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A Reduction in Opioid Prescription Size After Total Joint Arthroplasty Can be Safely Performed Without an Increase in Complications

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ABSTRACT

Background: Excessive opioid prescriptions after total joint arthroplasty (TJA) increase risks for adverse opioid-related events, chronic opioid use, and unlawful opioid diversion. Decreasing postoperative prescriptions may improve quality after TJA. Concerns exist that a decrease in opioids prescribed may increase complications, such as readmissions, emergency department (ED) visits, or worsened patient-reported outcomes (PROs). The purpose of this study was to explore whether a reduction in opioids prescribed after TJA resulted in increased complications.

Methods: Data originated from a statewide database prospectively abstracted, including oral morphine equivalents prescribed at discharge, readmissions, ED visits, and PROs. Data were collected from 84,998 TJA occurring 1 year before and after the creation of an opioid-prescribing protocol that had decreased prescriptions by approximately 50%. Trends were monitored using Shewhart control charts. Regression models were used to determine statistically significant changes over time.

Results: All groups showed a reduction in opioids prescribed by almost 50% without an increase in emergency room visits or readmissions and without a detrimental effect on PROs. Compared to baseline data before opioid reduction, opioid-naive total knee arthroplasty had significant improvements in all outcomes ($P = .03$, $P = .02$, $P < .001$, $P < .001$). Opioid-tolerant total knee arthroplasty and total hip arthroplasty had no worsened outcomes and significant improvement in (Knee Injury and Osteoarthritis Outcome score for Joint Replacement $P = .03$) and (Hip Disability and Osteoarthritis Outcome Score for Joint Replacement $P = .03$). Opioid-naive total hip arthroplasty had significant improvements in Hip Disability and Osteoarthritis Outcome Score Joint Replacement ($P = .003$) and Patient Reported Outcomes Measurement Information System ($P = .001$).

Conclusions: Postoperative opioid prescription recommendations from a statewide registry decreased prescribing by approximately 50% without decreasing PROs or increasing ED visits or readmissions. A reduction in opioids prescribed after TJA can be accomplished safely and without increased complications.

Pain management, surgical technique, anesthesia, and rehabilitation protocols after total joint arthroplasty (TJA) have changed dramatically over the last decade. Despite these changes, there has been little change in postoperative opioid prescribing patterns. Opioid-naive patients are at risk for chronic persistent opioid use after primary arthroplasty. At 6 months postoperative, 4.3% of hip and 8.2% of knee arthroplasty patients remain on opioids despite a lack of association with pain reduction or satisfaction after surgery [1]. Chronic opioid use is arguably the most common complication after primary TJA. There is evidence that a major portion of the prescribed opioids are not utilized and remain in the community leaving them at risk for unprescribed use, theft, diversion, and/or misuse [2,3].

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Chronic opioid use and abuse continues to be a major public health challenge. The National Institute of Health estimated that opioid overdoses in 2018 were responsible for 128 daily deaths and that the economic burden of the opioid crisis approximates $78.5 billion per year [4,5]. One common introduction to opioids is an episode of acute surgical care [6,7]. In TJA specifically, 4 to 8% of opioid-naive patients become chronic users postoperatively [1,8,9]. In addition, an estimated 67 to 92% of all surgical patients had unused opioids after weaning off of them postoperatively [10]. These excess pills are among the most common sources of diversion [11], and few patients are aware of how to properly dispose of opioids to avoid their inappropriate use [10].

It is important to safely reduce postoperative opioid prescriptions without negatively affecting patient satisfaction or outcomes. Increased opioid prescribing places the patient at a higher risk of opioid-related complications [12]. Increased prescription size correlates with increased opioid use and worse self-rated pain control after surgery [13,14]. There is even evidence that increased postoperative opioid use is associated with increased risk of periprosthetic joint infections [15]. Excess prescriptions also result in an increased opioid burden available in the community for diversion [16–18].

With regards to patient satisfaction, reducing the size (ie, number of pills) of postoperative prescriptions has not been shown to be associated with increased calls for refills or worsening postoperative pain or satisfaction [19]. In addition, smaller volume prescriptions result in less opioid consumption. Recent data also found a lack of association between script size and refill requests when using a 30 tablet limit [20].

