Discharge Opioid Prescription and Consumption Following Surgery: The POPCORN Observational Study

Kenzi Wassil Mokhtari, Anna Wong, Michelle Nguyen, Arianne Giard, Brian Ly, Dana Wazzan, David Williamson, and Vincent Dagenais-Beaulé

To cite: Mokhtari KW, Wong A, Nguyen M, Giard A, Ly B, Wazzan D, et al. Discharge opioid prescription and consumption following surgery: the POPCORN observational study. *Can J Hosp Pharm.* 2024;77(3):e3574. doi: 10.4212/cjhp.3574

ABSTRACT

Background: Few studies have evaluated opioid consumption after various inpatient surgical procedures.

Objectives: To describe opioid prescription patterns and to characterize patient-reported use of opioids after surgery.

Methods: This single-centre prospective observational study was conducted between February and October 2021 at the Jewish General Hospital in Montréal, Quebec. Patients 18 years of age or older who underwent a surgical procedure, were hospitalized for 24 hours or longer after the procedure, and had an opioid prescription at the time of discharge were included. Data were collected for the quantity of opioids prescribed, as documented in hospital records, and the quantity consumed, as reported by participants. Various potential predictors of opioid consumption were explored, and data were also collected on patients' use of non-opioid coanalgesia, scores on the Numeric Rating Scale for pain, opioid renewal requests, and proper opioid disposal during the 30-day follow-up period.

Results: A total of 150 participants completed the study. The median dose prescribed was 10 opioid pills (75.0 morphine milligram equivalents). By the end of the follow-up period, a median of 1 pill (7.5 morphine milligram equivalents) had been consumed from the total amount in the discharge prescription. Overall, 66 participants (44.0%) did not consume any of the opioids prescribed at discharge. Of the total number of pills prescribed, 58.2% (1193/2050) were unused, and 7.0% (5/71) of participants with unused pills disposed of them properly.

Conclusions: Following discharge from hospital, postoperative patients consumed a median proportion of only 10% of prescribed opioid pills. More than half of all prescribed pills were unused. Protocols implementing specific prescribing strategies warrant further investigation to evaluate their potential impact on opioid prescription and consumption.

Keywords: opioids, surgery, pain

RÉSUMÉ

Contexte : Peu d'études ont évalué la consommation d'opioïdes après diverses interventions chirurgicales en milieu hospitalier.

Objectifs : Décrire les schémas de prescription d'opioïdes et caractériser leur utilisation déclarée par les patients après une intervention chirurgicale.

Méthodologie : Cette étude observationnelle prospective monocentrique a été menée entre février et octobre 2021 à l'Hôpital général juif de Montréal, au Québec. Les patients d'au moins 18 ans ayant subi une intervention chirurgicale, ayant été hospitalisés pendant au moins 24 heures après l'intervention et qui avaient une prescription d'opioïdes au moment de leur congé ont été inclus dans l'étude. Des données ont été recueillies sur la quantité d'opioïdes prescrite, telle que documentée dans les dossiers de l'hôpital, et sur la quantité consommée, telle que déclarée par les participants. Divers prédicteurs potentiels de la consommation d'opioïdes ont été étudiés et des données ont aussi été recueillies, sur une période de suivi de 30 jours, sur l'utilisation de coanalgésie non opioïde par les patients, leurs scores sur l'échelle d'évaluation numérique de la douleur, les demandes de renouvellement d'opioïdes et l'élimination appropriée de ces dernières.

Résultats : Au total, 150 participants ont complété l'étude. La dose médiane prescrite était de 10 comprimés d'opioïdes (75,0 équivalents en milligrammes de morphine). À la fin de la période de suivi, une moyenne de 1 comprimé (7,5 équivalents en milligrammes de morphine) avait été consommée sur la quantité totale indiquée dans l'ordonnance remise au moment du congé. Dans l'ensemble, 66 participants (44,0 %) n'ont consommé aucun des opioïdes prescrits au moment du congé. Sur le nombre total de comprimés prescrits, 58,2 % (1193/2050) n'ont pas été utilisés et 7,0 % (5/71) des participants ayant des comprimés inutilisés s'en sont débarrassés correctement.

