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Narcotic prescribing practices in shoulder surgery before and after the institution of narcotic e-prescribing

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Background: Given the current opioid epidemic, it is crucial to highly regulate the prescription of narcotic medications for pain management. The use of electronic prescriptions (e-scripts) through the hospital's electronic medical record platform allows physicians to fill opioid prescriptions in smaller doses, potentially limiting the total quantity of analgesics patients have access to and decreasing the potential for substance misuse. The purpose of this study is to determine how the implementation of e-scripts changed the quantity of opioids prescribed following shoulder surgeries.

Methods: For this single-center retrospective study, data were extracted for all patients aged 18 years or more who received a shoulder procedure between January 2015 and December 2020. Total milligrams of morphine equivalents (MMEs) of opioids prescribed within the 90 days following surgery were compared between 3 cohorts: preimplementation of the 2017 New Jersey Opioid laws (Pre-NJ opioid laws), post-NJ Opioid Laws but pre-escripting, and postimplementation of e-scripting in 2019 (post-escripting). Any patient prescribed preoperative opioids, prescribed opioids by nonorthopedic physicians, under the care of a pain management physician, or had a simultaneous nonshoulder procedure was excluded from this study.

Results: There were 1857 subjects included in this study; 796 pre-NJ opioid laws, 520 post-NJ opioid laws, pre-escripting, and 541 postescripting. Following implementation of e-scripting on July 1, 2019, there was a significant decrease in total MMEs prescribed ($P < .001$) from a median of 90 MME (interquartile range 65, 65-130) preimplementation to a median 45 MME (interquartile range 45, 45-90) MME postimplementation Additionally, there was a statistically significant decrease in opioids prescribed for all procedures ($P < .001$) and for 3 ($P < .001$) of the 4 orthopedic surgeons included in this study.

Conclusion: Our study demonstrated a significant reduction in total MMEs prescribed overall, for all shoulder surgeries, and for the majority of our institution's providers in the postoperative period following the e-scripting implementation in July 2019. E-scripting is a valuable tool in conjunction with education and awareness on the national, institutional, provider, and patient levels to combat the opioid epidemic.

Opioids are commonly prescribed analgesics for pain management following shoulder surgery.[9,12] Pain has been considered a fifth vital sign since 1995, yet its evaluation, assessment, and management has proven more difficult and consequential than intended. Along with this change, patient's expectations have shifted. Patients expect physicians, in response to their pain, to manage and treat it, often with narcotics.[16] The reliance on prescription opioids for analgesia has contributed to the increase in opioid dependence and the evolving Opioid Epidemic.[6,13,14] Opioid overdose is both the number-one cause of death for individuals aged between 25 and 64 years and a significant contributor to the decline in average lifespan orthopedic surgeons have been identified as the third highest prescribers of opioids in the United States and are estimated to contribute to an estimated 7.7% of all US opioid prescriptions.[2,5]

This study was approved by Cooper Health System Institutional Review board: #21-198.

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To combat the issues inherent to the ongoing opioid epidemic, there have been multiple statewide and institutional measures implemented to stem the misuse of opioids and increase regulation on prescription of these drugs. Many of such measures target prescriber practices as studies have demonstrated they can influence the total milligrams of morphine equivalents (MMEs) prescribed to patients following orthopedic procedures.[3] On February 15, 2017, New Jersey Governor Chris Christie passed executive order 2019, one of the strictest opioid laws in the nation. This law mandates a 5-day limit on initial prescriptions for opioids to treat acute pain. Additionally, the Electronic Prescriptions (e-scripting) for Controlled Substances program was developed in 2010 by the Drug Enforcement Agency.[15,18] The program aimed to implement a streamlined process for prescribing, eliminating transcription errors, reducing fraud, forgery, and abuse.[15,18] New Jersey allowed physicians to prescribe controlled substances electronically as of January 7, 2013[20] and has become a common practice among hospital systems throughout the region. At our institution, e-scripting was implemented in July 2019.