Despite these studies, there remains wide variability in the number of tablets prescribed after common orthopaedic surgery with 1 standard deviation equating to 108 tabs after total knee arthroplasty (TKA) [21]. The American Academy of Orthopaedic Surgeons recommends that providers establish a consensus regarding prescriptions after common procedures and use a strict limit on prescription sizes to reduce variability and overall prescriptions [22].

Given the developing awareness of the opioid epidemic, in 2018 a quality improvement project was undertaken by our state's quality joint registry [13]. Actual medication usage was determined at multiple sites from the Michigan Arthroplasty statewide registry, MARCQI (Michigan Arthroplasty Registry Collaborative Quality Initiative). This work identified that the majority of hip arthroplasty patients took fewer than 30 oxycodone 5 milligram tablets or 225 oral morphine equivalents (OME), post-operatively and 15% took no opioids after leaving the hospital. The majority of knee arthroplasty patients took fewer than 56 pills, 420 OME, postoperatively, and approximately 10% took no opioids after discharge. In the data obtained, refill requests were independent of the original prescription size. Only approximately 35% of total heart arthroplasty (THA) patients and 50% of TKA patients can be expected to call for a refill or request one at follow-up regardless of the original prescription size. In addition, the study identified wide variations in prescribing patterns across the state, yet there were no associations between the amount of opioid prescribed and the likelihood of refill, postoperative pain, or satisfaction with pain control. The amount of opioid prescribed was associated with increased consumption, such that each increase of two pills prescribed was associated with approximately an additional 1 pill consumed after adjusting for other covariates. Moreover, 48.2% felt that they received "more" or "much more" opioid than they needed [13].

To address the variation in opioid prescribing in primary hip and knee arthroplasty, MARCQI made opioid education and prescribing an emphasis of our collaborative wide and local quality meetings. In addition, evidence-based guidelines on opioid prescribing for hip and knee arthroplasty patients were created. The goal was to make opioid prescribing more uniform across the state and to decrease excessive prescribing patterns that can put patients and communities at risk. This guideline was based on data from the aforementioned MARCQI patient consumption data and written to comply with Michigan law requiring: opioid prescriptions to not exceed 7 days for acute pain, prescriber evaluation of opioid prescription history, patient education on risks and disposal, established physician patient relationship, and encouragement of weaning in 3 to 5 days. The MARCQI evidenced-based opioid prescribing guidelines were created in January of 2019. The protocol involved patient education via opioid-start talking forms, Michigan automated prescription system checks, 7-day prescribing limit, prescribing only 1 opioid medication for <50 daily OME, avoidance of extended-release opioids and benzodiazepines, and a recommendation for adjunctive acetaminophen, and nonsteroidal anti-inflammatory use. Prescription guidelines included an upper limit of the equivalent of roughly 40 tablets of 5mg oxycodone in TKA (320 OME or less) and the equivalent of 30 tablets in THA (240 OME or less) [13].

Since the publication of the opioid prescribing guidelines, MARCQI made conformance with opioid prescription recommendations a quality initiative with pay for performance implications to further increase compliance and drive change. With over 97% of all TJAs in the state of Michigan captured in the registry each year, small changes in prescribing patterns can produce a large effect upon statewide prescriptions [23].

While several studies have shown that reducing opioid prescribing does not adversely affect patient satisfaction or need for refills, less is known about the impact on complication rates. The purpose of this study was to review the effect of decreased opioid prescribing on complications after TJA, specifically readmission rates, emergency department (ED) visits, and patient-reported outcome (PROs) scores. We examined a cohort of patients within our joint registry prior to and after initiation of a reduced opioid prescribing protocol, which significantly reduced the number of opioids prescribed statewide.

