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Original Article

Introduction of an Analgesia Prescription Guideline Can Reduce Unused Opioids After Cardiac Surgery: A Before and After Cohort Study

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Objective(s): The authors aimed to assess whether the introduction of a tailored Analgesia Prescription Guideline would decrease the amount of unused opioid following discharge from cardiac surgery.
Design: Prospective, observational, before and after study.
Setting: Quaternary care university hospital.
Participants: A total of 191 participants who underwent cardiac surgery requiring midline sternotomy and cardiopulmonary bypass. There were 99 participants in the before cohort (prior to introduction of the Analgesia Prescription Guideline), and 92 participants in the after cohort (after introduction of the Analgesia Prescription Guideline).
Interventions: Using prospectively collected observational data on participant opioid consumption in the before cohort, a tailored Analgesia Prescription Guideline was developed. This guideline then was introduced to all opioid-prescribing providers in the cardiothoracic surgery department. Prospective data then were collected in the after cohort of participants. Opioid prescription practices and opioid consumption between the two groups then were compared.
Measurements and Main Results: Opioid prescriptions were given to 62/99 participants (63%) in the before cohort, and 48/92 (52%) in the after cohort (rate difference 0.1, CI 95% -0.26, 0.046). In the before cohort, the mean (± standard deviation) number of opioid tablets prescribed, used, and leftover was 26 (±10), 11 (±10), and 15 (±12), respectively. In the after cohort, the mean number of opioid tablets prescribed, used, and leftover was 18 (mean difference -8, CI 95% -12, -5), 10 (mean difference -1, CI 95% -5, 3), and 8 (mean difference -7, CI 95% -11, -3), respectively. There were 110/191 (58%) participants using no opioids following discharge, and 10/191 (5%) still using opioids two weeks after discharge. There were no differences between groups with regard to demographics, opioid-related side effects, pain scores, satisfaction, opioid storage. and disposal practices.
Conclusions: The development and implementation of a tailored Analgesia Prescription Guideline decreased the amount of opioids prescribed after cardiac surgery and resulted in lower numbers of unused leftover opioid tablets in the community. Patient comfort and satisfaction scores remained high.

Key Words: opioid prescription; postoperative analgesia; cardiac surgery

THE OPIOID epidemic in the United States remains a public health emergency.[1] The number of deaths related to prescription opioid use have increased dramatically during the

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past two decades.[2] Prescription patterns are partly responsible for this crisis, as the amount of opioids prescribed per capita has tripled since 1999[3] and more than 40% of opioid overdose deaths involve a prescription opioid.[4]

Although current Centers for Disease Control and Prevention guidelines emphasize the judicious use of opioids in the treatment of chronic noncancer pain,[5] dosing guidelines in the acute postsurgical period are scarce.[6] Multimodal stepwise opioid-sparing analgesia prescriptions allow optimal pain management and reduce the risk of opioid-related side effects. In addition, reducing the duration of opioid exposure should reduce the risk for persistent opioid use.[7] Upward of 6.5% of opioid-naive patients develop new persistent opioid use in the postoperative period.

Opioids frequently are overprescribed following procedures across a number of surgical specialties, including general surgery, obstetrics, gynecology, thoracic, urology, and dental surgery.[8-10] A majority of the opioid tablets prescribed following these procedures are unused, undisposed, and are stored in unsecure locations in patients' homes.[8-11] Undisposed opioids create a reservoir in the community for further misuse and abuse. In one recent national survey, approximately 20% of respondents reported sharing prescribed opioid medication with another person.[11]

There currently is limited information regarding the patterns of opioid prescription and postdischarge opioid use after cardiac surgery. This information is essential to guide providers in prescribing opioid medications in a way that effectively provides analgesia while minimizing excess, unused medication. Furthermore, although patients' in-hospital opioid use prior to discharge has been suggested as a surrogate for opioid requirement after discharge, there are very few studies that assess the efficacy of individualized opioid prescription guidelines that are centered on postsurgical opioid use, written as closely as possible to discharge when patients' pattern of postoperative opioid intake is available to guide the prescription. To the authors' knowledge, no study has focused on opioid requirement after discharge in the cardiac surgery population.[6,12-14]

The authors hypothesized that the implementation of a tailored Analgesia Prescription Guideline to guide the predischarge prescription of opioids after cardiac surgery would lead to a reduction in unused leftover opioids. As a first step, they assessed opioid use after cardiac surgery in a before-intervention cohort. Using this information, they designed an Analgesia Prescription Guideline. The impact of the Analgesia Prescription Guideline was assessed in a subsequent after-cohort of patients, and opioid prescription patterns, opioid tablets used, and the number of unused leftover opioid tablets were assessed.