The use of electronic prescriptions (e-script function) in the electronic medical record (EMR) may allow prescribers to prescribe smaller quantities of opioids. The literature supports the use of a multimodal approach for pain control during the postoperative period,[18,20] and cites how regulation for default settings and optimizing the use of the e-script functions in EMR systems can directly affect prescriber behavior.[1,4,15] However, there is no current literature comparing the difference of narcotic prescribing practices before and after the implementation of the e-scripting functions. There is also no current literature on how the total amount of opioids prescribed following shoulder surgery changed following the implementation of the e-scripting function. The purpose of this study is to determine how opioid prescribing practices changed for opioid naive patients after the implementation of e-scripts at a single institution and evaluate if the electronic scripting function increased or decreased the quantity of opioids prescribed following shoulder surgeries.

Methods

This retrospective, single-center review was conducted at a high-volume level 1 trauma center using the EMR platform EPIC (EPIC, Verona, WI, USA) for all patients aged 18 years or more who received any type of shoulder surgery between January 2015 and December 2020. Patients were divided into 3 time-period cohorts delineated by the timing of procedure relative to the NJ Opioid law enactment date of February 15, 2017, and e-scripting institutional implementation date of July 1, 2019. The 3 cohorts are as follows: pre-NJ opioid laws (January 1, 2015 to February 14, 2017), post-NJ Opioid Laws and pre-escripting (February 15, 2017 to June 30, 2019), and postescripting in (July 1, 2019 to present). Total MMEs of opioids prescribed within the 90 days following surgery were compared between the 3 cohorts. Any patient who was prescribed preoperative opioids, prescribed opioids by nonorthopedic physicians, was under the care of a pain management physician, or had a simultaneous nonshoulder procedure was excluded from this study. The opioid medications analyzed in this study were limited to patients who were considered opioid naïve prior to surgery and were exclusively prescribed oral oxycodone, hydrocodone, codeine, tapentadol, or tramadol during the postoperative period. Opioid naïve patients were defined as patients who did not have opioids listed in their preoperative medication list. Only patients prescribed oral opioids were included in this study and any patient prescribed an opioid with any other route of administration was excluded. Current Procedural Terminology codes were separated into 4 groups. Group 1 is the “arthroplasty” group which included codes 23470 and 23472 for hemi, total, and reverse shoulder arthroplasty. Group 2 is the “rotator cuff” group which included codes 29827, 29828, 23412, and 23410 for arthroscopic and open rotator cuff and bicep procedures. Group 3 is the “labrum” group which included codes 29806 and 29807 for arthroscopic labral and SLAP (Superior Labrum, Anterior to Posterior) tear repair procedures. Group 4 is the “open instability” group which included codes 23460, 23462, 23455, and 23466 for open instability procedures. Independent *t*-test, Mann-Whitney U test, and Linear Regressions were used for analysis. A P value $\leq .05$ was defined as statistically significant.

Results

Initially, 2791 subjects were identified using Current Procedural Terminology procedure codes. Following the implementation of exclusion criteria, 1857 subjects were included in this study: 796 pre-NJ opioid laws, 520 post-NJ opioid laws, pre-escripting, and 541 postescripting (Supplementary Table S1). The difference in MMEs between the 3 cohorts was statistically significant with a median of 90 MME (interquartile range [IQR] 70, 60-130) for patients treated pre-NJ opioid laws, 90 MME (IQR 40, 90-130) post-NJ opioid laws, pre-escripting, and 45 MME postescripting (IQR 45, 45-90) ($P <$ .001; Table I). This represents a 50% reduction in average MMEs prescribed following the implementation of e-scripting in addition to the NJ opioid laws. Analyzing the effects of e-scripting implementation directly, the data demonstrated a significant decrease in mean MMEs prescribed after the implementation of e-scripting on July 1, 2019 when comparing total MMEs between the post-NJ law and postescripting group to those of the pre-NJ opioid laws and pre-escripting group ($P <$ .001; Table II).

When analyzing the MME trends per-provider, there was a significant decrease for 3 of the 4 orthopedic surgeons included in this study between the 3 time periods (Table III). For surgeons 1, 2, and 3, there was a significant difference in median MMEs between the 3 time points ($P <$ .001; Table III). This difference was not significant for surgeon 4 ($P = .822$; Table III). When evaluating the difference in median MMEs between the post-NJ opioid, pre-escripting patients compared to the postescripting patients, there was a significant decrease in MMEs prescribed following e-scripting implementation for surgeons 1, 2, and 3 ($P <$ .001; Table IV). This relationship was not statistically significant for surgeon 4 ($P = .729$; Table IV).