Methods

The institutional review board of the University of Michigan's Medical School provided a notice of determination of "not regulated" status for this project because it does not fit the definition of human subject research according to 45 code of federal regulations 46 and 21 code of federal regulations 56. "Not regulated" status is different than "exempt," it reflects that the purpose of the data collection was quality or process improvement. This notice is available upon request. Data were obtained from the MARCQI registry, which captures data on over 97% of all elective THA and TKA cases performed in Michigan [24]. Data included all MARCQI elective primary THAs and TKAs performed between January 1, 2018, and December 31, 2019. The data were collected from 63 hospitals and 2 ambulatory surgery centers, comprising a total of 84,998 TJAs. This included 22,774 opioid-naive THAs, 9,124 opioid-tolerant THAs, 40,882 opioid-naive TKAs, and 12,218 opioid-tolerant primary TKAs. OME prescribed at discharge was collected as a part of the standard data abstraction as performed by MARCQI. Opioid-naive was defined as not taking opioids 30 days prior to surgery. If opioids were taken within 30 days of surgery, patients were identified as opioid-tolerant. All applicable data at active hospitals and ambulatory surgery centerss were used to evaluate outcomes.

Demographic and clinical data were collected on each TJA. The clinical endpoints of interest were readmission or unplanned admission and emergency department visit within 30 days

following the primary procedure. In addition, changes in the patient reported outcomes measurement information system (PROMIS) survey pain response question were assessed from the preop survey to the postop survey (collected 14 to 112 days postoperative). Mean changes in the total scores for the hip disability and osteoarthritis outcome score (HOOS, JR) and knee injury and osteoarthritis outcome score (KOOS, JR) and PROMIS-10 were also assessed from the preop survey to the 14 to 112-day postop survey. The preoperative survey time period is defined as 90 days before surgery.

Shewhart charts, a type of statistical process control chart, were generated to monitor how postoperative events and opioid prescription amounts at discharge, calculated using total OME values, changed over time. A Shewhart chart compares these values to an upper and lower limit established using the historical occurrence rate of each monitored event [25]. These charts constructed for each variable and each subgroup were used to monitor the time series for changes. Time trends were assessed for binary-outcome variables (ie, 30-day ED visits, readmissions) using logistic regressions with time as a predictor, and similar analyses were conducted for change in HOOS Jr, KOOS Jr, and PROMIS-10 pain scores using ordinary least squares regressions. All statistical analyses were performed in SAS software version 9.4 (SAS Institute Inc, Cary, NC).

Results

From January 1, 2018 to December 31, 2019, the average opioid prescription at discharge for opioid-naive and opioid-tolerant patients undergoing TKAs and THAs decreased by roughly 50% among all groups (See Fig. 1). For TKA, in opioid-naive patients prescribing decreased by 48% from 608.5 to 315.4 OME, and in opioid-tolerant patients, prescribing decreased by 48% from 756.2 to 390.5 OME. For THA, in opioid-naive patients, prescribing decreased by 47% from 530.2 to 280.3 OME, and in opioid-tolerant patients, prescribing decreased 53% from 684.6 to 319.1 OME.

Regression modeling showed no statistically significant problematic trends in unplanned admission/readmissions, 30-day ED visits, changes in HOOS Jr, changes in KOOS Jr, or PROMIS-10 pain scores. That is, the slope of linear fit for readmissions/unplanned admissions and 30-day ED visit was not significantly different from zero for hips (either opioid-naive or opioid-tolerant). Moreover, the slope of the linear regression models for the change in HOOS-JR for the opioid-naive ($P < .0001$) and opioid-tolerant ($P < .05$) were statistically greater than zero. The slope for the change in PROMIS-10 pain score was statistically less than zero ($P = .001$) for the opoid-naive group and was not found to be different from zero for the opioid-tolerant group ($P = .78$). For knees, the readmission/unplanned admission regression slope was statistically significantly less than zero ($P < .05$) for the opioid-naive group but not significantly different than zero for the opioid-tolerant group ($P = .05$). A similar result was found for 30-day ED visits ($P < .05$ for opioid-naive and $P = .41$ for opioid-tolerant). The change in KOOS-Jr score showed a statistically significant increase for both the opioid-naive ($P < .0001$) and opioid-tolerant ($P < .03$) groups. The change in PROMIS-10 pains score decreased statistically for the opioid-naive group ($P < .0001$) but not for opioid-tolerant group ($P = .07$). These results can be viewed in Table 1 and Figures 2 and 3.