Conclusions : Suite au congé de l'hôpital, les patients postopératoires ne consommaient qu'une proportion médiane de 10 % des comprimés d'opioïde prescrits. Plus de la moitié de tous les comprimés prescrits n'ont pas été utilisés. Les protocoles mettant en œuvre des stratégies de prescription spécifiques justifient des recherches plus approfondies pour évaluer leur incidence potentielle sur la prescription et la consommation d'opioïdes.

Mots-clés : opioïdes, chirurgie, douleur

INTRODUCTION

A recent analysis by the Canadian Institute for Health Information showed that rates of opioid-related harms and deaths were continuing to rise across Canada.[1] Between 2022 and 2023, the rate of hospital admission due to opioid poisoning increased by 16%, and more than 8000 opioid-related deaths occurred in 2023 alone.[2] In fact, Canada now has the second-highest per capita consumption of opioids in the world.[3] Prescription opioids are an important contributing factor.[4] In addition, postoperative opioid prescriptions often do not reflect patients' consumption.[5-9] In the United States, multiple studies have shown that excessive amounts of opioids are routinely prescribed for numerous types of surgical procedures and that proper disposal of leftover pills is rare.[5-8] The leftover pills may then be available for diversion and inappropriate use.[10,11] In addition, receiving an opioid prescription at hospital discharge after surgery has been associated with an increased risk of long-term use.[12] There is little literature describing postoperative opioid prescription and consumption for inpatients undergoing procedures other than gynecological and orthopedic procedures.[13] The appropriate quantity of opioids to be prescribed upon discharge for inpatients after a wide range of surgeries is unknown.

The primary aim of this study was to describe current prescription and consumption patterns following a wide range of understudied inpatient surgical procedures. We hypothesized that the quantity of opioids prescribed at discharge would be greater than participants' requirements. The secondary aim was to explore the factors affecting opioid consumption after hospital discharge, as well as to describe opioid renewal requests and proper disposal.

METHODS

Study Design

This single-centre, prospective, observational study was conducted at the Jewish General Hospital, a university-affiliated teaching hospital in Montréal, Quebec. All patients undergoing surgery and admitted to 1 of 3 surgical wards were screened, between Monday and Friday each week, over the period February 5 to July 5, 2021.

Participants and Setting

All patients scheduled for surgery or who had undergone surgery were initially approached by clinical staff. The potential participants were then screened by an investigator (K.W.M, A.W., M.N., A.G., or B.L.) to confirm their eligibility. Eligible participants were adults 18 years of age or older who had undergone a urological, gynecological, colorectal, vascular, ear–nose–throat (ENT), or general surgical procedure and had been admitted for at least 24 hours after the surgery. Participants who underwent multiple procedures were included. Final eligibility was confirmed if the participant received an opioid prescription upon discharge. Of note, no specific postoperative prescribing guidelines were implemented on the wards for this population.

Patients were excluded if they had regularly scheduled opioid use in the 30 days before admission, had an opioid use disorder, had been hospitalized for 30 days or more before their surgery, were unable to give informed consent, were not discharged home, or were unable to complete the follow-ups because of incomprehension of French or English or severe hearing impairment. Patients were excluded post hoc if they were admitted to palliative care services after their surgery.

Data Collection

After consent was obtained, demographic characteristics, surgical variables, and hospital-related variables, such as opioid and analgesic consumption before discharge, were collected from the participants' electronic hospital charts and electronic medication administration records. Ethnicity was self-reported, without cues. Participants completed the Fear of Pain Questionnaire III (FPQ)[14] after their surgery.

A structured telephone interview, based on the literature and feedback from experienced clinicians, was designed.[13] All recruited participants were contacted on days 3 (± 1), 7 (± 2), 14 (± 2), and 30 (± 2) after hospital discharge. If the participant did not answer during a follow-up attempt, data for that follow-up were considered to be missing. Participants who were readmitted to hospital during the follow-up period were excluded from the analysis.

During each follow-up telephone interview, participants were asked questions about their opioid use, requests for opioid renewal, and level of pain (Appendix 1).

For each participant, data were collected by 1 of 5 investigators (K.W.M., A.W., M.N., A.G., or B.L.). For 10% of all participants, the collected data were reviewed by 2 other investigators from the same group, as a method of quality control. For each participant, all data concerning the quantity of opioids prescribed and consumed before and after discharge were reviewed by a pair of investigators from the same group of 5 coauthors.

