changes in MEA were very rarely significant based on OLS regressions using the natural logarithm of the measure.

occurred because of the very large variation in the MEA of opioids received by workers in each subsample. We further tested whether the estimates of change in the frequency and amount of opioids received by workers were significantly different across different subsamples. In Chapter 3, we highlighted comparisons where the tests of difference in changes across subsamples were statistically significant.

Table TA.3 Odds Ratios from Logistic Regressions Estimating the Likelihood of an Injured Worker Receiving Opioids and Chronic Opioids within One Year of Injury

	% of Injured Workers with Pain Medications Who Received an Opioid Prescription		% of Injured Workers With Opioid Prescriptions Who Had at Least 60 Days of Opioid Supply in Any 90-Day Period	
	Odds Ratio	**Standard Error**	**Odds Ratio**	**Standard Error**
Observations	17,771		6,150	
Study period[a]				
Pre-reform (base)				
Partial post-reform	0.828***	(0.035)	0.954	(0.095)
Post-reform	0.615***	(0.027)	0.946	(0.099)
Age group				
Age under 25	0.615***	(0.035)	0.453***	(0.100)
Age 25 to 39 (base)				
Age 40 to 54	1.234***	(0.051)	0.989	(0.096)
Age 55 to 60	1.236***	(0.084)	0.896	(0.137)
Age over 60	1.223**	(0.100)	0.633**	(0.124)
Gender				
Female	0.899***	(0.034)	0.793**	(0.076)
Male (base)				
Gender is missing	0.598	(0.239)	0.000	0.000
Marital status				
Married	1.102**	(0.042)	0.989	(0.088)
Single, separated, divorced (base)				
Marital status is missing	0.785***	(0.063)	0.588**	(0.137)
Location type				
Urban area (base)				
Rural area	2.036***	(0.112)	1.333**	(0.158)
Very rural area	2.339***	(0.121)	1.883***	(0.185)
Location is missing	1.303***	(0.105)	2.137***	(0.382)
Industry type				
Construction	1.288***	(0.123)	1.983***	(0.345)
Manufacturing (base)				
Clerical and professional	0.719***	(0.063)	1.568**	(0.332)
Trade	0.947	(0.054)	1.409**	(0.221)
High-risk services	0.894**	(0.046)	1.261*	(0.165)
Low-risk services	0.879*	(0.059)	1.366**	(0.211)
Other industries	0.595***	(0.035)	1.572***	(0.237)
Industry is missing	1.150	(0.220)	1.457	(0.472)

continued

Table TA.3 Odds Ratios from Logistic Regressions Estimating the Likelihood of an Injured Worker Receiving Opioids and Chronic Opioids within One Year of Injury (continued)

	% of Injured Workers with Pain Medications Who Received an Opioid Prescription		% of Injured Workers With Opioid Prescriptions Who Had at Least 60 Days of Opioid Supply in Any 90-Day Period	
	Odds Ratio	**Standard Error**	**Odds Ratio**	**Standard Error**
Injury type				
Neurologic spine pain	0.537***	(0.064)	5.923***	(1.086)
Back and neck sprains, strains, and non-specific pain	0.159***	(0.015)	2.807***	(0.499)
Fractures (base)				
Lacerations and contusions	0.193***	(0.018)	0.725	(0.174)
Inflammations	0.312***	(0.034)	1.579**	(0.343)
Other sprains and strains	0.175***	(0.016)	1.879***	(0.328)
Upper extremity neurologic (carpal tunnel)	0.572***	(0.114)	0.626	(0.360)
Other injuries	0.507***	(0.049)	1.021	(0.189)
Comorbidities				
Elixhauser comorbidities, count	2.438***	(0.159)	1.522***	(0.086)
Pseudo R-squared	0.120		0.320	

Note: The study sample comprises Kentucky workers injured in calendar years 2011, 2012, and 2013.

