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Clinical Studies

Utilizing previous patient opioid experiences for pain plan implementation: Role of opioid use categorization on inpatient and outpatient opioid use, length of stay, pain scores, and clinic resource utilization following elective spine surgery

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ABSTRACT

Background: A Pain Plan was formulated for all patients undergoing elective spine surgery at our institution. It was based on prior opioid experiences and developed collaboratively between the patient and the surgeon at a preoperative clinic visit. Category 1 patients had no previous opioid experience, Category 2 patients had remote previous opioid experience with acceptable pain control and no side effects, Category 3 patients had remote previous opioid experience with unacceptable pain control and/or side effects, and Category 4 patients had opioid use leading up to surgery.

Methods: This is a retrospective cohort study comparing adult patients within four different pain plan categories over one year (n = 313) to determine if categorization is predictive. Demographic data collected included age, gender, ASA class, BMI, smoking status, insurance status, substance abuse, and comorbid psychiatric diagnoses. Demographic factors between categories were compared and controlled for as covariates within analyses. Outcomes measures comprised self-reported pain scores and functional measurements, including inpatient opioid use, outpatient opioid prescription quantities, and postoperative healthcare utilization.

Results: Inpatient and outpatient opioid use were statistically significant amongst the categories, with prescription quantities greatest in Category 4, followed by Categories 2, 3, and 1, respectively. There was no difference in LOS or complexity of communication encounters amongst any of the groups. Patient-reported pain scores showed statistically significant differences and followed the same trend as opioid quantities, 4, 2, 3, and 1. The number of communication encounters was significant exclusively for Category 3 vs. 4.

Conclusions: The use of categorization in Pain Plan formation has been a helpful tool for postoperative pain management at our institution. Categorization is predictive of pain scores and opioid use after surgery, allowing the surgical team to tailor their care and counseling towards individual patients. In addition, the plan's collaborative nature enables patients to be involved in their pain management decisions while also setting limits and expectations.

Introduction

The opioid epidemic is a substantial healthcare and social challenge of the 21st century. Approximately 4% of the US population is addicted to opioids, and of the 70,200 overdose deaths in 2017, opioids accounted for 68% [1,2]. These trends have led to increased awareness and interest amongst legislators, regulators, and medical systems to reduce opioid consumption, which has prompted research. Therefore, over the past few years, extensive research on chronic opioid use and addiction has identified various patient-specific risk factors: sociodemographic

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characteristics, comorbid psychological conditions, history of substance abuse, and, most importantly, prior opioid exposure [3]. In addition, many studies have stratified findings based on surgical severity, suggesting surgical magnitude as an additional patient-specific factor [4,5]. Until recently, interventions to reduce opioid consumption have not fully harnessed this information. In 2019, Chaudhary and Schoenfeld developed a predictive modeling bedside assessment that utilized this data to determine the likelihood of sustained opioid use [6]. Moving forward, more predictive methodologies and interventions will be needed.

Two surgeons at our institution implemented a Pain Plan for all patients undergoing elective spine surgery. The Madison Pain Plan is formulated collaboratively between the patient and the surgical team during a clinic visit. It includes intraoperative, postoperative, and anticipated opioid and non-opioid discharge medications and is referenced throughout all care phases and modified as needed. The Pain Plan incorporates our institutions' multi-modality pharmacological approach to pain management that was previously established on the spine service several years prior; there were no changes to the medications available for postoperative pain control. The Pain Plan provides guidelines on the expected duration of postoperative opioid use and gives specific instructions for requesting refills. Given that prior opioid exposure is the most impactful risk factor for prolonged postoperative opioid use, patients were stratified based on their previous opioid history and experiences [7]. The purpose of this study is to analyze the utility of Pain Plan patient categorization by determining if it is predictive of inpatient opioid use, outpatient opioid prescription quantities, hospital length of stay (LOS), patient-reported pain scores for inpatients, and pain management-related clinic resource utilization.

Methods

Overview of existing pain management protocol and the Madison Pain Plan

The spine service at our institution implemented a standardized multi-modality pain management protocol in 2014. Non-steroidal anti-inflammatory medications (NSAIDs) are used during hospitalization in all patients without a contraindication. They are continued as an outpatient for two weeks unless a fusion is performed, in which case they are only used during hospitalization. Corticosteroids are almost always used intraoperatively for a 24-hour period, the only exceptions being allergies or diabetes that is difficult to control. Gabapentin is optionally used if patients are already on the medication or have had a favorable past experience or if a patient is undergoing a large magnitude surgery such as a multi-level fusion. Oral opioids, usually oxycodone, and intravenous opioids, usually hydromorphone, are available for use as needed, as is a muscle relaxant. Acetaminophen is administered on a scheduled basis and continued for two weeks postoperatively.

The Madison Pain Plan maintained this same multi-modality pharmacologic approach; there were no changes in the medications used for pain management after surgery. The main change implemented by the Pain Plan was the in-depth discussion with patients regarding prior opioid use and associated collaborative decision on what opioid regimen to use postoperatively and clear and concise documentation of Pain Plan specifics. Additionally, the discussion included each medication available postoperatively, projections for expected postoperative opioid duration based on the magnitude of the surgery, and specific instructions for requesting opioid or other medication refills during standard clinic hours.