Discussion

The MARCQI opioid guideline meant to reduce opioid prescribing patterns by providing prescribing recommendations and encouraging compliance with a statewide performance measure was successful. The average opioid prescription after THA and TKA in opioid-naive patients went down by almost 50% without a corresponding rise in complications or corresponding drop in PROs. Actually, our data showed a significant improvement in many variables that correlated with a decrease in prescription size.

The MARCQI joint registry is uniquely equipped to drive quality improvement efforts across the state as not only is it a large outcomes database, but each participating hospital is required to have a physician champion who manages quality improvement on an individual physician and institutional level based on hospital and individual physician specific data. Quarterly meetings of the collaborative with all physician champions are used to discuss opportunities for quality improvement, which are then disseminated at the institutional level to individual surgeons through hospital quality meetings.

This database captured the majority (approximately 97%) of TJAs performed in Michigan over the timeframe of the study. Therefore, the meaningful change in prescriptions occurred across providers from a variety of settings from small to large-volume academic and community hospitals. To our knowledge, this is the first study to show that the use of a prescription guideline as a performance measure can produce substantive change in the practice of orthopaedic surgeons across multiple health systems.

Despite recent studies, many surgeons remain concerned that decreasing opioid prescriptions will result in increased patient pain, request for refills, poor patient satisfaction values, emergency room visits, or readmissions [13,26,27]. On the contrary, we did not find an increase in ED visits, hospital readmissions, or observation unit admissions, and notably, we had a decrease in ED visits and readmissions for opioid-naive TKAs. Importantly, this study found that there was no worsening of postoperative PROs associated with reducing opioid prescribing using HOOS and KOOS scores. Again,

Table 1
Results of Logistic RegressionModel.

Outcome Measures	n	Opioid-naive-*P*-value	n	Opioid-tolerant *P*-value
Knee				
Readmission/Unplanned admission	43,460	0.03	13,370	.05
30-d ED visit	43,460	0.02	13,370	.41
Change in KOOS-JR total score	31,801	<.0001	9,452	.03
Change in PROMIS pain score	31,734	<.0001	9,440	.07
Hip				
Readmission/Unplanned admission	23,735	0.38	9,859	.67
30-d ED visit	23,735	0.07	9,859	.12
Change in HOOS-JR total score	17,451	0.003	6,857	.03
Change in PROMIS pain score	17,437	0.001	6,849	.78

ED, emergency department; KOOS-JR, knee injury and osteoarthritis outcome score-joint arthroplasty; PROMIS, patient-reported outcome measurement information system; HOOS-JR, hip injury and osteoarthritis outcome score-joint arthroplasty.