[a] The pre-reform period includes Kentucky workers injured in 2011, the partial post-reform period includes workers injured in 2012, and the post-reform period includes workers injured in 2013. We observed the prescriptions of each patient for one year following the date of injury.

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

Table TA.4 Estimates from OLS Regressions for Morphine Equivalent Amount per Claim

	MEA per Claim with Opioids in Milligrams	
	Estimate	**Standard Error**
Observations	9,661	
Study period[a]		
Pre-reform (base)		
Partial post-reform	-199.2**	(92.7)
Post-reform	-225.1**	(93.1)
Age group		
Age under 25	-549.1***	(100.3)
Age 25 to 39 (base)		
Age 40 to 54	-41.1	(99.3)
Age 55 to 60	-314.8***	(115.4)
Age over 60	-503.2***	(114.0)
Gender		
Female	-251.2***	(83.4)
Male (base)		
Gender is missing	-1,127.6***	(224.4)
Marital status		
Married	-21.9	(77.1)
Single, separated, divorced (base)		
Marital status is missing	-50.2	(219.4)

continued

Table TA.4 Estimates from OLS Regressions for Morphine Equivalent Amount per Claim (continued)

	MEA per Claim with Opioids in Milligrams	
	Estimate	**Standard Error**
Location type		
Urban area (base)		
Rural area	90.7	(118.8)
Very rural area	208.7**	(84.6)
Location is missing	554.8**	(222.5)
Industry type		
Construction	890.8***	(215.2)
Manufacturing (base)		
Clerical and professional	51.5	(166.8)
Trade	142.2	(109.9)
High-risk services	221.1*	(114.3)
Low-risk services	124.8	(121.2)
Other industries	411.3***	(138.8)
Industry is missing	-42.2	(253.1)
Injury type		
Neurologic spine pain	1,922.9***	(219.4)
Back and neck sprains, strains, and non-specific pain	153.2	(139.7)
Fractures (base)		
Lacerations and contusions	-500.1***	(146.0)
Inflammations	293.3**	(149.2)
Other sprains and strains	126.0	(110.8)
Upper extremity neurologic (carpal tunnel)	-431.3***	(152.4)
Other injuries	-124.5	(116.1)
Comorbidities		
Elixhauser comorbidities, count	640.4***	(76.2)
Constant	1,171.6***	(142.3)
Pseudo R-squared	0.1	

Note: The study sample comprises Kentucky workers injured in calendar years 2011, 2012, and 2013.

[a] The pre-reform period includes Kentucky workers injured in 2011, the partial post-reform period includes workers injured in 2012, and the post-reform period includes workers injured in 2013. We observed the prescriptions of each patient for one year following the date of injury.

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

Key: MEA: morphine equivalent amount; OLS: ordinary least squares.

Table TA.5 Odds Ratios from Logistic Regressions Estimating Binary Opioid Utilization Metrics

	Statistic	Pre-Reform (base)	Partial Post-Reform	Post-Reform
% of injured workers with Rx who received an opioid Rx	Odds ratio		0.860***	0.647***
% of injured workers with pain medications who received an opioid Rx	Odds ratio		0.828***	0.615***
% of injured workers with pain medications who received 2 or more opioid Rx	Odds ratio		0.846***	0.692***
% of injured workers with opioid Rx who had at least 60 days of opioid supply in any 90-day period	Odds ratio		0.954	0.946
% of injured workers with opioid Rx who had more than 50 MED of opioid supply for at least 60 days	Odds ratio		0.945	0.687*
% of injured workers with opioid Rx who had more than 90 MED of opioid supply for at least 60 days	Odds ratio		0.821	0.680

Notes: Odds ratios are relative to the base category of pre-reform claims.

The study sample comprises Kentucky workers injured in calendar years 2011, 2012, and 2013. The pre-reform period includes Kentucky workers injured in 2011, the partial post-reform period includes workers injured in 2012, and the post-reform period includes workers injured in 2013. We observed the prescriptions of each patient for one year following the date of injury.