Three different Pain Plan templates were created, one each for outpatient surgeries, inpatient surgeries without fusion, and inpatient surgeries with fusion (all fusion procedures were performed on an inpatient basis during the study period). The details of Pain Plan formulation are described in detail by Rozenfeld et al. [17]. The outpatient surgery template differed from the inpatient templates only in the lack of a list of inpatient medications. The two inpatient templates, fusion, and no fusion, differed only in NSAID use upon discharge, which were not prescribed for fusion patients. The templates were built by the senior author using "smartphrases" and "smart lists" in the electronic medical record (EMR – Epic, Verona, WI), thereby producing a standardized but customizable document for each patient. Residents and fellows received training on choosing the proper template and how to build the Pain Plan in collaboration with the patient. The Pain Plan is typically completed by the resident, fellow, or attending in the clinic when surgery is indicated. Pain Plan formulation takes on average 3 min for patients not on opioids preoperatively and 5 min for patients on opioids preoperatively [17].

All surgical patients undergo a separate History and Physical visit with a spine APP prior to surgery, and the Pain Plan is discussed at that visit, and modified if appropriate. On rare occasions when the Pain Plan was not built during the clinic visit with the surgeon, the APP formulates the plan with the patient at the History and Physical visit. The completed Pain Plan is a single-page document that is then printed for the patient to reference and is included in all physician documentation, including the preoperative history and physical, the brief operative note, and all daily progress notes for hospitalized patients. Because the outpatient and inpatient EMR are the same system, this allows for easy reference by all providers, including APP's, physicians, nurses, and pharmacists. Residents, fellows, and/or APPs refer to the Pain Plan when writing postoperative orders, including discharge prescriptions.

Patient categorization

Patients were categorized based on their reported previous opioid experiences as follows (see Fig. 1 for categorization schema; see Figs. 2-5 for Pain Plan examples for each category):

Category 1 – No prior history of opioid exposure
Category 2 – Remote prior opioid exposure with adequate pain control and no significant adverse side effects
Category 3 – Remote prior opioid exposure with inadequate pain control and/or significant adverse side effects
Category 4 – Opioid use leading up to the index procedure

cRemote use was defined as no active opioid prescription prior to surgery. Categories 1 and 4 were simple to identify via objective measures. Determination of Category 2 versus 3 was more subjective in nature. Many patients with previous opioid experience report some adverse effects; if these effects were significant to the point that they warranted a detailed discussion about alternative opioids and/or side effect mitigation measures, then they would be considered a Category 3. If they had side effects but they were tolerable to the extent that they would be comfortable using the same opioid as prior, then a more nuanced discussion is not required, and they would be considered a Category 2. The rationale for categorizing patients was two-fold. Firstly, it was the senior author's experience that patients who were on opioids leading up to the time of surgery (Category 4), and patients who previously did not experience pain relief with certain opioids or experienced adverse reactions (Category 3), required substantially more time and effort for postoperative pain management. Secondly, to create standardized but customizable Pain Plan templates, branching logic via Epic "SmartPhrases" and "SmartLists" required more steps for Category 3 and 4 patients to document their opioid use and history and specifically list any adverse reactions. We prefer to record any adverse reactions and patient preferences, especially in Category 3 and 4 patients, as it helps resolve pain management problems postoperatively. The Pain Plan serves as a point of reference for all pain management issues.

Inclusion criteria and data collection

Two surgeons at our institution implemented the Pain Plan on May 1, 2019, for all patients undergoing elective spine surgery. A retrospective cohort study was conducted comparing patients within the four Pain