Outcomes

The primary outcome was the quantity of opioids prescribed and consumed after hospital discharge in terms of number of opioid pills and morphine milligram equivalents (MME). The MME was calculated using Canadian recommendations (e.g., morphine 15 mg = hydromorphone 3 mg = oxycodone 10 mg).[15,16] The number of opioids prescribed was assessed from the discharge prescription and confirmed with the participant at the first follow-up. Opioids consumed were reported at each follow-up.

The secondary outcomes were factors potentially affecting opioid consumption after discharge, the participant's

use of coanalgesics after discharge, requests for opioid prescription renewal, proper disposal of remaining opioid pills, and the Numeric Rating Scale (NRS) score for pain assessment.[17,18] Proper disposal was defined as the return of any remaining opioid pills to a community pharmacy.[19]

Statistical Analysis

Descriptive statistics (frequencies, means with standard deviations [SDs], or medians with interquartile ranges [IQRs], as appropriate according to parametric or nonparametric distribution) were used to describe demographic characteristics, hospital-related characteristics, and opioid use. Patients who withdrew from the study or were readmitted to hospital during the follow-up period were not included in the analysis. The primary outcome of quantity of opioids prescribed was described by type of prescription (discharge prescription, additional prescription, old prescription), by prescribed opioid, by timing of follow-up, and by surgery type. The proportion of MME consumed was calculated in relation to the discharge prescription and was calculated only for those who completed the last follow-up.

For the secondary analyses, a multivariate logistic stepwise regression model was used to evaluate factors predicting the presence of opioid consumption after discharge. Four variables identified a priori on the basis of the literature[7,20-23] and expert opinion were introduced in the base model (age, opioid use in the 24 hours before discharge, quantity of opioids prescribed at discharge, and use of coanalgesics after discharge). An additional 8 variables were considered, based on the literature[6,14,20,24-33] and expert opinion—sex, insurance status, body mass index (BMI), Charlson Comorbidity Index,[34-36] type of procedure, surgery duration, length of stay (LOS), and FPQ score—and were added to the model if statistically significant ($\alpha = 0.05$). The model was validated using the Hosmer–Lemeshow test, *c*-statistic, and residuals analysis. A multivariate linear stepwise regression was performed to identify predictors of the quantity of opioids consumed by those patients who actually consumed their opioids using the same candidate variables. The linear regression model was validated by verifying the assumption of a linear relationship between variables and the outcome in the model. Both models were validated by an independent statistician.

Coanalgesic use was described by the number of participants using "coanalgesics", regardless of their opioid use. The proportion of proper opioid disposal was measured for participants who had discontinued using their prescribed opioids and still had leftover pills.

All analyses were performed using IBM SPSS statistical software, version 27.

Ethics Statement

All participants gave their free and informed consent for inclusion before enrolment. The study was conducted in accordance with the Declaration of Helsinki, and the protocol was approved by the Research Ethics Board of CIUSSS West-Central Montreal (Project 2021-268).

RESULTS

A total of 150 participants (84.3% of the 178 eligible candidates) completed the study (Appendix 2). The mean age was 58.6 (SD 16.3) years, 54.0% were female, and 70.0% were White. The most common type of surgery was general surgery (34.7%), the median LOS after surgery was 4.1 (IQR 2.1–6.8) days, and the mean FPQ score was 81.3 (SD 25.9) (Table 1). The characteristics of those excluded because of readmission to hospital or withdrawal from the study are presented in Appendix 3.

At discharge, the median number of pills prescribed was 10.0 (IQR 6.0–20.0) and the median MME was 75.0 (IQR 48.8–100.0) (Table 2). The most commonly prescribed opioids were oxycodone (50.0%, $n = 75$) and hydromorphone (48.0%, $n = 72$). Fifteen participants (10.0%) received a renewal prescription, in addition to their initial discharge order, and 2 participants (1.3%) had a pre-existing opioid prescription for hydromorphone as their discharge prescription. The median quantity and MME on additional prescriptions were 30.0 (IQR 20.0–40.0) pills and 225.0 (IQR 100.0–300.0) MME , respectively.