There was a statistically significant difference in MMEs for all 4 procedure groups between the 3 time periods (Table V). When evaluating the difference in median MME between the post-NJ opioid, pre-escripting patients compared to the postescripting patients, the difference in MMEs was statistically significant 3 of 4 surgical groups (Group 1-3 arthroplasty, rotator cuff, and labrum: $P <$ .001, Group 4- open instability: $P = .090$; Table VI). For all 4 surgical procedures groups, those who were in the post implementation/pre-escripting group had significantly higher MME than the pre-NJ opioid laws (Standardized $\beta = 0.0062$; $P =$ .010). Those who were in the postescripting group had lower MME than the pre-NJ opioid laws group (Standardized $\beta = -0.289$, $P <$ .001). When looking at the data in relation to e-scripting implementation, those who were in the postescripting group had lower MME than the post-NJ opioid laws, pre-escripting group (Standardized $\beta = -0.289$, $P <$ .001).

Discussion

This study sought to better understand the effects of e-scripting implementation on total MMEs prescribed at a single institution. With drug overdose being one of the leading causes of accidental death in the United States,[7,8,10,19] decreasing the total MMEs

Table I
Total milligrams of morphine equivalents.

Pre-NJ opioid laws (N, median) [IQR (25th-75th)]	Post-NJ opioid laws, Preimplementation (N, median) [IQR (25th-75th)]	Postimplementation (N, median) [IQR (25th-75th)]	*P* value
796, 90 [70 (60-130)]	520, 90 [40 (90-130)]	541, 45 [45 (45-90)]	**<.001**

IQR, interquartile range; *NJ*, New Jersey.
Bold values indicate statistically significant values ($P < .05$).

Table II
Total milligrams of morphine equivalents pre-escripting vs. postescripting.

Total MMEs		*P* value
Post-NJ opioid laws, pre-escripting (N, median) [IQR (25th-75th)]	Postescripting (N, median) [IQR (25th-75th)]	
520, 90 [40 (90-130)]	541, 45 [45 (45-90)]	**<.001**

IQR, interquartile range; *MMEs*, milligrams of morphine equivalents; *NJ*, New Jersey.
Bold values indicate statistically significant values ($P < .05$).

prescribed in the postoperative period may help lower the potential risk for opioid misuse.[9,11,12] While numerous studies have demonstrated that changes to the EMR default settings (ie, lowering number of pills) when prescribing narcotic medications led to a decrease in the amount of total MMEs prescribed,[3,4,15] there is not a clear understanding of the effects of e-prescribing on overall postoperative opioid consumption after shoulder surgery.

Our study demonstrated significant reduction in total MMEs prescribed overall, for all shoulder surgeries, and for the majority of our institution's providers in the postoperative period following the e-scripting implementation in July 2019. We found no significant change in average MMEs prescribed at this institution overall, by procedure, or by provider following passage of the NJ opioid laws. It is unclear as to why the opioid laws alone did not provide a significant reduction in MMEs at this institution, but this may be multifactorial including a lag in education and awareness, institutional and provider interest, and factors related to our patient population. Our institutional average MME preimplementation of the opioid laws was already in compliance which may also be why no difference was detected. We found that the addition of e-scripting in 2019 provided a larger reduction in average total MMEs prescribed than compared to the MME reduction seen after the enactment of the opioid laws alone. The NJ opioid laws are among the strictest nationwide, and in our experience are stricter than most insurance companies which allow for up to a 5-7–day initial supply or 90 MMEs. Following the institutional implementation of e-scripting, our total MMEs prescribed was decreased from 90 to 45 MME, a 50% reduction, which places our institutional prescribing practices far below the maximum delineated by the state laws and many insurance companies.