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

Key: MED: morphine equivalent daily dose in milligrams; Rx: prescriptions.

Table TA.6 OLS Regression Estimates for Continuous Opioid Utilization Metrics

	Statistic	Pre-Reform (base)	Partial Post-Reform	Post-Reform
Average number of pain medication Rx per claim	Estimate		-0.236***	-0.477***
Average number of opioid Rx per claim	Estimate		-0.286**	-0.375***
Average number of non-opioid analgesic Rx per claim	Estimate		-0.018	-0.078**
Average number of opioid pills per claim	Estimate		-12.60*	-15.92**
Average MEA per claim with opioids in milligrams	Estimate		-199.1**	-225.1**
Average number of opioid days per claim	Estimate		-2.344	-2.792
Average MED per claim with opioids in milligrams	Estimate		-0.693	0.289

Notes: Estimates are relative to the base category of pre-reform claims.

The study sample comprises Kentucky workers injured in calendar years 2011, 2012, and 2013. The pre-reform period includes Kentucky workers injured in 2011, the partial post-reform period includes workers injured in 2012, and the post-reform period includes workers injured in 2013. We observed the prescriptions of each patient for one year following the date of injury.

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

Key: MEA: morphine equivalent amount; MED: morphine equivalent daily dose in milligrams; Rx: prescriptions.

Table TA.7 Odds Ratios from Logistic Regressions Estimating the Likelihood of Receiving Different Types of Pain Medications

	Statistic	Pre-Reform (base)	Partial Post-Reform	Post-Reform
% of injured workers with Rx who received pain medication Rx	Odds ratio		1.068	0.908**
% of injured workers with pain medications who received only opioid Rx	Odds ratio		0.833***	0.701***
% of injured workers with pain medications who received only non-opioid pain Rx	Odds ratio		1.208***	1.625***
% of injured workers with pain medications who received both opioid and non-opioid pain Rx	Odds ratio		0.951	0.772***

Notes: Odds ratios are relative to the base category of pre-reform claims.

The study sample comprises Kentucky workers injured in calendar years 2011, 2012, and 2013. The pre-reform period includes Kentucky workers injured in 2011, the partial post-reform period includes workers injured in 2012, and the post-reform period includes workers injured in 2013. We observed the prescriptions of each patient for one year following the date of injury.

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

Key: Rx: prescriptions.

Table TA.8 Odds Ratios from Logistic Regressions Estimating the Likelihood of Receiving a Medical Service within One Year of Injury

	Statistic	Pre-Reform (base)	Partial Post-Reform	Post-Reform
Evaluation and management	Odds ratio		0.970	0.987
Emergency services	Odds ratio		0.969	0.874***
Physical medicine	Odds ratio		0.987	0.967
Pain management injections	Odds ratio		1.032	1.027
Major surgery	Odds ratio		0.993	1.007

Notes: Odds ratios are relative to the base category of pre-reform claims.

The study sample comprises Kentucky workers injured in calendar years 2011, 2012, and 2013. The pre-reform period includes Kentucky workers injured in 2011, the partial post-reform period includes workers injured in 2012, and the post-reform period includes workers injured in 2013. We observed the medical service utilization of each patient for one year following the date of injury.

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

Table TA.9 OLS Regression Estimates for Number of Visits, by Type of Medical Service

	Statistic	Pre-Reform (base)	Partial Post-Reform	Post-Reform
Evaluation and management	Estimate		-0.046	-0.002
Emergency services	Estimate		0.004	0.002
Physical medicine	Estimate		0.489*	0.259
Pain management injections	Estimate		-0.007	0.013
Major surgery	Estimate		-0.010	-0.016

Notes: Estimates are relative to the base category of pre-reform claims.