Methods

This before and after study was performed at a large quaternary academic medical center from January 2, 2018 to November 30, 2018. Institutional review board approval was obtained. All patients with planned or unplanned cardiac surgery requiring a midline sternotomy incision were screened using the operating room schedule and electronic medical record. Enrollment criteria included patients who had a coronary artery bypass graft (CABG) procedure, single left-heart valve repair or replacement, aortic root replacement, or any combination of these procedures. Exclusion criteria were limited English proficiency (defined as requiring interpreter services), lack of capacity to provide informed consent, postoperative mechanical circulatory device support, including extracorporeal membrane oxygenator cannulation, ventricular assist device implantation, or aortic balloon pump placement, or a prolonged postoperative length of hospitalization defined as greater than 21 days.

Consent was obtained in accordance with the approved institutional review board protocol. Patients were approached for participation postoperatively after the intensive care unit (ICU) or the cardiac surgery inpatient service, usually on the second-to-fourth days after surgery. Study staff first approached the patient's nursing staff to assess the patient's ability to provide consent; patients who had postoperative delirium, excessive sedation, or who otherwise lacked decision-making capacity as determined by the nursing staff were rescreened on a subsequent day. Written consent was obtained prior to hospital discharge.

Participants enrolled in the study were contacted by phone ten-to-14 days after hospital discharge. Those who did not answer the first phone call attempt were called two-to-four times per week for three consecutive weeks and were deemed lost to follow-up if no contact was made during that period. Participants who were still using opioids at the time of the phone survey were called again every week until they stopped using opioids, or up to eight weeks of continued opioid use, at which point the patient was considered a new persistent opioid user if not taking any opioids before this surgery. If a patient had a history of chronic opioid use prior to the cardiac procedure, follow-up was discontinued once the baseline amount of opioid intake was resumed.

Two members of the study team (J.P. and H.C.) conducted all the phone interviews. The phone survey was a modified version of the structured interview used by Bateman et al. that was adapted to fit the cardiac surgery population, and the elements of the survey can be found in Appendix 1.[10] The interview consisted of: maximal pain scores on an 11-point numeric rating scale at five time points (on the day of their procedure, immediately after discharge, the first week after discharge, the second week after discharge, and at the time of the interview), additional medical care obtained after discharge, use of opioids and other analgesics, medication-related side effects at any time point (including drowsiness, nausea/vomiting, abdominal discomfort, constipation, dizziness, confusion, insomnia/sleeping issues, itching, difficult urination, mood swings), and a Likert-scale, which assessed overall satisfaction with pain management (rated as very satisfied, slightly satisfied, satisfied, slightly dissatisfied, dissatisfied, or very dissatisfied).

If the participant filled the opioid prescription, the type of opioid dispensed, the dose, and the number of tablets were defined by asking the participant to read out the label. This information was confirmed using the discharge prescription in

the participant's medical record. If the participant received an opioid prescription at discharge but did not fill the prescription, the participant was not called again. If the bottle was not available, this information was abstracted from the participant's medical record. For two participants, information about the discharge prescription was missing from the medical record and could not be estimated by the participants; these two patients were excluded from analysis. Participants also were asked whether they requested a refill of the opioid medication. If a participant was not given an opioid prescription, he or she was asked about whether he or she obtained an opioid prescription after discharge.

The number of leftover tablets then was defined. If the participant reported taking all the tablets that were dispensed in the initial prescription, the number of leftover tablets was defined as zero. If there was leftover medication and the bottle was still available, the number of tablets left in the bottle were counted. If the bottle was not available, the participant was asked to estimate the number of leftover tablets. The number of used tablets was defined by subtracting the number of leftover tablets from the number of tablets dispensed as written on the bottle.

Chart review was performed to gather patient demographics, surgery performed, anesthetic management, cardiopulmonary bypass duration, length of stay, postoperative analgesic regimen, smoking status, and home medications. Collected survey data were transcribed into the Research Electronic Data Capture database (REDCap). The code book for the data elements collected in the survey is available in Appendix 1.