Given the literature available on the impact of prescriber practices on the ongoing opioid epidemic, there has been an effort among physicians to minimize opioids prescribed. Before physicians at our institution were able to electronically prescribe narcotics, patients needed to physically return to the provider's office to obtain their prescription. Anecdotally, in our experience, physicians prescribed a larger amount of MMEs upfront to limit obstacles to care including access to transportation. This is an important factor to consider in our patient population which includes a large proportion of working-class and lower-class patients who already face a lot of financial and logistical barriers to accessing healthcare. With the introduction of electronic narcotic prescriptions, easy accessibility to refilling medications if required allows physicians to

Table III
Total milligrams of morphine equivalents by provider.

Provider	Pre-NJ opioid laws (N, median) [IQR (25th-75th)]	Post-NJ opioid laws, pre-escripting (N, median) [IQR (25th-75th)]	Postescripting (N, median) [IQR (25th-75th)]	*P* value
1	7, 160 [12.5 (90-202.5)]	217, 90 [55.5 (90-145.5)]	198, 45 [45 (45-90)]	**<.001**
2	2, 161.3 (90-161)	78, 90 [75 (63.8-138.8]	147, 45 [52.5 (30-82.5)]	**<.001**
3	297, 90 [65 (45-110)]	72, 90 [49.5 (55.5-105)]	80, 45 [21.5 (45-66.5)]	**<.001**
4	490, 90 [67.5 (67.5-135)]	153, 90 [0 (90-90)]	116, 90 [37.5 (90-127.5)]	.822

IQR, interquartile range; *NJ*, New Jersey.
Bold values indicate statistically significant values ($P < .05$).

Table IV
Total milligrams of morphine equivalents, unadjusted pre-escripting vs. postescripting.

Provider	Post-NJ opioid laws, pre-escripting (N, median) [IQR (25th-75th)]	Postescripting (N, median) [IQR (25th-75th)]	*P* value
1	217, 90 [55.5 (90-145.5)]	198, 45 [45 (45-90)]	**<.001**
2	78, 90 [75 (63.8-138.8]	147, 45 [52.5 (30-82.5)]	**<.001**
3	72, 90 [49.5 (55.5-105)]	80, 45 [21.5 (45-66.5)]	**<.001**
4	153, 90 [0 (90-90)]	116, 90 [37.5 (90-127.5)]	.729

IQR, interquartile range; *NJ*, New Jersey.
Bold values indicate statistically significant values ($P < .05$).

prescribe the minimum necessary MMEs to adequately control postoperative pain, knowing they could refill it easily if necessary. On the other hand, one could argue that e-scripting could make opioids more available as all a patient has to do is call in to have a prescription refilled. As we did not see this at our institution, the effects of patient and physician education on limiting narcotics postoperatively may also play a role in the decrease we saw over time. However, the 4 surgeons do not feel their education of their patients changed significantly over this time period and therefore, the effects of e-scripting should not be discounted.

Despite the reduction across all shoulder procedures, the shoulder arthroplasty cohort had a median 30 more total MMEs as compared to other shoulder procedures. This contrasts with a study performed by Patel et al, which identified that patients undergoing shoulder arthroplasty used significantly fewer opioids than patients undergoing rotator cuff repair. However, their results did demonstrate that approximately 75% of patients undergoing shoulder surgery had excess pills.[17] The discrepancy between our results and those existing in the literature may reflect overprescription of opioids across shoulder procedures. Interestingly, Vattigunta et al reported that opioid consumption was not affected by the type of shoulder surgery and instead was predicted by age, gender, and pain scores.[21] We do believe further research should be pursued to identify the average amount of opioids consumed by patients following shoulder procedures to give better evidence-based guidelines to providers.

There are several limitations to our study. First, there are inherent limitations of retrospective studies and biases associated with data collected at a single institution, including missing data or data not recorded in patient charts. Our study did not evaluate the quantity of opioids that were consumed by patients but instead focused on prescribing practices of the provider, so how these data apply to the actual MMEs consumed by patients cannot be

Table V
Total milligrams of morphine equivalents by surgical procedure group, unadjusted.