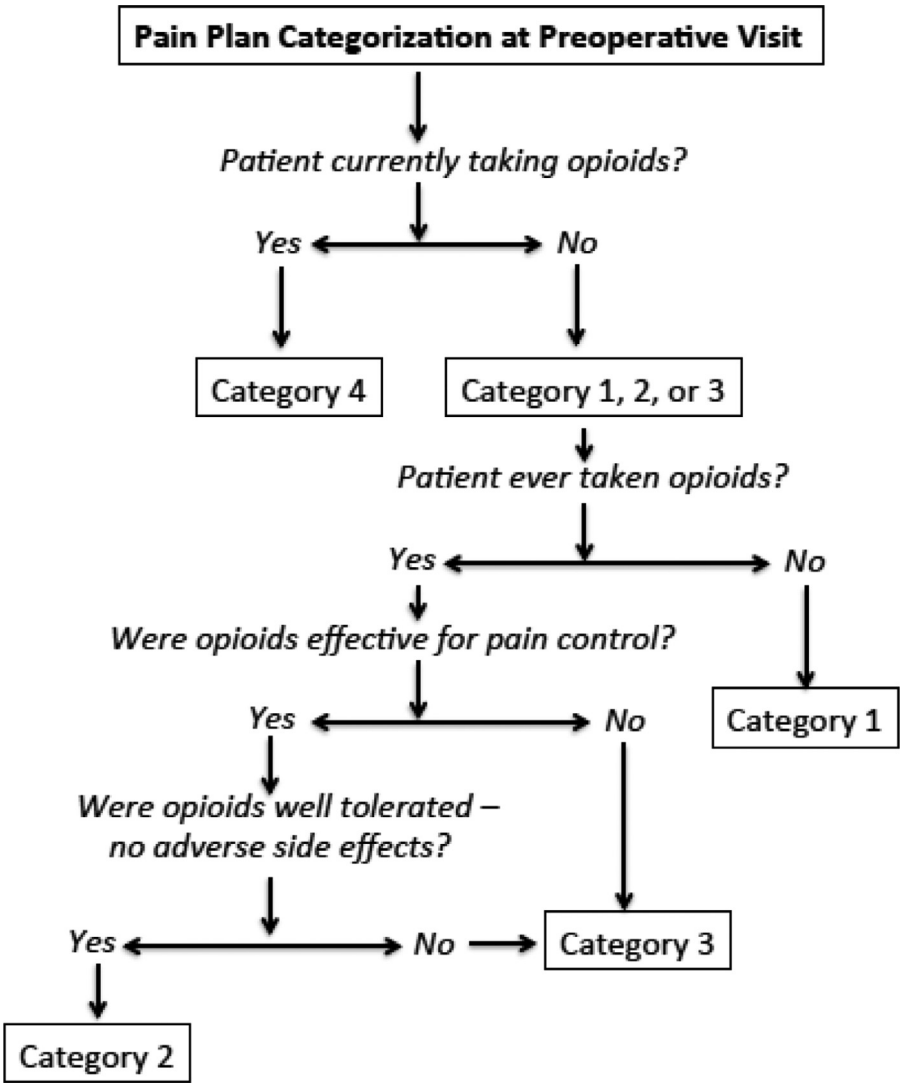

Fig. 1. Pain plan flow diagram. This schematic illustrates the patient categorization process based on prior opioid experiences.

Plan categories over a one-year period, from May 1, 2019, to April 30, 2020 (n = 319). Institutional Review Board approval with an exemption was obtained (study #2019–1549-CP002). Data was collected for all adult patients age 18 and older undergoing elective spine surgery during the one year study period. Demographic data collected included age, gender, American Society of Anesthesiologists (ASA) class, body mass index (BMI), smoking status, insurance details, history of alcohol or substance abuse, and psychiatric illnesses including depression and anxiety. Exclusion criteria included incarceration, death within 90 days of the index procedure, and patients undergoing surgery due to trauma, infection, or oncologic lesions. No patients were lost to follow-up.

Data was extracted from the electronic medical record, which included access to all major healthcare organizations in Wisconsin via an established data-sharing agreement. Pharmacists tabulated inpatient opioid use and outpatient opioid prescription quantities for 90-days postoperatively and converted all values to morphine milliequivalents (MME) using Center for Disease Control guidelines [16]. MME's were used to allow for adequate comparison given the variety of different opioids prescribed.

Outcome measures and statistical analysis

Surgical invasiveness (SI) indices were calculated for each surgery using a previously validated method [15]. Additional information collected included inpatient patient-reported numerical (1–10) NRS pain scores and LOS. Postoperative pain management-related telephone encounters and electronic messages were tabulated for 90-days post operatively and assessed for complexity using the number of "steps" required for encounter resolution as an objective measure. Clinic nurses, advanced practice providers (APP's), and surgeons document all patient-related communications in the EMR as standard practice. A "step" consisted of any pain management-related communication between the surgical team and the patient. For example, if a patient called the clinic and spoke with a nurse about a pain management question, and the nurse needed to pass the query on to an APP or surgeon for a response, this would be considered 2 "steps" to complete a single encounter. Complexity results are reported as the average number of steps per encounter over the 90-day period.

Outcome measures included inpatient opioid use, outpatient opioid prescription quantities, LOS, patient-reported pain scores during hospitalization, number of communication encounters, and communication encounter complexity determined by the number of steps to complete an encounter. Pain scores (0–10) were recorded by nurses as part of standard postoperative care. These scores are collected at regular intervals. Demographic factors and surgical invasiveness indices were compared amongst the four categories via ANOVA, Mann-Whitney U, or Chi-square tests to assess for underlying group differences. Differences between categories in patient age, surgeon, and surgical invasiveness were statisti-

POSTOPERATIVE PAIN PLAN – Patient: Mr. Laminoplasty (Category 1)

Mr. Laminoplasty's opioid history:
None

What medications (include doses and schedule) for pain has Mr. Laminoplasty been taking recently?
None

Postoperative Pain Plan:
In the operating room:
1. No Toradol - contraindicated due to age > 65 and history of diabetes
2. Decadron 4 mg IV

