

Opioid use among veterans undergoing major joint surgery managed by a multidisciplinary transitional pain service

Michael J Buys ^{1,2}, Kimberlee Bayless,² Jennifer Romesser,³ Zachary Anderson,² Shardool Patel,² Chong Zhang,⁴ Angela P Presson,⁴ Benjamin S Brooke^{5,6}

¹Department of Anesthesiology, University of Utah, Salt Lake City, Utah, USA

²Anesthesiology, VA Salt Lake City Health Care System, Salt Lake City, Utah, USA

³Psychology, VA Salt Lake City Health Care System Mental Health Services, Salt Lake City, Utah, USA

⁴Internal Medicine-Epidemiology, University of Utah Health Sciences Center, Salt Lake City, Utah, USA

⁵Surgery, University of Utah School of Medicine, Salt Lake City, Utah, USA

⁶Surgery, VA Salt Lake City Health Care System, Salt Lake City, Utah, USA

Correspondence to

Dr Michael J Buys, Department of Anesthesiology, University of Utah, Park City, UT 84098, USA; michael.buys@hsc.utah.edu

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ABSTRACT

Background Chronic postsurgical pain and opioid use is a problem among patients undergoing many types of surgical procedures. A multidisciplinary approach to perioperative pain management known as a transitional pain service (TPS) may lower these risks.

Methods This retrospective cohort study was conducted at the Salt Lake City VA Medical Center to compare patients undergoing elective primary or revision total knee, hip, or shoulder replacement or rotator cuff repair in the year before (2017) and after (2018) implementation of a TPS. The primary outcome is the proportion of patients taking opioids 90 days after surgery. Secondary outcomes include new chronic opioid use (COU) after surgery as well as the proportion of previous chronic opioid users who stopped or decreased opioid use after surgery.

Results At 90 days after surgery, patients enrolled in TPS were significantly less likely to be taking opioids (13.4% TPS vs 27.3% pre-TPS; $p=0.002$). This relationship remained statistically significant in a multivariable logistic regression analysis, where the TPS group had 69% lower odds of postoperative COU compared with the preintervention group (OR: 0.31; 95% CI: 0.14 to 0.66; $p=0.03$). Opioid-naïve patients enrolled in TPS were less likely to have new COU after surgery (0.7% TPS vs 8.4% pre-TPS; $p=0.004$). Further, patients enrolled in TPS with existing COU prior to surgery were more likely to reduce or completely stop opioid use after surgery (67.5% TPS vs 45.3% pre-TPS; $p=0.037$) as compared with pre-TPS.

Conclusions These data suggest that a TPS is an effective strategy for preventing new COU and reducing overall opioid use following orthopedic joint procedures in a Veterans Affairs hospital.

INTRODUCTION

Despite many advances over the past decade, perioperative pain management strategies continue to be inadequate for a high percentage of surgical patients. Ranges from 10% to 49% have been reported for patients experiencing chronic postsurgical pain (CPSP),^{1–5} which is defined generally as pain in the surgical area that lasts beyond the expected time frame of surgical healing. Analgesic therapies are often only marginally effective, and/or have significant deleterious effects associated with them. Consequently, as many as 14% of previously

opioid-naïve patients go on to develop chronic opioid use (COU) after surgery.^{6–13}

Historically, perioperative pain management has fallen primarily under the direction of the surgical team whereby pain management is discussed briefly with the patient, but typically without any standardized education or coordination with primary care providers after surgery. When patients have ongoing surgical pain beyond the normal follow-up period, primary care and emergency room providers are frequently tasked with deciding whether to continue opioids and other pain medications. Together, these factors can lead to fragmentation of perioperative pain management and inappropriate continuation of opioid medications.