With use of data from a total of 147 enrolled participants between January 2 and April 30 (the before cohort), the Analgesia Prescription Guideline (Fig 1) was developed. A linear regression model was applied to determine the relationship among participant demographics, postoperative data, known risk factors for pain after sternotomy[15] and opioid use after discharge. Among all variables tested, opioid use in the 24- and 48-hour period prior to discharge had the strongest association with opioid use after discharge. Therefore, participants' opioid use in the 48-hour period prior to discharge was included in the individualized Analgesia Prescription Guideline as a factor to be considered in the opioid prescription. Second, the overall number of opioid tablets that participants consumed after discharge in the BEFORE cohort (median = ten, interquartile range [IQR]one18) was used to determine an estimated appropriate range of opioid tablets in the Analgesia Prescription Guideline. Third, to avoid underprescribing, a range of opioid tablets was used in the Analgesia Prescription Guideline that assumed an overestimation of the number of pills a patient likely would require.

The intervention consisted of presenting this guideline in a lecture to all opioid-prescribing providers on the cardiac surgery inpatient service and providing physical copies of the guideline for providers' reference. The lecture was given on multiple occasions July 2 to 13, 2018. An attendance sheet was used to ensure that all providers on the service were exposed to the intervention. The team of prescribers consisted of physician assistants (n = 19) who care for patients under the supervision of cardiac surgical physicians. The after cohort was evaluated from July 2 to November 30, 2018 (n = 149 screened participants) to assess the efficacy of this intervention in reducing the amount of unused opioid.

Statistical Analysis

This data represent a convenience sample with the number of participants determined by comparison to similar descriptive studies performed in other surgical populations.[8] Descriptive statistics are presented as means (standard deviations [SD]), medians (IQR), or frequency counts (%). For continuous variables, normality was assessed using Q-Q plot and histogram, and the Mann-Whitney U or independent two-sample *t* tests were used to compare medians or means of the two groups. For categorical variables, a chi-square or Fisher exact tests were used to test for associations between the categorical variables and group status. Confidence intervals of difference of proportions were calculated using the chi-square test with

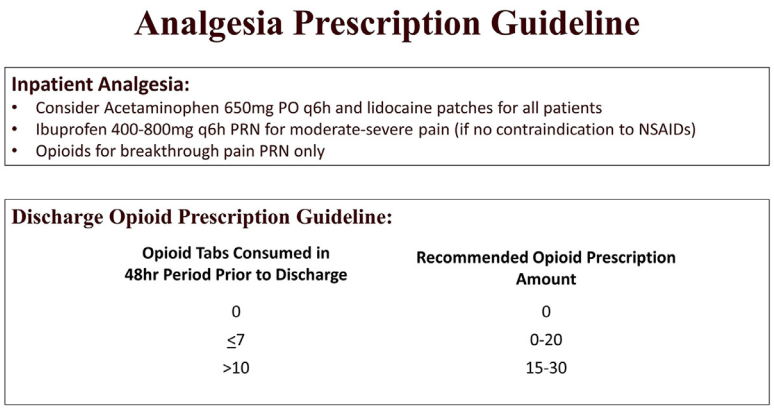

Fig. 1. This Analgesia Prescription Guideline was presented to all prescribing providers in the cardiothoracic surgery inpatient service and included both inpatient analgesia and discharge opioid prescription recommendations. Inpatient recommendations emphasized the routine use of nonopioid analgesics prior to prescribing opioids, and discharge opioid prescription recommendations advised prescribing a varying number of opioid tablets based on the amount of opioid tablets patients used in the 48-hour period prior to discharge as well as shared decision-making with the patient.

Yates continuity correction, and confidence intervals of difference of medians were calculated using bias-corrected and accelerated bootstrap.

A univariate test was performed to examine the association of each variable and the use of opioids after discharge. Participant demographic and opioid consumption data from the before and after cohorts were combined and a simple logistic regression model was built for each variable with the binary use of opioids after discharge as outcome and each variable of interest as covariate. The odds ratio (OR) of using opioids after discharge and its 95% CI, which were derived from the coefficient of the model, together with the p value, were determined for each variable. All analyses were conducted using SPSS (IBM SPSS version 25) or R statistical software (RStudio, version 3.5.1; R Foundation for Statistical Computing, Vienna, Austria). Figures were made using Microsoft Excel, SPSS, or R statistical software. This manuscript adheres to the applicable EQUATOR (STROBE) guidelines.