During hospitalization:
1. Tylenol (acetaminophen) 1,000 mg orally 3 times daily scheduled
2. No Toradol - contraindicated due to age > 65 and history of diabetes
3. No NSAID's - contraindicated due to history of diabetes
4. Oral opioid for pain: Oxycodone 5 mg orally every 4 hours as needed
   - If pain control inadequate, may increase to 5 – 10 mg orally every 4 hours as needed
5. IV opioid for breakthrough pain: Dilaudid 0.1 - 0.2 mg IV Q2 hours prn (as needed) for breakthrough pain
6. Decadron 4 mg IV x 3 doses scheduled (hold if blood glucose control is suboptimal)
7. Flexeril 5-10 mg orally prn (as needed) 3 times daily
8. Gabapentin – not scheduled, consider implementation if he is having difficulties with pain control

For discharge from hospital (anticipated, may be changed if needed):
1. Tylenol (acetaminophen) 1,000 mg 3 times daily scheduled x 2 weeks, then taper
   - If you are taking other medications that contain Tylenol (acetaminophen), such as hydrocodone, make sure to adjust your Tylenol (acetaminophen) dose to keep total daily dose below 3000 mg.
2. Oral opioid for breakthrough pain: Oxycodone 5 mg tabs #42 (consider refill to be Ultram if needed)
3. Flexeril 5-10 mg po prn TID #20 (if used in the hospital)
4. Gabapentin – only if started in the hospital

Refill Requests
Please allow at least 2 full days for refill requests. For example, if you expect to run out of pain medications on a Thursday, please call the clinic by Tuesday morning to request a refill. The clinic is open from 8 am to 5 pm, Monday - Friday. Please do not call after hours, as refills will not be provided after hours or on weekends.

Generally speaking, we do not expect you to require opioid medications beyond 1-2 weeks, depending on the surgery. Our hope is that these medications are not needed beyond that time. However, if these medications were used preoperatively, and you feel you will need to continue taking them, we ask you to please make arrangements with the previously prescribing provider to resume management of opioids if use is ongoing. We generally do not prescribe opioids beyond 6 weeks postoperatively.

We discussed this plan in detail in the clinic, and Mr. Laminoplasty was in agreement. This Pain Plan will be copied into the preoperative History and Physical performed in the Spine Clinic prior to surgery, as well as the Discharge Summary to facilitate communication.

Fig. 2. Example of Category 1 Patient Pain Plan- Mr. Laminoplasty. Pain Plan appearance within the EMR and in print for the patient.

cally significant and were included as covariates in modeling differences in outcomes between the categories. Group data were summarized by mean (SD), median (interquartile range or IQR), or N (%) when appropriate. ANOVA models with covariates were fit to test for differences between groups. Log-transformation was used to ensure model assumptions were met for LOS, inpatient opioid use, and outpatient opioid prescription quantities. For the number of encounters, a Poisson regression fit was used. Post-hoc two-way comparisons with Holm adjustment were examined for those outcomes with a significant ANOVA p-value. A biostatistician conducted all analyses at a 5% significance level using R for statistical computing version 3.5 (The R Foundation, Vienna, Austria).

Results

During the study period, 486 patients underwent spine surgery, of which 313 met the inclusion criteria of undergoing elective spine surgery. Demographic data is reported in Table 1. The mean age (SD) difference was statistically significant between Category 1 and Category 3 patients ($p = 0.012$). One surgeon performed more surgeries ($p < 0.001$), and surgical invasiveness approached statistical significance ($p = 0.051$). All other demographic data was similar and statistically insignificant amongst categories. A regression model was used to control for the differences including age, surgeon, and surgical invasiveness as they could be confounding variables. Table 2 lists adjusted results.

POSTOPERATIVE PAIN PLAN – Patient: Mr. Corpectomy (Category 2)

Mr. Corpectomy's opioid history:
Previously took hydrocodone after shoulder surgery, and pain control was effective, no significant side effects. Oxycodone was also used for a short period in the hospital and was effective and well tolerated. In addition, he previously took gabapentin, which helped with nerve pain, and he would like to go back on gabapentin after surgery to help with pain control.

What medications (include doses and schedule) for pain has Mr. Fusion been taking recently?
Tylenol 2-3 times per day, occasionally takes a muscle relaxant.

Postoperative Pain Plan:
In the operating room:
1. No Toradol - contraindicated due to age > 65 and history of renal disease and GI bleed
2. Decadron 4 mg IV

During hospitalization:
1. Tylenol (acetaminophen) 1,000 mg orally 3 times daily scheduled
2. No Toradol - contraindicated due to age > 65 and history of renal disease and GI bleed
3. No NSAID's - contraindicated due to history of renal disease and GI bleed
4. Oral opioid for pain: Oxycodone 5 mg orally every 4 hours as needed
   - If pain control inadequate, may increase to 5 – 10 mg orally every 4 hours as needed
5. IV opioid for breakthrough pain: Dilaudid 0.1 - 0.2 mg IV Q2 hours prn (as needed) for breakthrough pain
6. Decadron 4 mg IV x 3 doses scheduled
7. Flexeril 5-10 mg orally prn (as needed) 3 times daily
8. Gabapentin 100 mg orally 2 times daily scheduled POD #1, then 100 mg orally 3 times daily scheduled starting POD #2.; may increase if needed.