Across the 149 participants who completed the last follow-up, a total of 2050 pills were prescribed at discharge, of which 1193 (58.2%) were not taken. The median number of pills consumed from the discharge prescriptions by the end of the follow-ups was 1.0 (IQR 0.0–10.0), and the median MME consumed was 7.5 (IQR 0.0–50.0) (Table 3). The median proportion of MME consumed was 10.0% (IQR 0.0%–84.2%) for these 149 participants. The 2 participants with pre-existing opioid prescriptions consumed opioids exclusively from those prescriptions, rather than from the discharge prescription. Of the 149 participants who completed the last follow-up, 66 (44.3%) did not take any opioid pills, 51 (34.2%) partially consumed their prescription, and 32 (21.5%) finished their entire prescription by day 30.

The median number of pills prescribed ranged from 5 (IQR 5.0–5.0) for participants who underwent ENT surgery to 20 for those who underwent vascular surgery (IQR 10.0–25.0) or multiple simultaneous procedures (IQR 15.0–22.5) (Table 4). The median MME prescribed ranged from 37.5 (IQR 37.5–37.5) for participants who underwent ENT surgery to 100.0 for participants who underwent vascular surgery (IQR 75.0–150.0) or multiple simultaneous procedures (IQR 87.5–168.8).

Determinants of Opioid Consumption after Hospital Discharge

Of the 4 predictors of opioid consumption identified a priori, opioid use in the 24 hours before discharge (odds ratio [OR] 1.46, 95% confidence interval [CI] 1.16–1.84) and quantity

TABLE 1 (part 1 of 2). Demographic, Surgical, and Hospital-Related Characteristics

Characteristic	Study Group; No. (%) of Patients[a]		
	Opioid Consumption (*n* = 84)	No Opioid Consumption (*n* = 66)	Total (*n* = 150)
Age (years) (mean ± SD)	57.1 ± 15.2	60.4 ± 17.5	58.6 ± 16.3
Sex, female	49 (58.3)	32 (48.5)	81 (54.0)
Ethnicity (self-reported)[b]			
White	47 (74.6)	30 (63.8)	77 (70.0)
Afro-descendant	8 (12.7)	9 (19.1)	17 (15.5)
Asian	6 (9.5)	3 (6.4)	9 (8.2)
Middle Eastern	2 (3.2)	3 (6.4)	5 (4.5)
Hispanic	0 (0.0)	2 (4.3)	2 (1.8)
Public insurance	53 (63.1)	46 (69.7)	99 (66.0)
Weight (kg) (mean ± SD)[c]	80.8 ± 20.4	74.1 ± 16.1	77.9 ± 18.9
Body mass index (mean ± SD)[d]	28.7 ± 6.0	26.3 ± 5.2	27.7 ± 5.8
Charlson Comorbidity Index (median and IQR)	2.0 (0.0–3.0)	2.0 (0.0–3.0)	2.0 (0.0–3.0)
Active smoker[e]	7 (8.6)	8 (12.9)	15 (10.5)
Psychiatry disorder	7 (8.3)	6 (9.1)	13 (8.7)
Non-opioid substance use disorder[f]	1 (1.2)	0 (0.0)	1 (0.7)
FPQ score (mean ± SD)[g]	79.9 ± 26.9	83.0 ± 24.8	81.3 ± 25.9
Acute opioid use before admission	8 (9.5)	5 (7.6)	13 (8.7)
ICU stay	5 (6.0)	3 (4.5)	8 (5.3)
Type of surgery			
General surgery	31 (36.9)	21 (31.8)	52 (34.7)
Vascular	5 (6.0)	6 (9.1)	11 (7.3)
Colorectal	21 (25.0)	18 (27.3)	39 (26.0)
Ear, nose, throat	7 (8.3)	11 (16.7)	18 (12.0)
Urological	11 (13.1)	5 (7.6)	16 (10.7)
Gynecological	6 (7.1)	2 (3.0)	8 (5.3)
Multiple simultaneous	3 (3.6)	3 (4.5)	6 (4.0)
Surgery duration (h) (median and IQR)	2.6 (1.7–4.1)	2.7 (1.1–3.9)	2.6 (1.4–4.0)
Elective surgery	60 (71.4)	45 (68.2)	105 (70.0)
Laparoscopic surgery	31 (36.9)	29 (43.9)	60 (40.0)
Length of stay (days) (median and IQR)			
Total in hospital	4.6 (2.4–7.3)	4.6 (2.8–8.0)	4.6 (2.6–7.4)
Postoperative	4.0 (2.1–6.4)	4.2 (2.1–7.4)	4.1 (2.1–6.8)
No. of OR visits			
1	83 (98.8)	65 (98.5)	148 (98.7)
2	1 (1.2)	1 (1.5)	2 (1.3)
Patient-controlled analgesia	29 (34.5)	16 (24.2)	45 (30.0)
Continuous epidural infusion analgesia	15 (17.9)	11 (16.7)	26 (17.3)
NRS within 24 h before discharge (median and IQR)	1.5 (0.0–4.0)	0.0 (0.0–3.3)	1.0 (0.0–4.0)
Opioid use in the 24 h before discharge[h]			
No. of doses (median and IQR)	2.0 (0.0–4.0)	0.0 (0.0–0.5)	1.0 (0.0–3.0)
MME (median and IQR)	10.0 (0.0–30.0)	0.0 (0.0–1.3)	2.75 (0.0–20.0)
Coanalgesic doses used in 24 h before discharge (median and IQR)	3.0 (1.0–4.0)	2.0 (0.0–3.0)	2.0 (1.0–3.0)