To standardize opioid prescriptions across different opioid formulations, conversion factors from the Centers for Disease Control and Prevention and Centers for Medicare and Medicaid Services were used: oxycodone to morphine 1:1.5 mg; tramadol to morphine 1:0.1 mg; and hydromorphone to morphine 1:4 mg.[16,17]

Results

There were 353 eligible patients for inclusion in the study (before n = 178, after n = 175). Participants were not enrolled with refusal to participate, or excluded for loss to follow-up, readmission after discharge, or refusal to participate at the time of contact. An additional two participants were removed following chart review and prior to data analysis due to an inability to obtain discharge opioid prescription information. Two participants were removed from the authors' analysis after intervention because the prescribing provider was not exposed to the authors' intervention. A total of 191 participants were included in the study analysis (before n = 99, after n = 92; Fig 2).

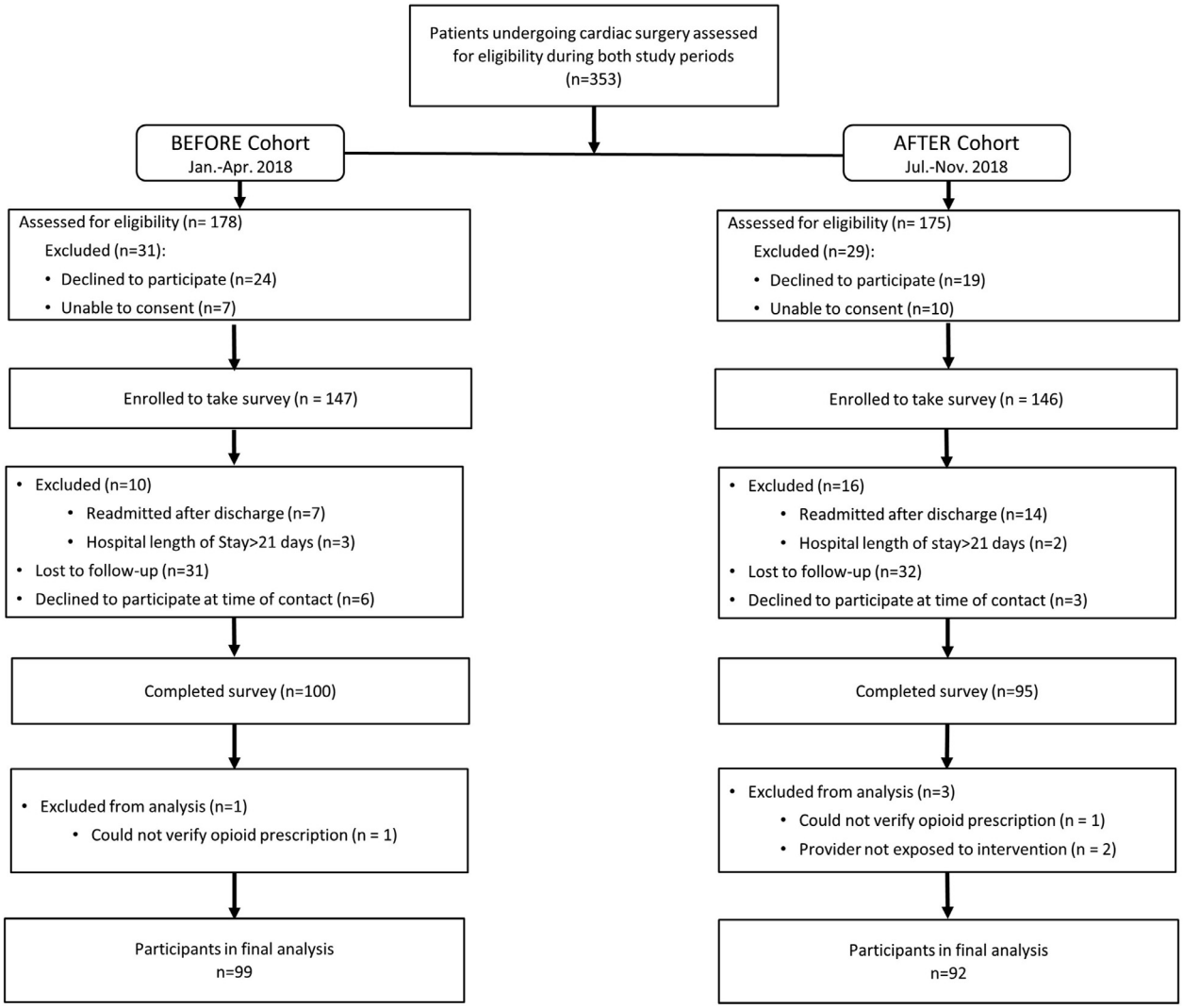

Fig. 2. Participant flow chart. Abbreviation: LOS, length of stay.