The study sample comprises Kentucky workers injured in calendar years 2011, 2012, and 2013. The pre-reform period includes Kentucky workers injured in 2011, the partial post-reform period includes workers injured in 2012, and the post-reform period includes workers injured in 2013. We observed the medical service utilization of each patient for one year following the date of injury.

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

Key: OLS: ordinary least squares.

Table TA.10 Odds Ratios from Logistic Regressions Estimating the Likelihood of an Injured Worker in Each Subsample with Pain Medications Receiving an Opioid Prescription within One Year of Injury

	Pre-Reform (base)	Partial Post-Reform	Post-Reform
All claims		0.828***	0.615***
Surgery			
Worker had a major surgery		0.852	0.947
Worker did not have a major surgery		0.789***	0.539***
Injury type			
Fractures		0.924	0.582**
Lacerations and contusions		0.753***	0.592***
Neurologic spine pain		0.591**	0.392***
Back and neck sprains, strains, and non-specific pain		0.724***	0.463***
Other sprains and strains		0.965	0.737***
Age group			
Age under 25		0.904	0.677***
Age 25 to 39		0.752***	0.516***
Age 40 to 54		0.852**	0.626***
Age 55 to 60		0.888	0.886
Age over 60		0.815	0.701*
Gender			
Female		0.820***	0.603***
Male		0.835***	0.634***
Marital status			
Married		0.811***	0.624***
Single, separated, divorced		0.825***	0.608***
Location type			
Urban area		0.874***	0.635***
Rural area		0.604***	0.461***
Very rural area		0.804**	0.666***
Location type 2			
Eastern Kentucky		0.713**	0.584***
Rest of Kentucky		0.843***	0.621***

Notes: Odds ratios are relative to the base category of pre-reform claims.

The study sample comprises Kentucky workers injured in calendar years 2011, 2012, and 2013. The pre-reform period includes Kentucky workers injured in 2011, the partial post-reform period includes workers injured in 2012, and the post-reform period includes workers injured in 2013. We observed the prescriptions of each patient for one year following the date of injury.

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

Table TA.11 Estimates from OLS Regressions for Morphine Equivalent Amount per Claim, by Claim Group

	Pre-Reform (base)	Partial Post-Reform	Post-Reform
All claims		-199.2**	-225.1**
Surgery			
Worker had a major surgery		-111.2	-269.1*
Worker did not have a major surgery		-298.3***	-311.3***
Injury type			
Fractures		-209.0	-246.4
Lacerations and contusions		-432.1	-469.5
Neurologic spine pain		-53.3	-797.3*
Back and neck sprains, strains, and non-specific pain		-417.5*	-222.3
Other sprains and strains		75.0	179.1
Age group			
Age under 25		-121.1	-123.4
Age 25 to 39		-115.9	-182.0
Age 40 to 54		-268.0*	-299.3*
Age 55 to 60		-206.6	-167.7
Age over 60		-370.4*	-103.7
Gender			
Female		-118.9	-184.4
Male		-243.8**	-229.8*
Marital status			
Married		-172.5	-333.7**
Single, separated, divorced		-276.7**	-222.7*
Location type			
Urban area		-378.0***	-255.4**
Rural area		-15.8	-58.4
Very rural area		-61.2	-234.6
Location type 2			
Eastern Kentucky		20.7	-343.6
Rest of Kentucky		-278.9***	-194.6*

Notes: Estimates are relative to the base category of pre-reform claims.

The study sample comprises Kentucky workers injured in calendar years 2011, 2012, and 2013. The pre-reform period includes Kentucky workers injured in 2011, the partial post-reform period includes workers injured in 2012, and the post-reform period includes workers injured in 2013. We observed the prescriptions of each patient for one year following the date of injury.

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

Key: OLS: ordinary least squares.