TABLE 1 (part 2 of 2). Demographic, Surgical, and Hospital-Related Characteristics

Characteristic	Study Group; No. (%) of Patients[a]		
	Opioid Consumption (*n* = 84)	No Opioid Consumption (*n* = 66)	Total (*n* = 150)
Prescriber for opioid discharge prescription[i]			
Resident	81 (96.4)	58 (89.2)	139 (93.3)
Medical staff	3 (3.6)	7 (10.8)	10 (6.7)

FPQ = Fear of Pain Questionnaire, ICU = intensive care unit, IQR = interquartile range, MME = morphine milligram equivalents, NRS = Numeric Rating Scale for pain assessment, OR = operating room, SD = standard deviation.
[a]Except where indicated otherwise.
[b]Data for ethnicity were missing for 21 participants with opioid consumption and 19 participants with no opioid consumption.
[c]Data for weight were missing for 5 participants with opioid consumption and 6 participants with no opioid consumption.
[d]Data for body mass index were missing for 7 participants with opioid consumption and 7 participants with no opioid consumption.
[e]Data for smoking status were missing for 3 participants with opioid consumption and 4 participants with no opioid consumption.
[f]Data for non-opioid substance use disorder were missing for 1 patient with opioid consumption.
[g]Data for FPQ score were missing for 9 participants with opioid consumption and 3 participants with no opioid consumption.
[h]Data for opioid use in the 24 hours before discharge were missing for 1 participant with opioid consumption and 1 participant with no opioid consumption.
[i]One participant with no opioid consumption did not have a discharge prescription in the electronic databases. The prescription was confirmed at first follow-up.

TABLE 2. Quantity of Opioids Prescribed

Opioid	No. (%) of Patients (*n* = 150)	No. of Pills (Median and IQR)[a]	MME (Median and IQR)[a]
Prescribed at discharge			
Morphine	3 (2.0)	10.0 (range 10.0–20.0)	50.0 (range 50.0–100.0)
Hydromorphone	72 (48.0)	15.0 (10.0–20.0)	75.0 (50.0–100.0)
Oxycodone	75 (50.0)	10.0 (5.0–15.0)	75.0 (37.5–112.5)
Total	150 (100.0)	10.0 (6.0–20.0)	75.0 (48.8–100.0)
Prescribed after initial discharge prescription			
Hydromorphone	9 (6.0)	30.0 (20.0–50.0)	200.0 (100.0–325.0)
Oxycodone	6 (4.0)	30.0 (17.5–47.5)	225.0 (131.3–356.3)
Total	15 (10.0)	30.0 (20.0–40.0)	225.0 (100.0–300.0)
Prescribed from previous prescription			
Hydromorphone	2 (1.3)	80.0 (range 40.0–120.0)	400.0 (range 200.0–600.0)
Total	2 (1.3)	80.0 (range 40.0–120.0)	400.0 (range 200.0–600.0)

IQR = interquartile range.
[a]Except where indicated otherwise.

of opioids prescribed at discharge (OR 1.10, 95% CI 1.03–1.18) were statistically significant. The use of coanalgesics after discharge was removed from the model, as 90.0% (135/150) of patients reported using coanalgesics during at least 1 of the 4 follow-up interviews. Length of postoperative stay (OR 0.92, 95% CI 0.85–1.00) and BMI (OR 1.11, 95% CI 1.03–1.20) were added to the model as predictors. In the linear regression (n = 84), the quantity of opioids prescribed at discharge was the only statistically significant predictor of the quantity of pills consumed.