One solution to address fragmentation of perioperative pain management is to deliver opioid education, risk modification, cognitive behavioral therapy, and prescribing recommendations by a single transitional pain service (TPS). This type of multidisciplinary pain approach has been previously described, although other TPS programs have not been designed to engage surgical patients beginning in the preoperative period.^{14–16} In 2018, we designed and implemented a novel TPS at the Salt Lake City VA Medical Center that engages at-risk patients starting in the preoperative period and follows them until up to 6 months after surgery. The goals of this TPS are to (1) reduce pain suffering through education, risk modification, cognitive interventions, and optimization of pharmacologic and non-pharmacologic therapy; (2) eliminate the development of new COU after surgery; and (3) assist prior chronic opioid users to decrease or completely taper off opioid use after surgery.

This study was designed to evaluate whether implementation of a TPS would reduce opioid use among veterans undergoing major joint surgery, a patient population at high risk for CPSP.¹⁷ We hypothesized that a multidisciplinary approach to pain management would decrease fragmentation during care transitions and significantly reduce opioid use after orthopedic surgery for both chronic opioid users and opioid-naïve patients.

METHODS

TPS intervention

The TPS intervention consists of comprehensive pain management and care coordination delivered by a multidisciplinary team. This team is made up of anesthesiologists with specialization in acute pain

management, nurse practitioners with experience in both acute and chronic pain management, nurse care coordinators, and a psychologist. These multidisciplinary providers work together as an integrated team to deliver comprehensive pain management for any surgical patient at risk for CPSP and COU. Patients are eligible for TPS engagement based on presence of individual risk factors such as a history of substance use disorder or COU, or if they are undergoing a surgical procedure such as total joint replacement associated with a high-risk for CPSP.¹⁷ TPS engagement of these patients occurs during all three main phases of a surgical episode of care: (1) the preoperative period, (2) the surgical hospitalization, and (3) postoperative recovery period up to 6 months.

Preoperative period

Patients are identified for enrollment in TPS at the time they are scheduled for elective surgical procedures. A TPS nurse contacts each patient before surgery and performs a directed history including mental health diagnoses, pain history, opioid use history, and baseline patient-reported pain measures using Patient Reported Outcome Measurement Information System (PROMIS) instruments as well as pain catastrophizing scale scores.¹⁸ Patients receive preoperative education either through a 1 hour surgical expectations class or one-on-one visit, where topics such as pain after surgery, analgesic strategies, appropriate use of opioids, and non-pharmacologic pain coping strategies are discussed. Individual sessions with a psychologist are also offered prior to surgery with a focus on Mindfulness-Based Intervention (MBI), and Acceptance and Commitment Therapy (ACT). All patients are then reviewed by the anesthesiologist and nurse practitioner prior to surgery to develop individualized plans for perioperative pain management. This may include a discussion with the patient regarding preoperative opioid taper, opioid-free surgery and recovery, buprenorphine strategy, or other multimodal analgesic techniques such as peripheral nerve blocks. Any changes for opioid taper or buprenorphine use are discussed directly and done in coordination with the prescribing provider.

Surgical hospitalization period

Individualized pain management plans and Enhanced Recovery After Surgery protocols are implemented including preoperative non-steroidal anti-inflammatory drug (NSAID), acetaminophen, and gabapentinoid, local infiltrative anesthesia by the surgeon, and regional anesthesia, where appropriate. Postoperative scheduled acetaminophen, NSAID, and gabapentinoid were provided with breakthrough opioids as needed for postoperative analgesia. Daily rounds are conducted on hospitalized patients by the multidisciplinary TPS team and any new pain management recommendations are made to the surgical team to include discharge medications and opioid taper plan. During their in-hospital stay, patients are offered individual sessions with a psychologist on a daily basis or more frequently for mindfulness meditation and/or relaxation techniques.

Postoperative period

Follow-up telephone calls are made by the TPS nurse at post-discharge days 2, 7, 10, 14, 21, 28, and at least monthly until 6 months postoperative. During each call, 24-hour morphine equivalent daily dose (MEDD), PROMIS scores, date of last opioid use, and number of opioid tabs remaining after date of last opioid use are recorded. Outpatient sessions with the psychologist are offered with a continuation of ACT Matrix and MBI used as well as assessment and referral for appropriate

long-term mental health services. The anesthesiologist and nurse practitioner provide opioid taper support and prescribe alternative analgesic therapies when needed. Any change in medications is done through close communication and coordination with the surgical team, primary care, mental health and/or chronic pain providers. For patients with chronic pain and COU, transition to a chronic pain team is offered and facilitated.