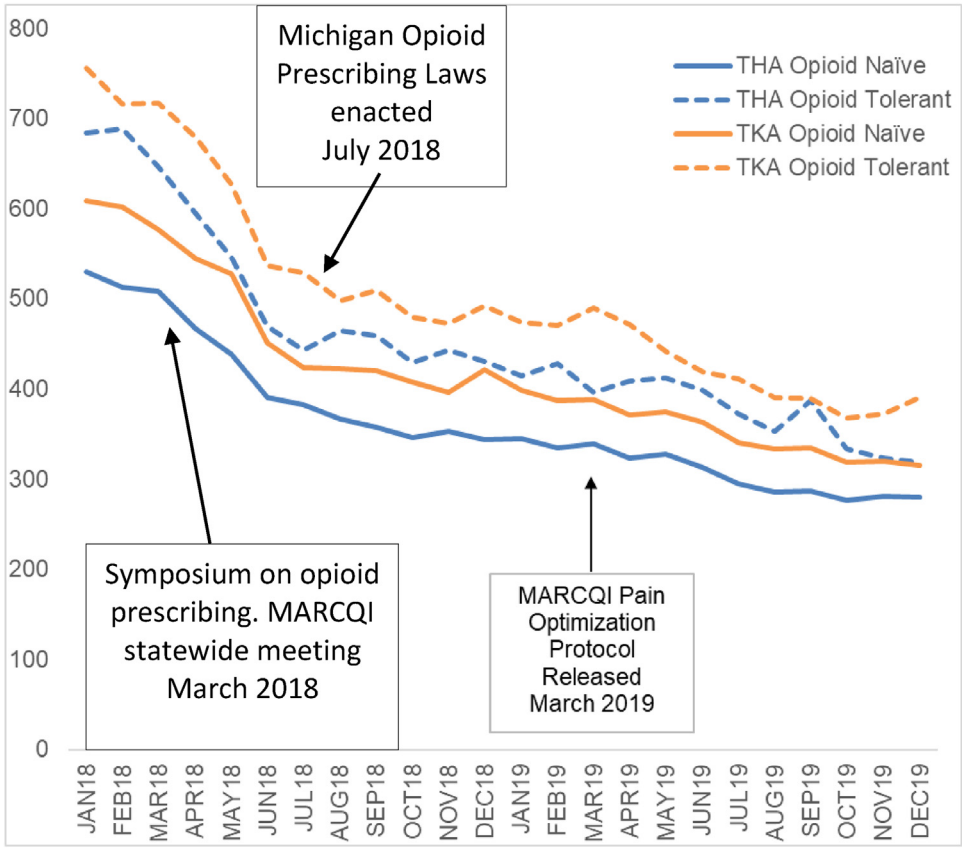

Fig. 1. Oral Morphine Equivalents Prescribed for Primary TKA and THA in Michigan Arthroplasty Registry Collaborative Quality Initiative From 2018 to 2019.

there was actually improvement in HOOS/KOOS scores among all groups during this time period. Our prior work also demonstrates that request for refills and patient satisfaction of their pain control did not decrease with smaller prescriptions [13]. These findings are consistent with previous studies as well suggesting that patient satisfaction and pain control does not correlate with narcotic prescription size in narcotic-naive patients undergoing TJA [23].

We recognize that patient satisfaction with pain control is determined by multiple variables beyond just the prescription size and duration, including things such as anesthesia type, patient

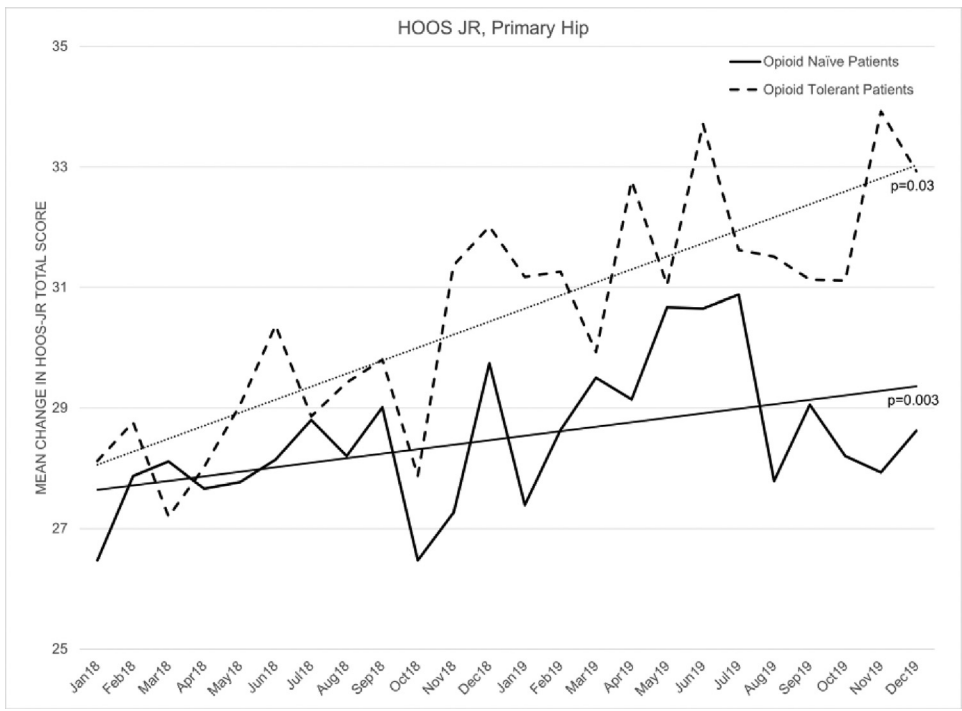

Fig. 2. Postoperative hip injury and osteoarthritis outcome score, joint arthroplasty scores after total hip arthroplasty.