Use of Coanalgesics after Discharge

Among the 150 participants, 90.0% reported using coanalgesics during at least one of the follow-up interviews. On day 3 of follow-up, 118 (78.7%) participants reported using coanalgesics, of whom 54 were using only coanalgesics. On day 30 of follow-up, 58 (38.7%) participants reported using coanalgesics, of whom 43 were using only coanalgesics (Table 5).

NRS for Pain Assessment

Patients' pain declined steadily after discharge. More specifically, the median score on the NRS (which ranges from 0 to 10) was 3.0 (IQR 1.0–5.0; n = 146) on day 3 of follow-up, 2.0 (IQR 0.0–4.0; n = 144) on day 7 of follow-up, 1.0 (IQR 0.0–3.0; n = 147) on day 14 of follow-up, and 0.0 (IQR 0.0–2.0; n = 149) on day 30 of follow-up.

Request for Renewal of Opioid Prescription

Among the 149 participants who completed the last follow-up, 32 (21.5%) had consumed the entire quantity of their discharge prescription, 20 (13.4%) had requested a

prescription renewal, and 15 (10.1%) had received a new prescription after their discharge prescription. Of the latter 15 participants, 1 received a different opioid than the initial discharge prescription.

Disposal of Unused Opioids

Among the 150 participants, 122 filled their opioid prescription. Of these, 71 stopped taking their opioid prescription and had opioids remaining at day 30. Of these 71 participants, only 5 (7.0%) returned their pills to the pharmacy, and 14 (19.7%) planned to return them. Notably, 1 participant who had no opioids remaining at day 30 reported having lost some of the pills.

DISCUSSION

In this single-centre prospective observational study, the median quantity of opioids prescribed was 75.0 MME, equivalent to 15 pills of hydromorphone 1 mg or 10 pills of oxycodone 5 mg. The quantity prescribed was lower than reported in the literature.[32] The smaller prescription size may be explained by recent Canadian initiatives to encourage appropriate opioid prescribing.[37,38] Another explanation for the smaller prescription size could be the difference in prescribing practices between the United States and Canada. In a cohort study involving patients in Canada, the United States, and Sweden, the median opioid prescription

TABLE 3. Quantity of Opioids Consumed

Follow-Up Day	No. (%) of Patients[a] (*n* = 150)	No. of Pills (Median and IQR)	MME (Median and IQR)	% MME Consumed (Median and IQR)
Opioid consumption from discharge prescription				
Follow-up day 3	147 (98.0)	0.0 (0.0–3.0)	0.0 (0.0–20.0)	–
Follow-up day 7	147 (98.0)	0.0 (0.0–1.0)	0.0 (0.0–7.5)	–
Follow-up day 14	150 (100.0)	0.0 (0.0–0.0)	0.0 (0.0–0.0)	–
Follow-up day 30	149 (99.3)	0.0 (0.0–0.0)	0.0 (0.0–0.0)	
Cumulative by end of follow-up period	149 (99.3)	1.0 (0.0–10.0)	7.5 (0.0–50.0)	10.0 (0.0–84.2)
Opioid consumption from all prescriptions				
Follow-up day 3	147 (98.0)	0.0 (0.0–3.0)	0.0 (0.0–22.5)	–
Follow-up day 7	147 (98.0)	0.0 (0.0–2.0)	0.0 (0.0–10.0)	–
Follow-up day 14	150 (100.0)	0.0 (0.0–0.0)	7.5 (0.0–36.8)	–
Follow-up day 30	149 (99.3)	0.0 (0.0–0.0)	7.5 (0.0–35.0)	
Cumulative by end of follow-up period	150 (100.0)	0.0 (1.0–10.0)	7.5 (0.0–67.5)	10.0 (0.0–66.7)

IQR = interquartile range, MME = milligram morphine equivalent.
[a]Number of participants for whom data were available at the follow-up date, out of the total sample size of 150.