PREDICTED UTILIZATION METRICS

Throughout the report, we compare opioid utilization metrics before and after Kentucky's reforms by comparing predictions from the regression models outlined earlier. Case-mix adjusted measures allow us to make meaningful comparisons over time while holding all available relevant factors constant. Our estimates are based on the regression models that have dummy variables for the reform period (treating 2011 as the pre-reform period and a comparison group, 2012 as the partial post-reform period, and 2013 as the post-reform period) and include an intercept. We can recover predictions for the utilization measures for each of these years. To estimate predicted values, we first constructed a sample of claims covering all Kentucky workers underlying each measure while setting the reform dummy to reflect the injury year of interest. The prediction sample includes all of the injured workers from each analysis. For example, for estimating predictions for the MEA of opioids per claim measure, our prediction sample includes all the injured workers across the three years that received opioids, and for estimating predictions for the percentage of injured workers with pain medications who received opioids, the prediction sample includes all Kentucky workers with pain medications across the three years. Then, we estimated the predicted value of the measure based on the regression results while assuming that all workers came from the same year. We repeated this exercise for each year in our analysis by varying the values of the year identifiers that are turned on and off for different predictions. For instance, to estimate the likelihood that the worker received an opioid prescription in 2013, we computed the predicted value of the measure using coefficients from Table TA.3 for the full sample of claims while assuming that all claims come from 2013. We repeated this exercise for each year in the analysis. As a result of this exercise, we have predicted utilization metrics for the identical set of claims, and any differences in predicted values over time are not due to differences in the case mix.

DIFFERENCE-IN-DIFFERENCE ANALYSIS OF CHANGES IN OPIOID DISPENSING: KENTUCKY AND NEIGHBORING STATES

The study period coincided with a period of time during which there was a growing awareness of the opioid problem. The increasing attention to the opioid epidemic may have triggered organizational efforts to alter prescribing and dispensing of opioids. Other federal efforts such as up-scheduling of hydrocodone-combination products toward the end of the study period[7] and risk evaluation and mitigation strategies (REMS) to control opioid use may also have confounded our results. To assess whether the changes in opioid dispensing observed in Kentucky between 2011 and 2013 were an artifact of the provisions of HB 1 or a response to the increased awareness of the opioid epidemic and federal changes, we compared changes in opioid dispensing in Kentucky over this period with the changes in three neighboring states (Illinois, Indiana, and Missouri) without similar reforms. The frequency of injured workers with pain medications receiving opioids in two of the three neighboring states was fairly similar to the rate in Kentucky prior to the reforms, although the amount of opioids received by Kentucky injured workers was somewhat higher than the neighboring states. Table TA.12 shows the changes in unadjusted measures of frequency and amount of opioids received by injured workers in Kentucky and the neighboring states.

[7] In October 2014, the Drug Enforcement Administration moved hydrocodone-combined products, including Vicodin® and Lortab®, to Schedule II, the category of medically accepted drugs with the highest potential for abuse, mainly because of the rise in hydrocodone abuse and trafficking in the last several years.

Table TA.12 Changes in Opioid Dispensing, Kentucky versus Neighboring States

	KY	Neighboring States		
		IL	IN	MO
% of claims with pain medications that had opioids				
2011	54%	45%	59%	60%
2013	44%	45%	57%	62%
% point change from 2011 to 2013	-11	0	-2	2
Average MEA per claim with opioids, in milligrams				
2011	1,516	1,361	1,038	893
2013	1,261	1,238	996	838
% change from 2011 to 2013	-17%	-9%	-4%	-6%

Notes: Data underlying this table comprise workers from Illinois, Indiana, Kentucky, and Missouri who were injured in calendar years 2011, 2012, and 2013. We examined opioid prescriptions for one year following the date of injury for each injured worker.

Unadjusted measures are reported.

Key: MEA: morphine equivalent amount.