For discharge from hospital (anticipated, may be changed if needed):
1. Tylenol (acetaminophen) 1,000 mg 3 times daily scheduled x 2 weeks, then taper
   - If you are taking other medications that contain Tylenol (acetaminophen), such as hydrocodone, make sure to adjust your Tylenol (acetaminophen) dose to keep total daily dose below 3000 mg.
2. Oral opioid for breakthrough pain: Oxycodone 5 mg tabs #42 (consider refill to be hydrocodone if needed)
3. Flexeril 5-10 mg po prn TID #20 (if used in the hospital)
4. Gabapentin taper: 100 mg orally 3 times daily x 1 week, then 100 mg orally 2 times daily x 1 week, then 100 mg orally daily x 1 week, and then discontinue
   - Taper may be modified depending on pain control needs

Refill Requests
Please allow at least 2 full days for refill requests. For example, if you expect to run out of pain medications on a Thursday, please call the clinic by Tuesday morning to request a refill. The clinic is open from 8 am to 5 pm, Monday - Friday. Please do not call after hours, as refills will not be provided after hours or on weekends.

Generally speaking, we do not expect you to require opioid medications beyond 1-2 weeks, depending on the surgery. Our hope is that these medications are not needed beyond that time. However, if these medications were used preoperatively, and you feel you will need to continue taking them, we ask you to please make arrangements with the previously prescribing provider to resume management of opioids if use is ongoing. We generally do not prescribe opioids beyond 6 weeks postoperatively.

We discussed this plan in detail in the clinic, and Mr. Corpectomy was in agreement. This Pain Plan will be copied into the preoperative History and Physical performed in the Spine Clinic prior to surgery, as well as the Discharge Summary to facilitate communication.

Fig. 3. Example of Category 2 Patient Pain Plan- Mr. Corpectomy. Pain Plan appearance within the EMR and in print for the patient.

There was no statistically significant difference in hospital LOS amongst the categories. The greatest inpatient opioid use was observed within Category 4 with a median total of 35.8 MME, followed by Categories 2 (20.0 MME), 3 (15.5 MME), and 1 (7.5 MME) (Table 2). Outpatient opioid prescription quantities followed a similar trend. Category 4 showed significantly larger outpatient opioid prescription quantities with a median total of 630.0 MME, more than double the quantity compared to the next highest group, Category 2, with 240.0 MME. Inpatient opioid use showed statistical significance for multiple comparisons, including Categories 1 versus 2, 1 versus 4, and 3 versus 4. Outpatient

POSTOPERATIVE PAIN PLAN – Patient: Mrs. Diskectomy (Category 3)

Mrs. Diskectomy's opioid history:
Previously took oxycodone and Vicodin, and pain control was effective with both, but she had constipation and nausea with both, and prefers not to take these medications.

What medications (include doses and schedule) for pain has Mrs. Diskectomy been taking recently?
Gabapentin 300 mg po TID, Tylenol as needed, occasional ibuprofen

Postoperative Pain Plan:
In the operating room:
1. Toradol 15 mg IV upon wound closure
2. Decadron 4 mg IV

During hospitalization:
1. Tylenol (acetaminophen) 1,000 mg orally 3 times daily scheduled
2. Toradol 15 mg IV x 3 doses
3. Ibuprofen 600 mg orally 3 times daily scheduled starting POD #2 (once Toradol finished)
4. Oral opioid for pain: Ultram 50-100 mg orally every 4 hours as needed
   - If Ultram is ineffective, she prefers to use hydrocodone rather than oxycodone
5. IV opioid for breakthrough pain: Dilaudid 0.1 - 0.2 mg IV Q2 hours prn (as needed) for breakthrough pain
6. Decadron 4 mg IV x 3 doses scheduled
7. Flexeril 5-10 mg orally prn (as needed) 3 times daily
8. Gabapentin 300 mg orally 3 times daily scheduled

For discharge from hospital (anticipated, may be changed if needed):
1. Tylenol (acetaminophen) 1,000 mg 3 times daily scheduled x 2 weeks, then taper
   - If you are taking other medications that contain Tylenol (acetaminophen), such as hydrocodone, make sure to adjust your Tylenol (acetaminophen) dose to keep total daily dose below 3000 mg.
2. Ibuprofen 600 mg 3 times daily x 2 weeks, then taper as desired
3. Oral opioid for breakthrough pain: Ultram 50 mg tabs #30
4. Flexeril 5-10 mg po prn TID #20 (if used in the hospital)
5. Gabapentin taper: 300 mg orally 3 times daily x 1 week, then 300 mg orally 2 times daily x 1 week, then 300 mg orally daily x 1 week, and then discontinue
   - Taper may be modified depending on pain control needs

Refill Requests
Please allow at least 2 full days for refill requests. For example, if you expect to run out of pain medications on a Thursday, please call the clinic by Tuesday morning to request a refill. The clinic is open from 8 am to 5 pm, Monday - Friday. Please do not call after hours, as refills will not be provided after hours or on weekends.