TPS implementation

The TPS intervention as described above was implemented at the VA Salt Lake City Medical Center in January 2018 as a 1 year pilot. During this pilot period, we enrolled all patients scheduled to undergo primary or revision total knee, hip, or shoulder surgery or rotator cuff surgery based on the established risk of CPSP and opioid use among this patient population. After a year, the TPS program was expanded to include other surgical patient populations. To support implementation, electronic decision support tools were created, including electronic medical record order sets to standardize practice, and decision-support dashboards to facilitate case review at the patient-level by all members of the TPS team.

Study design

We used a pre-post study design to compare changes in postoperative opioid use among patients undergoing orthopedic surgery procedures before and after implementation of the TPS intervention. Patients in the pre-TPS group who had primary or revision total knee, hip, or shoulder surgery or rotator cuff surgery at the Salt Lake City VAMC between January and December 2017 were compared with patients undergoing the same surgical procedures who were enrolled in TPS during 2018. Veterans who had a second surgery or that passed away within 90 days after their joint surgery were excluded from this analysis. This study was approved by the University of Utah Institutional Review Board and VA Research Review Committee, and informed consent was waived.

TPS and pre-TPS groups

For the pre-TPS group, medical records and state-controlled substance databases were reviewed to ascertain baseline demographics, history of substance use disorder, depression, anxiety, post traumatic stress disorder (PTSD) or other mental health diagnosis, and use of opioid medications before and after surgery. MEDD was calculated at baseline prior to surgery and at 90 days after discharge based off of active prescriptions in the medical record and/or state-controlled substance database at those time points. Number of opioid tablets prescribed at discharge was recorded. Patients were designated as chronic opioid users if they had received a prescription of opioids for either 60 continuous days prior to surgery, or if they filled three or more prescriptions for opioids within 180 days prior to surgery. Veterans who did not meet these criteria were considered opioid naive. New COU after surgery was defined as having either an active opioid prescription at 90 days postdischarge or filling an opioid prescription between 90 and 120 days after discharge.

Patients in the TPS cohort had opioid use history and MEDD documented in TPS clinic notes using patient report as well as medical record and controlled substance database verification prior to surgery and at 90 days after discharge. Number of opioid tablets prescribed at discharge was recorded. In addition, history of mental health disorders and substance abuse history were recorded at baseline prior to surgery.

Outcome measures

The primary outcome measure for this study was the proportion of patients taking any opioid medication at 90 days after surgery. Secondary outcomes included the proportion of COU patients who were either weaned off opioids or decreased their opioid dose as compared with preoperative levels, the proportion of non-opioid use (NOU) patients still on opioids after 90 days, and the number of opioid tablets prescribed at discharge.

Statistical analysis

Baseline patient characteristics were summarized stratified by the pre-TPS and post-TPS exposure groups. Continuous variables were summarized as mean, SD, median, IQR, and range; and analyzed using a t-test for approximately normally distributed variables and a Wilcoxon rank-sum test otherwise. Categorical variables were summarized as count (%) and analyzed using a χ^2 test. A Cochran-Armitage trend test was used to compare 90-day outcomes coded as an ordinal variable (off opioids, reduced, same, increased) among the patients in pre-TPS and post-TPS who had COU. We also used a χ^2 test to compare off or reduced versus same or increased opioid use. We first compared predictor variables between the pre-TPS and post-TPS NOU and COU groups using univariate analysis. A multivariable logistic regression model was then used to assess the relationship between TPS exposure status and postoperative COU, adjusting for age, type of procedure, number of days in hospital, and COU at baseline. Covariates were selected for adjustment in logistic regression models if they met statistical significance at the $p < 0.1$ level in univariate analyses. ORs were reported with 95% CIs and p values. Statistical significance was assessed at the 0.05 level, and all tests were two-sided. Preimplementation and postimplementation outcomes for number of opioid tablets prescribed at discharge and percentage of new COU are presented in a Statistical Process Control Chart.¹⁹ All analyses were conducted using R V.3.6.1 (R Foundation for Statistical Computing, Vienna, Austria).