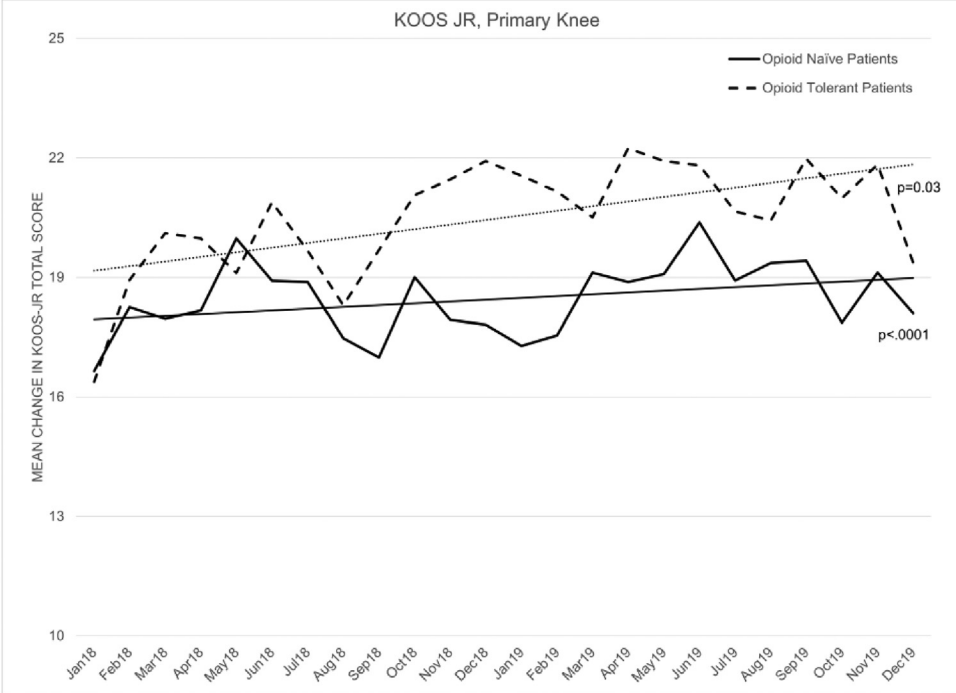

Fig. 3. Postoperative knee injury and osteoarthritis outcome score, joint arthroplasty scores after total knee arthroplasty.

response to pain, variations in surgical technique, or patients needed medication usage after discharge, which all can be confounding variables and were not assessed in this study. As such, there may be various subgroups for which the conclusions from this study do not apply. Ultimately, a pain management plan needs to be patient-centered and focused on the individual needs and expectations of each patient to achieve an optimal outcome. We also recognize that the improvements noted in this time period were an association, and this does not prove causation between decreased opioid prescriptions and improvement in outcome scores/ED visits.

Achieving quality improvement based on evidence is critical to improving value in health care. The American Academy of Orthopaedic Surgeons' strategic plan states a goal to equip members to thrive in value-based environments and advance the quality of orthopaedic care. Registries are an integral part of this as they provide physicians and institutions real data on outcomes. The ability to leverage that data to change physician behavior through performance measures and assessing how that change impacts outcomes in a registry is critical for process improvement. This study validates how registry data and evidence-based quality improvement can be used to impact favorably the care of our patients and our communities.

Conclusion

Publication of an evidenced-based opioid prescribing guideline within a state joint arthroplasty registry, when combined with educational efforts and its inclusion as a performance measure resulted in a roughly 50% reduction of opioid prescriptions after TJA in opioid-naive and opioid-tolerant patients undergoing primary THAs and TKAs. There was no significant corresponding increase in 30-day ED visits, readmissions, or unplanned admissions, and no decrease in PRO scores.

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