Generally speaking, we do not expect you to require opioid medications beyond 1-2 weeks, depending on the surgery. Our hope is that these medications are not needed beyond that time. However, if these medications were used preoperatively, and you feel you will need to continue taking them, we ask you to please make arrangements with the previously prescribing provider to resume management of opioids if use is ongoing. We generally do not prescribe opioids beyond 6 weeks postoperatively.

We discussed this plan in detail in the clinic, and Mrs. Diskectomy was in agreement. This Pain Plan will be copied into the preoperative History and Physical performed in the Spine Clinic prior to surgery, as well as the Discharge Summary to facilitate communication.

Fig. 4. Example of Category 3 Patient Pain Plan- Mrs. Diskectomy. Pain Plan appearance within the EMR and in print for the patient.

opioid prescription quantities showed statistically significant differences for Categories 2 versus 4, 1 versus 4, and 3 versus 4.

Patient-reported pain scores followed the same pattern as inpatient opioid use, with the highest pain scores reported by patients in Category 4 (4.9), followed by Category 2 (4.0), Category 3 (3.9), and Category 1 (3.2). The number of pain-related communication encounters showed a statistically significant difference for Category 3 versus 4. There was no statistically significant difference in the complexity of the pain-related communication encounters amongst any comparison.

Discussion and conclusion

The Pain Plan was implemented to collaboratively address pain management with patients to minimize opioid consumption without compromising pain control after surgery, and to improve the pain management process for patients and providers. The Pain Plan is individualized based upon prior patient opioid exposure and takes just a few minutes to formulate with the patient in clinic. Categorizing patients based on prior opioid exposure helps guide the discussion and is necessary when

POSTOPERATIVE PAIN PLAN – Patient: Mrs. Osteotomy (Category 4)

Mrs. Diskectomy's opioid history:
Currently taking oxycontin 15 mg po BID (in the past, she has been on doses up to 30 mg TID, but has bee stable at current doses) – prescribed by PCP. In the past, oxycodone has been helpful for pain control and is well tolerated.

What medications (include doses and schedule) for pain has Mrs. Diskectomy been taking recently?
Oxycontin 15 mg po BID, Gabapentin 300 mg po TID, Tylenol as needed, occasional ibuprofen

Postoperative Pain Plan:
In the operating room:
1. Toradol 15 mg IV upon wound closure
2. Decadron 4 mg IV

During hospitalization:
1. Tylenol (acetaminophen) 1,000 mg orally 3 times daily scheduled
2. Toradol 15 mg IV x 3 doses
3. Ibuprofen 600 mg orally 3 times daily scheduled starting POD #2 (once Toradol finished)
4. Oral opioid for pain: Oxycontin 15 mg po 3 times daily (slight increase from preoperative 2 times daily); and oxycodone 5-10 mg po every 4 hours as needed for breakthrough pain.
5. IV opioid for breakthrough pain: Dilaudid 0.1 - 0.2 mg IV Q2 hours prn (as needed) for breakthrough pain
6. Decadron 4 mg IV x 3 doses scheduled
7. Flexeril 5-10 mg orally prn (as needed) 3 times daily
8. Gabapentin 300 mg orally 3 times daily scheduled

For discharge from hospital (anticipated, may be changed if needed):
1. Tylenol (acetaminophen) 1,000 mg 3 times daily scheduled x 2 weeks, then taper
   - If you are taking other medications that contain Tylenol (acetaminophen), such as hydrocodone, make sure to adjust your Tylenol (acetaminophen) dose to keep total daily dose below 3000 mg.
2. Ibuprofen 600 mg 3 times daily x 2 weeks, then taper as desired
3. Oral opioid: Oxycontin 15 mg po TID x 1 week, then 15 mg po BID x 1 week, then 15 mg po daily x 1 week, then discontinue (#42). If further Oxycontin prescriptions are desired, those would need to be from her PCP. In addition, oxycodone 5 mg tabs 1-2 po every 4 hours as needed (#50)
4. Flexeril 5-10 mg po prn TID #20 (if used in the hospital)
5. Gabapentin taper: 300 mg orally 3 times daily x 1 week, then 300 mg orally 2 times daily x 1 week, then 300 mg orally daily x 1 week, and then discontinue
   - Taper may be modified depending on pain control needs

Refill Requests
Please allow at least 2 full days for refill requests. For example, if you expect to run out of pain medications on a Thursday, please call the clinic by Tuesday morning to request a refill. The clinic is open from 8 am to 5 pm, Monday - Friday. Please do not call after hours, as refills will not be provided after hours or on weekends.

Generally speaking, we do not expect you to require opioid medications beyond 1-2 weeks, depending on the surgery. Our hope is that these medications are not needed beyond that time. However, if these medications were used preoperatively, and you feel you will need to continue taking them, we ask you to please make arrangements with the previously prescribing provider to resume management of opioids if use is ongoing. We generally do not prescribe opioids beyond 6 weeks postoperatively.