RESULTS

A total of 164 patients met criteria for the TPS program between January and December 2018, and were compared with 172 patients in pre-TPS from the year prior that underwent the same types of orthopedic procedures. This cohort included 53 (31%) patients in pre-TPS and 37 (23%) patients in the TPS cohort with a history of COU before surgery. The characteristics of patients in pre-TPS and TPS groups prior to surgery are shown in table 1.

After implementation of TPS there was a significant reduction in the number of opioid tablets prescribed to patients at the time of hospital discharge (TPS: 45 (25,60) vs pre-TPS: 80 (60,90); $p < 0.001$; figure 1). Opioid tablets prescribed by month are shown in figure 2. This finding was consistent for patients who were opioid naive as well as on chronic opioid therapy before surgery.

The decrease in opioid use associated with the TPS intervention was found to extend beyond 3 months after surgery for patients who were either opioid naive or on chronic opioids before surgery. Only 22 (13.4%) patients under TPS were still on opioids after 90 days as compared with 47 (27.3%) patients in pre-TPS ($p = 0.002$). Among individuals who were opioid naive prior to surgery, only a single patient who received the TPS intervention continued opioids beyond 90 days after hospital discharge (0.7% vs 8.4%; $p = 0.004$) as compared with 10 patients from the pre-TPS period. Figure 3 shows this trend over time. Similarly, the TPS intervention was effective for patients

Table 1 Characteristics of patients enrolled in the TPS and patients in no TPS undergoing the same major joint procedures during the year prior

Variables	No TPS	TPS	P value
	n=172	n=164	
Age, mean (SD)	65.7 (9.9)	64.2 (12.0)	0.21
Sex, male, n (%)	159 (92.4)	145 (88.4)	0.21
BMI, median (IQR)	31.0 (28–35)	31.6 (29–35)	0.39
History of mental health disorders, n (%)	81 (47.1)	79 (48.2)	0.84
History of substance use disorders, n (%)	25 (14.5)	22 (13.4)	0.77
Surgical procedure, n (%)			0.38
Rotator cuff repair	40 (23.3)	33 (20.1)	
Total hip arthroplasty	46 (26.7)	34 (20.7)	
Total knee arthroplasty	66 (38.4)	72 (43.9)	
Total shoulder arthroplasty	20 (11.6)	25 (15.2)	
Hospital length of stay, median (IQR)	2.0 (1–2)	2.0 (1–2)	0.58
Opioid use history			
COU, n (%)	53 (30.8)	37 (22.6)	0.09
Preop MEDD, mean (SD)	15.4 (35.8)	10.3 (31.2)	0.07

BMI, body mass index; COU, chronic opioid use; MEDD, morphine equivalent daily dose; TPS, transitional pain service.

on chronic opioids before surgery. As shown in table 2, among chronic opioid users there was a significant increase in the proportion of patients enrolled in the TPS program who either completely stopped their opioids or decreased their preoperative opioid dose (67.5% vs 45.3%) when compared with pre-TPS ($p = 0.037$).

As a result, fewer chronic opioid users engaged by TPS were found to have increased their opioid dose at 90 days (5.5% TPS vs 15.1% Pre-TPS) following surgery. However, the trend across these ordered levels was not statistically significant ($p = 0.054$).