	Pre-NJ opioid laws (N, median) [IQR (25th-75th)]	Post-NJ opioid laws, pre-escripting (N, median) [IQR (25th-75th)]	Postescripting (N, median) [IQR (25th-75th)]	*P* value
Surgical Group #1- Arthroplasty (arthroplasty procedures)	124, 90 [99 (81-180)]	117, 90 [67.5 (90-157.5)]	121, 75 [60 (45-105)]	**<.001**
Surgical Group #2- Rotator Cuff (arthroscopic and open rotator cuff and bicep procedures)	472, 90 [75 (45-120)]	312, 90 [45 (90-135)]	332, 45 [45 (45-90)]	**<.001**
Surgical Group #3- Labrum (arthroscopic labral and SLAP repair)	159, 90 [60 (60-120)]	71, 90 [45 (45-90)]	65, 45 [60 (30-90)]	**<.001**
Surgical Group #4- Open Instability (open instability procedures)	41, 90 [35 (90-125)]	20, 90 [30 (90-120)]	23, 45 [70 (40-110)]	**.027**

IQR, interquartile range; *NJ*, New Jersey; *SLAP*, superior labrum, anterior to posterior.
Bold values indicate statistically significant values ($P < .05$).

Table VI
Total milligrams of morphine equivalents by surgical procedure group, pre-escripting vs. postescripting.

	Post-NJ opioid laws, pre-escripting (N, median) [IQR (25th-75th)]	Postescripting (N, median) [IQR (25th-75th)]	*P* value
Surgical Group #1- Arthroplasty (arthroplasty procedures)	117, 90 [67.5 (90-157.5)]	121, 75 [60 (45-105)]	**<.001**
Surgical Group #2- Rotator Cuff (arthroscopic and open rotator cuff and bicep procedures)	312, 90 [45 (90-135)]	332, 45 [45 (45-90)]	**<.001**
Surgical Group #3- Labrum (arthroscopic labral and SLAP repair)	71, 90.0 [45 (45-90)]	65, 45 [60 (30-90)]	**<.001**
Surgical Group #4- Open Instability (open instability procedures)	20, 90 [30 (90-120)]	23, 45 [70 (40-110)]	.090

IQR, interquartile range; *NJ*, New Jersey; *SLAP*, superior labrum, anterior to posterior.
Bold values indicate statistically significant values ($P < .05$).

concluded. This study is limited to our single institution and access to records of opioid prescriptions from providers outside of the hospital could not be obtained. Thus, our analysis only considers opioid prescriptions from our institutional providers. Providers are instructed to consult the New Jersey Prescription Monitoring Program and make prescribing decisions based on this information but reported total MMEs might not truly reflect total prescribed. Our goal was to determine patient access to opioids and understand changing physician prescribing behaviors. This study does not elucidate the specific reasons for the decrease in opioids prescribed. We understand that pain control following surgery is complex and opioid consumption is a multidimensional issue complicated by both patient and physician attitudes and biases. The study instead focused on the impact of electronic prescribing on opioid prescribing practices in the postoperative period. While e-scripting has been shown here to be a factor in decreasing the amount of narcotics prescribed, there may be other factors at play such as increasing awareness of both physicians and patients on then negative impacts of opioid use. Also, changes in regional anesthetic available for shoulder surgery did occur during this time frame with liposomal bupivacaine being approved for interscalene blocks in April 2018. While this has been used at our institution, it is anesthesia provider dependent and not all patients receive it in their blocks. This time point also occurred over a year prior to e-scripting and we still saw a significant decrease in MMEs prescribed, so we believe e-scripting did play a significant role in the trend we observed. However, it is difficult to fully elucidate the impact of e-scripting on opioid consumption alone.

Conclusion

Narcotic pain medications are a common modality for postoperative pain control following orthopedic surgeries. Awareness of the opioid epidemic has led to changes in the management of postoperative pain control. The development and implementation of electronic narcotic prescriptions have helped physicians to prescribe fewer amounts of narcotics during the postoperative period. Our institution's implementation of e-scripting was associated with a statistically significant decrease in the total MMEs prescribed. It is evident that the implementation of the e-scripting technology in conjunction with education and awareness on the national, institutional, provider, and patient levels has helped to limit the unnecessary consumption of opioid pain medications, thus minimizing the potential risk of chronic opioid use.

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Supplementary Data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.xrrt.2024.01.004.

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