We discussed this plan in detail in the clinic, and Mrs. Diskectomy was in agreement. This Pain Plan will be copied into the preoperative History and Physical performed in the Spine Clinic prior to surgery, as well as the Discharge Summary to facilitate communication.

Fig. 5. Example of Category 4 Patient Pain Plan- Mrs. Osteotomy. Pain Plan appearance within the EMR and in print for the patient.

using an electronic medical record to populate the appropriate documentation fields while the Pain Plan is built. In addition, categorization facilitates research with respect to pain management (opioid use in particular), because the patient population is quite heterogenous. Patients receive a printed copy of their individualized Pain Plan for review and future reference. The plan is then referenced throughout all phases of care during the perioperative period. It is flexible and may be modified as needed.

Based on the attending spine surgeons' prior experience, we expected patients with either no previous opioid exposure (Category 1) or a his-

Table 1
Demographics.

Characteristic	Category 1 (n = 52)	Category 2 (n = 126)	Category 3 (n = 48)	Category 4 (n = 87)	p-value
Age (No. [%])	50.0 (18.9)	54.6 (15.0)	59.9 (16.3)	57.0 (14.6)	0.012[B]
Female (No. [%])	18 (34.6%)	55 (43.7%)	22 (45.8%)	42 (48.3%)	0.462
BMI No. (No. [%])	28.8 (5.0)	30.1 (5.4)	29.2 (5.5)	30.3 (5.4)	0.301
ASA Class (No. [%])					0.012[A]
1	12 (23.1%)	12 (9.5%)	2 (4.2%)	6 (6.9%)	
2	34 (65.4%)	77 (61.1%)	35 (72.9%)	63 (72.4%)	
3–4	6 (11.5%)	37 (29.4%)	11 (22.9%)	18 (20.7%)	
Anxiety (No. [%])	5 (9.6%)	28 (22.2%)	10 (20.8%)	25 (28.7%)	0.071
Depression (No. [%])	8 (15.4%)	30 (23.8%)	14 (29.2%)	29 (33.3%)	0.109
Alcohol or Drug Abuse (No. [%])	2 (3.8%)	14 (11.1%)	3 (6.2%)	14 (16.1%)	0.098
Surgeon (No. [%])					0.001
1	19 (36.5%)	81 (64.3%)	34 (70.8%)	57 (65.5%)	
2	33 (63.5%)	45 (35.7%)	14 (29.2%)	30 (34.5%)	
Surgical Invasiveness (median [IQR])	1.5 (1.0 - 5.0)	3.5 (2.0 - 9.0)	2.0 (1.0 - 7.2)	3.0 (1.0 - 9.0)	0.051

The following superscripts indicate significant Holm adjusted two-way comparisons:
A = Category 1 vs 2, B = Category 1 vs 3, C = Category 1 vs 4, D = Category 2 vs 3, E = Category 2 vs 4, F = Category 3 vs 4.

Table 2
Opioid use, patient pain scores, and communication encounters by category.

Variable	Category 1 (n = 52)	Category 2 (n = 126)	Category 3 (n = 48)	Category 4 (n = 87)	p-value
LOS (hrs.)	8.6 (6.3 - 30.5)	29.8 (7.6 - 33.3)	30.5 (20.8 - 34.8)	30.1 (8.8 - 51.6)	0.262
Inpatient Opioids (MME)	7.5 (0.0 - 21.4)	20.0 (7.5 - 56.0)	15.5 (4.0 - 48.0)	35.8 (13.2 - 92.2)	< 0.001[ACF]
Outpatient Opioids (MME)	147.5 (100.0 - 300.0)	240.0 (150.0 - 600.0)	217.5 (150.0 - 320.2)	630.0 (257.5 - 1630.2)	< 0.001[CEF]
Pain Score (1–10)	3.1 (2.1)	4.1 (2.1)	3.8 (2.2)	5.0 (2.2)	< 0.001[CEF]
Communication Encounters	0.0 (0.0 - 1.0)	1.0 (0.0 - 2.0)	0.0 (0.0 - 1.2)	1.0 (0.0 - 3.0)	0.006[F]
Average Steps per Encounter	2.9 (1.5)	2.7 (1.3)	2.6 (0.9)	3.1 (1.2)	0.48

The following superscripts indicate significant Holm adjusted two-way comparisons:
A = Category 1 vs 2, B = Category 1 vs 3, C = Category 1 vs 4, D = Category 2 vs 3, E = Category 2 vs 4, F = Category 3 vs 4.
Results reported as mean (standard deviation) or median (interquartile range).
MME= Morphine Milligram Equivalents.

tory of opioid use after surgery with adequate pain control and no significant side effects (Category 2) to have the most straightforward Pain Plans and the least amount of opioid use postoperatively. Conversely, we anticipated spending more time and effort and having more difficulty with postoperative pain control in patients who previously had poor pain control or adverse reactions to opioids (Category 3), or especially in those actively taking opioids in the preoperative period (Category 4). Our expectations were confirmed for Category 1 and 4 patients. However, Category 3 patients used fewer inpatient opioids, had lower outpatient opioid prescription quantities, and reported lower pain scores than Category 2 patients.