Multivariable logistic regression analysis showed 69% lower odds of postoperative COU in the TPS group compared with

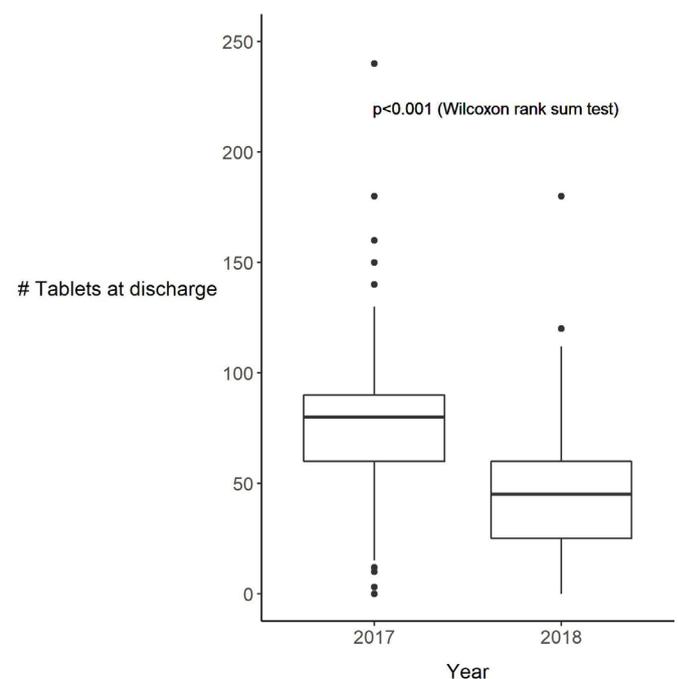


Figure 1 Number of opioid tablets prescribed at hospital discharge before and after implementation of a TPS. TPS, transitional pain service.

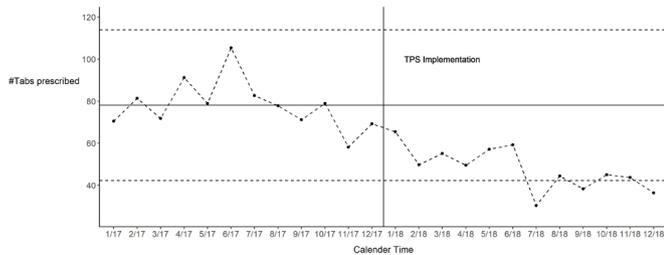


Figure 2 Statistical control chart for number of opioid tablets prescribed at hospital discharge, by month, before and after implementation of a TPS. Dots are average number of tabs prescribed at discharge per month. Solid horizontal line is the mean number of tabs prescribed at discharge in 2017. Two dashed horizontal lines represent 3SDs from the mean of the monthly number of tabs at discharge for year 2017. In 2018, all months had an average #tabs at discharge below the central line (2017 average), 3 months (7, 9, and 12) were outside of the lower boundary (mean -3SD), suggesting special causes of variation. TPS, transitional pain service.

the pre-TPS group (OR: 0.31; 95% CI: 0.14 to 0.66; p=0.03; table 3).

COU at baseline was associated with over 40 times higher odds of postop COU (OR: 43.2; 95% CI: 20.1 to 102.1; p<0.001). In this model, patient age, type of procedure, and hospital days were not independently associated with COU after surgery adjusting for TPS intervention and baseline COU.

DISCUSSION

Perioperative care coordination for pain management is commonly fragmented and increases the risk for COU after surgery. Implementing a TPS has been suggested as one approach to address this issue and to optimize the perioperative pain management strategy.²⁰⁻²² Here we describe the successful implementation of a TPS in a Veterans Affairs (VA) medical