We then estimated OLS and logistic regression models to assess changes in amount of opioids dispensed and claim frequency of receiving opioids between 2011 and 2013 among injured workers in Kentucky and neighboring states, after adjusting for the control variables listed earlier, using the following empirical model:

$$Y_{ist} = f(\alpha + STATE_s\theta + YEAR_t\gamma + STATE * YEAR_{st}\mu + WORKER_{ist}\beta_1 + INDUSTRY_{ist}\beta_2 + INJURY_{ist}\beta_3 + COMORBIDITIES_{ist}\beta_4) + \varepsilon_{ist} \quad \text{(TA.3)}$$

Where, Y_{ist} stands for the utilization measure of interest; θ reflects the coefficient on the state dummies; γ reflects the coefficient on the year dummy (2013, which represents the post-reform period in Kentucky); μ indicates whether utilization trends differed by state between 2011 and 2013; β_1, β_2, β_3, and β_4 reflect vectors of estimated coefficients on the worker, industry, and injury characteristics, and comorbidity indices; $f(.)$ takes logistic and linear functional forms for the frequency and amount measures. Generally, the difference in difference represents the average difference in opioids dispensed in Kentucky between 2013 and 2011, less the average difference among the comparison states (which did not have similar policy changes). Estimates for binary dependent variables are difficult to interpret in nonlinear models; therefore, we present the marginal effects from the difference-in-difference logistic and OLS regression models in Tables TA.13 and TA.14. To assess the robustness of the logistic regression, we conducted additional analyses using a linear probability model for the frequency measure. We observed very similar results using logistic and linear functional forms. Table TA.15 summarizes the case-mix adjusted changes in opioid dispensing in Kentucky and neighboring states between 2011 and 2013.

As evidenced from Table TA.13, the interaction terms of the comparison states and the 2013 injury year (corresponding to μ in the TA.3 equation) were statistically significant, signifying different trends in frequency of opioid dispensing in Kentucky and the neighboring states, after controlling for the variables specified in equation TA.3. The interaction terms from the OLS regression for the MEA of opioids were not significant.

Table TA.13 Marginal Probabilities from Logit Model Estimating the Likelihood of Receiving Opioid Prescriptions

	% of Injured Workers with Pain Medications Who Received Opioid Rx	
	Marginal Effect	**Standard Error**
Observations	99,851	
State		
Kentucky (base)		
Illinois	-0.107***	(0.021)
Indiana	0.050**	(0.022)
Missouri	0.051**	(0.022)
Time period		
2011 (base)		
2013	-0.103***	(0.009)
State x time period		
Illinois x 2013	0.104***	(0.010)
Indiana x 2013	0.078***	(0.011)
Missouri x 2013	0.117***	(0.012)
Age group		
Age under 25	-0.059***	(0.005)
Age 25 to 39 (base)		
Age 40 to 54	0.028***	(0.004)
Age 55 to 60	0.028***	(0.005)
Age over 60	0.038***	(0.006)
Gender		
Female	-0.019***	(0.003)
Male (base)		
Gender is missing	-0.009	(0.030)
Marital status		
Married	0.015***	(0.003)
Single, separated, divorced (base)		
Marital status is missing	-0.105***	(0.005)
Location type		
Urban area (base)		
Rural area	0.171***	(0.014)
Very rural area	0.185***	(0.014)
Location is missing	0.063***	(0.021)
Industry type		
Construction	0.110***	(0.008)
Manufacturing (base)		
Clerical and professional	-0.016**	(0.007)
Trade	0.018***	(0.005)
High-risk services	-0.012***	(0.004)
Low-risk services	-0.007	(0.005)
Other industries	0.016**	(0.006)
Industry is missing	0.035***	(0.009)

continued

Table TA.13 Marginal Probabilities from Logit Model Estimating the Likelihood of Receiving Opioid Prescriptions (continued)

	% of Injured Workers with Pain Medications Who Received Opioid Rx	
	Marginal Effect	**Standard Error**
Injury type		
Neurologic spine pain	-0.019*	(0.010)
Back and neck sprains, strains, and non-specific pain	-0.358***	(0.008)
Fractures (base)		
Lacerations and contusions	-0.374***	(0.008)
Inflammations	-0.204***	(0.009)
Other sprains and strains	-0.337***	(0.008)
Upper extremity neurologic (carpal tunnel)	-0.012	(0.015)
Other injuries	-0.147***	(0.008)
Comorbidities		
Elixhauser comorbidities, count	0.222***	(0.007)

Note: The study sample comprises workers from Illinois, Indiana, Kentucky, and Missouri who were injured in calendar years 2011 and 2013.