We propose four possible reasons for these findings. First, Category 3 and 4 patients required substantially more time and effort to formulate the Pain Plan. We believe that this extra effort is partially responsible for Category 3 patients showing pain management characteristics similar to Category 1 patients. Another possibility is related to the observation that some patients try to avoid opioids as much as possible postoperatively because of previously experienced adverse reactions (which are subjective and vary from patient to patient). These patients are typically placed into Category 3. It, therefore, makes sense that these particular Category 3 patients would use fewer opioids. Still, it does not fully explain the difference in reported pain control, with category 3 patients reporting lower pain scores than category 2. Additionally, Category 3 patients with prior unfavorable opioid experiences may have a learned regimen that works for them based on trial and error; this successful regimen is readily carried forward via the Pain Plan. We did not subcategorize patients placed into Category 3 by a) poor pain management with prior opioid use versus b) acceptable pain management but with and adverse reaction with prior opioid use. We have now added this subcategorization to the Pain Plan. Finally, it is possible that some Category 2 patients with prior favorable opioid histories may tend towards increased opioid use because they tolerate the medications well and therefore may not be inclined to discontinue use.

We now believe that patients in Category 2 should have a more guided discussion based on whether their previous favorable experience resulted in short-term opioid use (2–3 weeks or less), intermediate-term use (1–3 months), or chronic use (greater than 3 months). This would help build expectations for everyone involved and would potentially allow for more detailed counseling for patients with a history of chronic opioid therapy in order to prevent another episode of long-term opioid use.

As expected, Category 4 patients reported higher pain scores and used more opioids than any other category. However, there was no difference in hospital length of stay, which we feel is also at least partially attributable to the Pain Plan. When encouraging Category 4 patients to wean off opioids as much as possible before surgery, we explain that postoperative pain management is more successful in patients without active preoperative opioid use. Category 4 patients tend to have a broader breadth of experience with opioids. When they participate in Pain Plan formulation, they agree to specific medications that have worked for them in the past. We feel that this decreases effort spent on pain management assessment and medication changes in the postoperative period, which seem to occur more commonly in patients with preoperative opioid use. We postulate that the expectations built into the Pain Plan helped the patients focus on their immediate recovery rather than pain management details.

Our findings build on Schoenfeld and others' research, which similarly highlight prior opioid exposure as a significant predictor of postoperative use [3,8]. Previous studies, including Ramos' work, which analyzed over 1.8 million spine surgery patients, illustrate the strong correlation between chronic preoperative opioid use and prolonged length of stay [9–11]. Our findings are further substantiated by Mariano and Austin's previous works, which also illustrate the powerful effect of counseling and patient engagement on reducing opioid use [12,13]. These referenced studies played a critical role in identifying risk factors for prolonged opioid use, and we sought to apply this knowledge

to our Pain Plan intervention as the next step in addressing the opioid epidemic. Our efforts to preemptively address pain management and thereby modify postoperative opioid use were successful and will be reported in a separate manuscript.

One limitation of this study is the use of opioid prescription data rather than actual opioid consumption, which may not accurately reflect opioid quantities consumed by patients. This limitation is commonly encountered during opioid research. In addition, Wisconsin state law prohibits using the state prescription drug monitoring program (PDMP) for research purposes with identified data. Therefore, we utilized the EMR, which included access to all the foremost healthcare organizations across Wisconsin. However, some opioid prescriptions were likely missed, although this would be true across all categories.

In conclusion, Madison Pain Plan implementation, particularly the use of categories when developing the plan, has proven to be a valuable tool for postoperative pain management at our institution. Nurses, orthopedic surgery residents, fellows, attendings, and APPs actively engage in the Pain Plan process because they have noticed a substantial improvement in pain management encounters with patients when the Pain Plan is referenced [17]. We feel that the Pain Plan formulation process empowers patients to be involved in pain management decision-making and sets expectations and limits. In addition, categorization is predictive of postoperative opioid use and pain scores, which can help physicians and healthcare staff tailor their counseling to individual patients. Even if a formal Pain Plan is not implemented, the categorization concept can help guide a discussion about postoperative pain management. In the future, the Pain Plan may be improved by adding more patient-specific factors to the categorization schema as identified by Schoenfeld's Stop Opioids after Surgery Score to help healthcare staff further individualize their counseling for patients [14]. Future research efforts will involve subcategorizing category 2 patients to stratify duration of prior opioid use in an effort to identify patients prone to long-term opioid use; and by subcategorizing category 3 patients by poor pain management versus adverse reactions, and tailoring education, counseling, and Pain Plan formulation accordingly.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Supplementary materials

Supplementary material associated with this article can be found in the online version at doi:10.1016/j.xnsj.2022.100139.

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