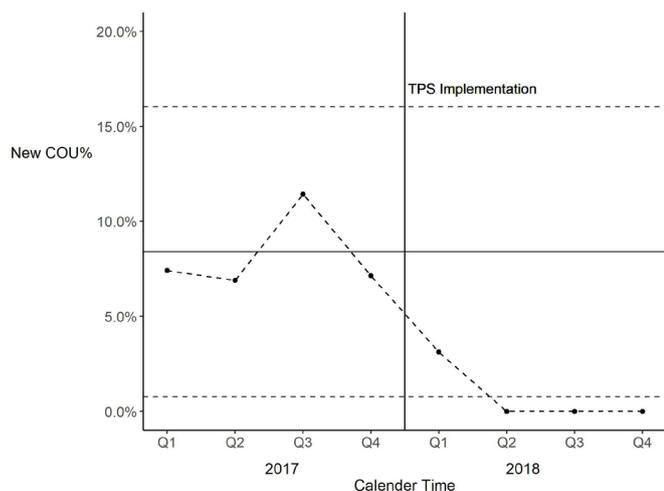


Figure 3 Statistical control chart for proportion of opioid-naive veterans with new persistent opioid use before and after implementation of a TPS. Dots are % new COU in each quarter. Solid horizontal line is the mean new COU% in 2017. Two dashed horizontal lines are 3SD from the mean new COU% in 2017. In 2018, new COU% in all four quarters were below the central line, quarters 2-4 had new COU% outside of the lower boundary (mean -3SD), suggesting special causes of variation. COU, chronic opioid use; TPS, transitional pain service.

Table 2 90-Day outcomes among patients with history of COU who received the TPS intervention as compared with standard care during prior year (no TPS)

Outcome	No TPS	TPS	P value
	n=53	n=37	
Off or reduced opioid use, n (%)	24 (45.3)	25 (67.5)	0.037*
Off all opioids, n (%)	16 (30.2)	16 (43.2)	
Reduced opioid use, n (%)	8 (15.1)	9 (24.3)	
Same or increased opioid use, n (%)	29 (54.7)	12 (32.5)	
Same opioid dose as baseline, n (%)	21 (39.6)	10 (27)	
Increased opioid use, n (%)	8 (15.1)	2 (5.5)	

* χ^2 test comparing off or reduced versus same or increased. COU, chronic opioid use; TPS, transitional pain service.

center that utilizes a multidisciplinary and multimodal approach across preoperative, surgical hospitalization, and postoperative transitions of care to address the problem of fragmented care coordination. Our data show that when patients receive preoperative education and are followed closely for at least 6 months after surgery, overall postoperative opioid use can be significantly reduced for both previously opioid naive as well as chronic opioid users. It is noteworthy that among opioid-naive patients in this study, TPS achieved substantial reduction of new COU after surgery. In addition, the majority of patients with prior COU were able to transition completely off opioids within 90 days after surgery or experience a reduction in their opioid dose. Together, these findings support the role for a TPS in optimizing perioperative pain management and reducing COU among at-risk patients.

Numerous evidence-based strategies have been promoted and/or put into practice during the preoperative, intraoperative, and postoperative period as a means to reduce opioid use and prevent CPSP. This includes individually tailored programs for preoperative education or pain management planning²³⁻²⁵; use of multimodal analgesia including regional or neuraxial techniques or non-opioid systemic medications²⁵; use of non-pharmacologic modalities such as cognitive-based intervention²⁶; as well as coordinated approach to postdischarge instructions and transitions of care.²⁶ Each of these individual strategies by themselves has been shown to have some effect on improving postoperative pain management. And all of these measures are supported by current professional guidelines for the management of postoperative pain.²⁷

There has been limited data, however, to show the beneficial effect when these therapeutic modalities are all bundled together into a single perioperative intervention. A multidisciplinary TPS program provides the mechanism within a health

Table 3 Multivariable regression analysis to assess independent factors associated with COU following orthopedic joint surgery

Variable	ORs (95% CI)	P value
Post-TPS vs Pre-TPS	0.32 (0.14 to 0.69)	0.005
Age at discharge	1.01 (0.97 to 1.05)	0.61
Type of surgery		
Hip arthroplasty	0.86 (0.24 to 3.16)	0.82
Total knee arthroplasty	1.74 (0.58 to 5.77)	0.34
Total shoulder arthroplasty	2.25 (0.59 to 8.78)	0.24
Length of hospital stay	1.08 (0.82 to 1.34)	0.52
Preop MEDD>0	1.08 (1.06 to 1.11)	<0.001