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

Key: Rx: prescriptions.

Table TA.14 Marginal Effects from OLS Regression for Morphine Equivalent Amount per Claim

	MEA per Claim with Opioids in Milligrams	
	Marginal Effect	**Standard Error**
Observations	47,329	
State		
Kentucky (base)		
Illinois	-331.7*	(193.3)
Indiana	-416.6**	(194.4)
Missouri	-587.2***	(193.0)
Time period		
2011 (base)		
2013	-244.5***	(94.7)
State x time period		
Illinois x 2013	128.1	(105.5)
Indiana x 2013	176.2	(110.6)
Missouri x 2013	160.8	(104.6)
Age group		
Age under 25	-344.6***	(39.0)
Age 25 to 39 (base)		
Age 40 to 54	67.6*	(37.8)
Age 55 to 60	-145.0***	(50.5)
Age over 60	-378.2***	(44.4)
Gender		
Female	-219.1***	(28.8)
Male (base)		
Gender is missing	216.5	(264.5)

continued

Table TA.14 Marginal Effects from OLS Regression for Morphine Equivalent Amount per Claim (continued)

	MEA per Claim with Opioids in Milligrams	
	Marginal Effect	**Standard Error**
Marital status		
Married	-56.2*	(32.8)
Single, separated, divorced (base)		
Marital status is missing	-311.6***	(41.2)
Location type		
Urban area		
Rural area (base)	-13.2	(165.2)
Very rural area	124.6	(107.0)
Location is missing	182.0	(191.2)
Industry type		
Construction	866.4***	(99.9)
Manufacturing (base)		
Clerical and professional	16.8	(71.3)
Trade	28.8	(42.0)
High-risk services	75.2*	(39.7)
Low-risk services	69.5	(46.2)
Other industries	200.4***	(61.7)
Industry is missing	161.9*	(93.8)
Injury type		
Neurologic spine pain	1,399.3***	(100.6)
Back and neck sprains, strains, and non-specific pain	-118.2	(72.1)
Fractures (base)		
Lacerations and contusions	-598.0***	(65.8)
Inflammations	109.5	(71.0)
Other sprains and strains	-109.3*	(63.7)
Upper extremity neurologic (carpal tunnel)	-508.7***	(65.9)
Other injuries	-172.4**	(67.7)
Comorbidities		
Elixhauser comorbidities, count	819.1***	(57.0)

Note: The study sample comprises workers from Illinois, Indiana, Kentucky, and Missouri who were injured in calendar years 2011 and 2013.

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

Key: MEA: morphine equivalent amount; OLS: ordinary least squares.

Table TA.15 Case-Mix Adjusted Changes in Opioid Dispensing, Kentucky versus Neighboring States

	KY	Neighboring States		
		IL	IN	MO
% of claims with pain medications that had opioids				
2011	54%	45%	59%	60%
2013	44%	45%	56%	61%
% point change from 2011 to 2013	-10	0	-3	1
Average MEA per claim with opioids, in milligrams				
2011	1,516	1,361	1,038	893
2013	1,271	1,244	970	809
% change from 2011 to 2013	-16%	-9%	-7%	-9%

Notes: Data underlying this table comprise workers from Illinois, Indiana, Kentucky, and Missouri who were injured in calendar years 2011, 2012, and 2013. We examined opioid prescriptions for one year following the date of injury for each injured worker.

Case-mix adjusted measures are reported.

Key: MEA: morphine equivalent amount.

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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:

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