Table 1
Participant Demographics and Risk Factors for Pain after Sternotomy

Participant demographics	Before Cohort (n = 99)	After Cohort (n = 92)	p Value	Mean/Rate Difference (95% CI)
Female (%)	25 (25)	21 (23)	0.737	-0.02 (-0.16, 0.11)
Age (SD)	65 (11)	67 (10)	0.248	2 (-1, 5)
BMI (SD)	28.9 (4.8)	28.7 (5.0)	0.730	-0.2 (-2, 1)
Participant risk factors for poststernotomy pain				
History of diabetes (%)	25 (25)	25 (27)	0.869	0.02 (-0.12, 0.15)
History of myocardial infarction (%)	16 (16)	15 (16)	>0.999	0.001 (-0.105, 0.107)
History of anxiety/depression (%)	13 (13)	6 (7)	0.151	-0.07 (-0.16, 0.03)
History of substance abuse				
Tobacco (%)	33 (33)	31 (34)	0.908	0.004 (-0.134, 0.141)
Other (alcohol, marijuana, and cocaine) (%)	5 (5)	6 (7)	0.761	0.015 (-0.062, 0.092)
History of chronic opioid use (%)	4 (4)	1 (1)	0.370	-0.03 (-0.08, 0.02)
Surgical information				
Nonelective surgery (%)	21 (21)	24 (26)	0.496	0.05 (-0.08, 0.18)
Repeat sternotomy (%)	10 (10)	5 (5)	0.287	-0.05 (-0.13, 0.04)
Harvested internal mammary artery (%)	50 (51)	51 (55)	0.562	0.05 (-0.10, 0.20)
Bypass time, min (SD)	109 (41)	113 (46)	0.521	4 (-8, 16)
Total intraoperative fentanyl, μg (SD)	2,400 (753)	2,470 (875)	0.550	71 (-161, 303)
Postoperative length of stay, d (SD)	7 (3)	7 (2)	0.445	-0.3 (-1.0, 0.4)
Opioid taken in last 24 hours prior to discharge (SD)	2 (3)	1 (2)	0.413	-0.27 (-0.9, 0.4)
Opioid taken in last 48 hours prior to discharge (SD)	3 (5)	3 (4)	0.510	-0.44 (-1.8, 0.9)

Abbreviation: SD, standard deviation.

Demographic data, medical comorbidities, and surgical information for both cohorts are presented in Table 1. There were no differences in demographic characteristics or type of procedure in mean intraoperative fentanyl administered or mean postoperative length of stay between the before and after cohorts. There was no difference between groups in the mean amount of opioid used in the 24- and 48-hour period prior to discharge (24-hour: mean difference -0.3 tablets, CI 95% -0.9, 0.4, 48-hour use: mean difference -0.4 tablets, CI 95% -1.8, 0.9). Additionally, there were no differences among participants who completed the survey and those who were lost to follow-up with regard to the variables in Table 1.

There were 19 different providers writing a discharge prescription for 62 participants in the before cohort (n = 99). Prescriptions were written for either oxycodone 5 mg (n = 43, 69%), tramadol 50 mg (n = 15, 24%), acetaminophen/oxycodone 325 mg/5 mg (n = 3, 5%), or hydromorphone 2 mg (n = 1, 2%). Four participants received an opioid prescription but did not fill it because they did not want or need opioids (n = two), and/or experienced side effects during prior exposure (n = one), or already had opioids at home (n = one) (Table 2).

In the after cohort (N = 92), 48 participants were given an opioid prescription (rate difference -0.1, CI 95% -0.3, 0.05). Prescriptions were written for either oxycodone 5 mg (n = 41, 85%), tramadol 50 mg (n = 5, 10%), acetaminophen/oxycodone 325 mg/5 mg (n = 1, 2%), or hydromorphone 2 mg (n = 1, 2%). Four participants received a prescription but did not fill it (rate difference 0.02, CI 95% -0.1, 0.14), because they did not want or need opioids (n = three) and/or they had experienced side effects during prior exposure to opioids (n = two).