MEDD, morphine milligram equivalent daily dose; TPS, transitional pain service.

system for delivering multiple interventions to patients at high risk for CPSP.^{14,20} Our study demonstrates the effectiveness of a TPS that integrates preoperative education and individual pain management planning in addition to postoperative care. This is a central component of our approach based on collective evidence showing that managing patient expectations before surgery reduces patient anxiety, perioperative opioid consumption, and hospital length of stay.^{28–30}

The other main function of a TPS is to ensure that this personalized pain management plan is carried out across all transitions of care. A TPS coordinates care across all transitions in the inpatient and outpatient setting and effectively lowers the risk that patient information is miscommunicated among surgical and non-surgical providers.²¹ This type of service is well-suited to an integrated healthcare system such as the VA given the shared electronic medical record system, the ability to collect and track data in both inpatient and outpatient settings, and the relative ease of communication among surgeons, primary care, and mental health providers. Moreover, coordination of care is facilitated given that most veterans who have surgery at a VA hospital typically receive all of their care through the VA healthcare system. In fact, the electronic note templates we created were designed to be utilized at other VA hospitals during future TPS dissemination, allowing common data elements to be captured and helping to guide best practices for perioperative pain management. Further, the real-time capturing of data through patient care notes allowed us to develop a provider-facing clinical decision tool that facilitated regular follow-up at specified intervals and ease of visualizing pertinent patient information in a single place.

Given the resource-intensive nature of a TPS like ours, we recognize that there is a need to demonstrate scalability and cost-effectiveness. After the first year of implementation of our TPS (2018), we expanded to include veterans having all types of surgery and have enrolled >1000 additional veterans since that time. We are also currently performing a cost analysis study. Additional work is needed to evaluate if a model such as this would be successful and feasible at other institutions with different financial models and higher surgical volume.

Our study has several limitations to discuss. First, we used a pre–post study design that may have been confounded by temporal changes in opioid prescribing patterns and as well as regression to the mean. Second, data between time periods was not collected in the same manner. While data were collected prospectively among patients enrolled in the TPS cohort, we had to perform retrospective electronic chart abstraction among patients in the historic pre-TPS group. As such, some degree of ascertainment bias may have been introduced. Third, there may be some unmeasured confounders in our analysis that influence risk of COU between patients enrolled in the TPS and the historic pre-TPS group and contribute to treatment selection bias. Finally, the reduction in COU observed among patients in the TPS program may have been influenced by other VA initiatives designed to reduce opioid use implemented during the study time period.

CONCLUSIONS

The significant reduction in COU observed in this pilot study of patients who had orthopedic surgery underscores the potential for a multidisciplinary TPS approach to comprehensive perioperative pain management. Future directions include evaluating TPS among other surgical patient populations as well as exploring implementation of the service for veterans who receive care through the VA but choose to have surgery outside of the

VA medical system. In addition, it will be important to identify those who are at risk for prolonged opioid use and poor functional outcomes to better focus resources on those who would most benefit from a TPS.

Correction notice This article has been corrected since it published Online First. The author name, Benjamin Brooke, has been corrected.

Twitter Kimberlee Bayless @DrKimBaylessNP

Contributors MJB contributed to the conception, design, data collection, data analysis and interpretation, and manuscript preparation. KB contributed to the conception, design, data collection, data analysis and interpretation, and manuscript preparation. JR contributed to the conception, design, data collection, data analysis and interpretation, and manuscript preparation. ZA contributed to the conception, design, data collection, data analysis and interpretation, and manuscript preparation. SP contributed to the conception, design, data collection, data analysis and interpretation, and manuscript preparation. CZ contributed to the data analysis and interpretation, and manuscript preparation. APP contributed to the data analysis and interpretation, and manuscript preparation. BB contributed to the conception, design, data analysis and interpretation, and manuscript preparation.

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ORCID iD

Michael J Buys <http://orcid.org/0000-0001-8222-1461>

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