Table 2
Opioid Prescription, Consumption, and Storage Outcomes

	Before Cohort (n = 99)	After Cohort (n = 92)	p Value	Mean/Rate Difference (95% CI)
Number of participants prescribed opioids (%)	62 (63)	48 (52)	0.187	-0.10 (-0.26, 0.046)
Number of participants who did not fill prescription (%)	4 (6)	4 (8)	0.727	0.02 (-0.10, 0.14)
Mean opioid tablets prescribed (SD)	26 (10)	18 (8)	<0.001	-8 (-12, -5)
Mean opioid tablets consumed (SD)	11 (10)	10 (9)	0.589	-1 (-5, 3)
Mean opioid tablets leftover (SD)	15 (12)	8 (8)	<0.001	-7 (-11, -3)
Stored opioids in a secure location (%)	4 (7)	6 (14)	0.321	0.07 (-0.07, 0.21)
Disposed of unused opioids (%)	5 (10)	3 (9)	>0.999	-0.01 (-0.14, 0.12)
Refill/new opioid prescription obtained (%)	3 (5)	4 (8)	0.697	0.03 (-0.08, 0.15)
Median pain score at time of follow-up (interquartile range)	1 (0, 2)	1 (1, 2)	0.733	0 (-1, 0)
Experienced adverse opioid side effect (%)	18 (31)	21 (48)	0.102	0.16 (-0.04, 0.38)
Satisfied with pain management (%)	83 (95)	83 (93)	0.747	-0.02 (-0.10, 0.06)

Abbreviations: CI, confidence interval; SD, standard deviation.

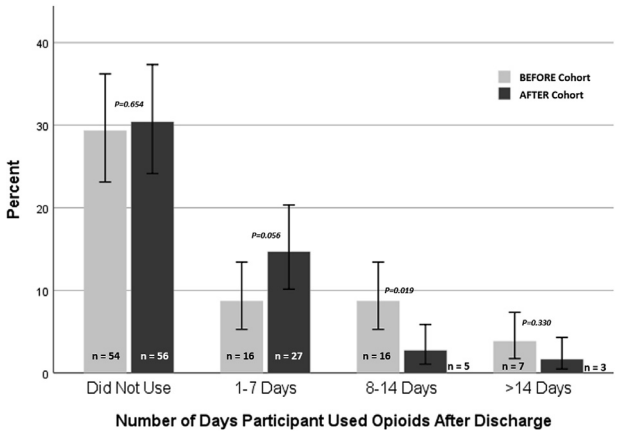

Fig. 3. Number of days that participants used opioids after discharge from cardiac surgery.

Prescribed opioid tablets, reported as mean oxycodone 5-mg equivalents, used and leftover, are listed in Table 2. There was a mean difference of -8 tablets prescribed (CI 95% -12, -4), -1 tablets consumed (CI 95% -5, 3), and -7 tablets leftover (CI 95% -11, -3) between the before and after cohorts.

Overall, there were 58% of participants who did not use any opioids (n = 110/191) and 5% (N = 10/191) opioids for more than two weeks after discharge (Fig 3). Among participants who received an opioid prescription (N = 102), 90% reported storing the opioid medication in an unlocked or unsecure location. Three participants reported losing track of the opioid pills and were unable to find the prescribed pills at the time of the interview. Among all participants with leftover opioid tablets (N = 87), 93% had not disposed of the excess medication. There were no differences in secure storage (rate difference 0.07, CI 95% -0.07, 0.2) or opioid disposal (rate difference -0.01, CI 95% -0.14, 0.12) between groups.

A total of 39/102 (38%) participants experienced adverse side effects related to the opioid medication. The most common side effects reported were excessive sedation/drowsiness (n = 21), gastrointestinal disturbances including nausea/vomiting/constipation (n = 19), and confusion (n = 12). Other reported side effects included visual disturbances (n = three), mood swings (n = two), itching (n = one), and urinary retention (n = one). There was no statistically significant difference between overall incidence of side effects between the before and after cohorts (rate difference 0.16, CI 95% -0.04, 0.38, p value 0.102).

With regard to participant satisfaction, 83/87 (95%) participants in the before group responded that they were "satisfied" or "very satisfied" with the perioperative pain management, compared with 83/87 (95%) participants in the after group (rate difference -0.02, CI 95% -0.10, 0.06).

The results of a univariate logistic regression model for the use of opioids after discharge using combined data from the before and after cohorts are in Table 3. Factors that were associated with opioid use after discharge are the number of prescribed tablets (OR 1.02, CI 95% 1.01, 1.02), the number of tablets used 24 hours prior to discharge (OR 1.31 CI 95% 1.20, 1.42), and age (OR 0.92, CI 95% 0.89, 0.95).

Discussion

The major finding of this study was that the implementation of a tailored Analgesia Prescription Guideline for opioid prescribers reduced 1.5-fold the number of prescribed opioid

Table 3
Univariate Logistic Regression for Opioid Use after Discharge

Variable	Reference Value	p Value	Odds Ratio	95% CI
Amount of opioid prescribed at discharge (morphine milligram equivalent)		<0.001	1.02	1.01, 1.02
Amount of opioid received 24 h prior to discharge (morphine milligram equivalent)		<0.001	1.31	1.2, 1.42
Amount of opioid received 48 h prior to discharge (morphine milligram equivalent)		<0.001	1.10	1.07, 1.13
Age, y		<0.001	0.92	0.89, 0.95
Sex (female/male)	Female	0.099	1.81	0.89, 3.65
On home medication for neuropathic pain (yes/no)	No	0.152	0.46	0.16, 1.34
History of myocardial infarction (yes/no)	No	0.201	0.58	0.26, 1.33
Postoperative length of stay, d		0.306	0.94	0.84, 1.06
History of smoking (nonsmoker/smoker)	Nonsmoker	0.413	1.30	0.70, 2.41
Redo sternotomy (yes/no)	No	0.451	1.50	0.52, 4.33
History of alcohol or substance abuse (yes/no)	No	0.471	1.57	0.46, 5.33
History of chronic opioid use (yes/no)	No	0.473	1.94	0.32, 11.91
Total intraoperative fentanyl received, μg		0.569	1.00	1.00, 1.00
History of diabetes (yes/no)	No	0.656	1.16	0.60, 2.26
Bypass time, min		0.697	1.00	0.99, 1.01
Length of surgery, min		0.786	1.00	1.00, 1.00
History of depression/anxiety (yes/no)	No	0.859	0.92	0.35, 2.40
BMI		0.912	1.00	0.95, 1.06
Internal mammary artery harvested (yes/no)	No	0.929	1.03	0.57, 1.84
Emergent surgery (scheduled/emergent)	Scheduled	48	1.02	0.52, 2.01

Abbreviations: BMI, body mass index; CI, confidence interval.

tablets (from 26 to 18) and reduced two-fold the number of leftover tablets (from 15 to 8) after cardiac surgery. There were no reductions in the in-hospital or the postdischarge opioid use after implementation of the guideline. The authors' data suggest that the significant decrease in leftover opioids observed was due to fewer opioid tablets being prescribed, rather than a change in opioid consumption behavior or postoperative pain.

Prior to the implementation of the Analgesia Prescription Guideline, there was wide variation in the amount of opioids prescribed from zero to 56 tablets, with a mean number of tablets (oxycodone 5-mg equivalent) of 26; 63% of participants received an opioid prescription at discharge. The majority of patients used less than half of the amount prescribed. This was consistent with similar studies across other surgical populations,[8] which have estimated that 70% to 80% of patients either do not fill or do not finish their discharge opioid prescription after surgery.

The before cohort was used to assess patterns of opioid use in the 48 hours before hospital discharge and subsequent opioid use after discharge; these data were used to develop the Analgesia Prescription Guideline. The goal of the Analgesia Prescription Guideline was to reduce both in-hospital opioid use and discharge opioid prescriptions, using multimodal opioid-sparing analgesia. Postoperative analgesic prescriptions included standard orders for nonopioid analgesics before escalating to opioids, which were prescribed for breakthrough pain only on an as-needed basis. Recommendations for the discharge opioid prescription were based on two important factors identified in the initial survey, one general and one specific to each patient. First, the median number of opioid tablets consumed across all surgeries was ten tablets (interquartile range one-18). Second, patients' opioid use during the 24- and 48-hour period prior to discharge was correlated with the number of opioid tablets they used at home. The authors used these two factors to propose ranges of opioid tablets to be prescribed, and this resulted in a recommendation from no opioid prescription to a maximum of 30 tablets. The authors decided for a relatively high upper limit of tablets to reduce the risk of insufficient prescription and need for refill, and this amount was higher than the zero to- 20-tablet range later proposed by expert consensus.[6] Notably, of the 15 patients in the after cohort who received prescriptions for more than 20 tablets, a median 16 tablets per participant were left over, suggesting that the authors' recommendation could be restricted further without adverse consequences.

Using univariate logistic regression, several factors were associated with opioid use after discharge, including younger age, higher number of prescribed tablets, and higher opioid use at 24 and 48 hours prior to discharge. Among these, the variable with the strongest association for opioid use after discharge was opioid use during the 24-hour period prior to discharge. This finding was consistent with a study of opioid use in obstetric and thoracic surgical populations.[18]

Individualized opioid prescription is especially important following cardiac surgery, as geriatric patients are more sensitive to opioid medications and are at increased risk for opioid-related adverse events.[19] In the authors' study, opioid-related side effects, such as increased sedation, confusion, and gastrointestinal complications, were reported in 38% of patients using opioids.

The authors acknowledge several limitations. They conducted a single-center observational study of English-speaking participants undergoing cardiac surgery at a large, academic medical center, generally expected to have uncomplicated postoperative recoveries ("fast-track" patients); as such, their results may not be representative of or generalizable to all cardiac surgery patients. Notably, right-heart valve, multiple valve, and aortic arch interventions, as well as mechanical circulatory device insertions, were not included in this study as these procedures were anticipated to have more complex intraoperative and postoperative courses. With regard to the intervention, the authors did not audit prescribers to see whether they were using the Analgesia Prescription Guideline, nor did they evaluate their satisfaction with the tool. Although the guideline was implemented as a recommendation, the authors cannot be certain that all prescribers actually followed the recommendations and used it on a case-by-case basis. The Analgesia Prescription Guideline did not incorporate shared decision-making, which may have further allowed to individualize the prescription. Approximately one-third of participants were lost to follow-up, and it is possible that these participants had different opioid use and pain recovery trajectories. For participants unable to retrieve their prescription bottle at the time of the phone survey but who reported still having remaining pills (n = nine), the authors relied on recall of their prescribed amount to calculate used and leftover opioid tablets, which may result in inaccuracy in their estimates. In addition, the authors did not include a control group simultaneous to the study period to specifically evaluate the effect of the Analgesia Prescription Guideline, and, therefore, they cannot exclude the impact of the lay and scientific press coverage of this topic, although the two cohorts were studied within the same year.

Finally, although the authors' Analgesia Prescription Guideline appears to have had a positive effect in reducing the amount of prescribed and unused opioid, it is not clear if this intervention will have a long-lasting effect on opioid prescribing practice, and additional follow-up is needed to demonstrate the lasting efficacy of this intervention.

Although the authors' educational intervention was effective in changing prescription practices, it did not improve outpatient safe storage nor disposal of opioid medications. Further interventions will be necessary to address the patient's role in opioid stewardship.

The pragmatic guideline used in this study was a cost-free and effective intervention that reduced opioid prescriptions in this cardiac surgery service. Future iterations of this guideline will explore further reduction in the recommended amount of opioids prescribed, as well as incorporate the use of additional nonopioid analgesics, which may reduce chronic pain following cardiac surgery.[20] The implementation of the Analgesia Prescription Guideline or similar guides that use multimodal therapies for perioperative analgesia likely would result in a

significant reduction in the number of leftover opioid tablets in the cardiac surgery population without a reduction in patient satisfaction and with improvement in postsurgical analgesia.

J. Pena helped across all aspects of this study, including conceptualization, study design, participant recruitment, data collection, data analysis, figure preparation, and manuscript preparation. C.J. Chen helped in participant recruitment, data collection, and figure preparation and helped review and edit the manuscript. H. Clifford helped in participant recruitment, data collection, and figure preparation and helped review and edit the manuscript. Z. Xue along with S. Wang performed the majority of statistical analyses for the manuscript and assisted in figure preparation as well as manuscript editing. S. Wang along with Z. Xue performed the majority of statistical analyses for the manuscript and assisted in figure preparation as well as manuscript editing. M. Argenziano assisted in study design as well as manuscript editing. R. Landau assisted in study design and data analysis, as well as manuscript preparation and editing. M.-L. Meng acted as the principal investigator for the study and coordinated all aspects of the study including conceptualization, study design, institutional review board submission, participant recruitment, data analysis, and manuscript and figure preparation, as well as editing.

Declaration of Competing Interest

None.

Supplementary materials

Supplementary material associated with this article can be found in the online version at doi:10.1053/j.jvca.2020.12.021.

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