TABLE 4. Opioids Prescribed at Discharge and Subsequently Consumed, by Type of Surgery (*n* = 150)

Data Set	Type of Surgery; Median (IQR)[a]						
	General Surgery	Vascular	Colorectal	ENT	Urological	Gynecological	Multiple Simultaneous
No. (%) of total	52 (34.7)	11 (7.3)	39 (26.0)	18 (12.0)	16 (10.7)	8 (5.3)	6 (4.0)
Quantity prescribed (*n* = 150)							
Pills	10.0 (5.0–20.0)	20.0 (10.0–25.0)	15.0 (10.0–19.0)	5.0 (5.0–5.0)	12.5 (10.0–20.0)	10.0 (10.0–10.0)	20.0 (15.0–22.5)
MME	75.0 (37.5–100.0)	100.0 (75.0–150.0)	75.0 (50.0–112.5)	37.5 (37.5–37.5)	87.5 (75.0–140.6)	50.0 (50.0–75.0)	100.0 (87.5–168.8)
Quantity consumed (*n* = 149[b])							
Pills	1.0 (0.0–10.0)	0.0 (0.0–10.0)	0.75 (0.0–10.0)	0.0 (0.0–5.0)	5.5 (0.0–13.8)	2.5 (0.1–8.5)	4.5 (0.0–12.5)
MME	7.5 (0.0–61.9)	0.0 (0.0–50.0)	3.8 (0.0–50.0)	0.0 (0.0–35.6)	32.5 (0.0–76.9)	12.5 (0.6–42.5)	33.8 (0.0–81.3)
% MME used	17.5 (0.0–100.0)	0.0 (0.0–85.0)	41.7 (0.0–59.1)	0.0 (0.0–77.5)	55.0 (0.0–87.5)	25.0 (2.5–79.2)	15.0 (0.0–87.5)

ENT = ear, nose, and throat; IQR = interquartile range; MME = milligram morphine equivalent; SD = standard deviation.
[a]Except where indicated otherwise.
[b]Data missing for 1 participant because they missed the final follow-up.

TABLE 5. Use of Coanalgesics after Discharge

Follow-Up Day	Group; No. of Participants: Using Coanalgesics Only	Using Coanalgesics with Opioids	Total[a]
Day 3	54	64	118
Day 7	58	40	98
Day 14	67	21	88
Day 30	43	15	58

[a]This group includes those using coanalgesics only and those using coanalgesics and opioids together.

dispensed for all surgical procedures was highest in the United States.[29] As distinct from the literature, our population included patients who underwent ENT, vascular, and colorectal surgeries, for which prior data are lacking. Patients who underwent ENT surgeries had the smallest quantity of opioids prescribed at discharge, which may also help to explain the overall smaller prescription size observed.

The median quantity of opioids consumed by patients in this study was 7.5 MME, and the median proportion consumed was 10.0%, much lower than observed in previous studies.[6,7,9] Indeed, Howard and others[7] reported a median consumption of 45 MME, and Fujii and others[9] reported a median consumption of 24 MME. In those 2 studies and that of Hill and others,[6] the median proportion consumed was similar, at 27%, 27%, and 28%, respectively (Hill and others[6] did not report median consumption in terms of MME). These differences could be explained by the fact that patients in the current study were hospitalized for at least 24 hours after surgery and stayed a median of 4.1 days postoperatively, whereas the other studies included outpatient surgeries.[6,7,9] To our knowledge, ours is the first study to evaluate the median quantity of opioids consumed after discharge by adult surgical patients who remained in hospital for at least 24 hours after their surgery.

The median MME consumed by the time of first follow-up (3 days) was 0.0, which indicates that at least half of the patients did not take any opioids in the immediate postoperative period. At subsequent follow-ups, there was an increase in consumption, with a median of 7.5 MME consumed by 1 month after discharge. These data might suggest that patients are not consuming their prescribed opioids for the intended purpose of treating acute postsurgical pain. Interestingly, patients who underwent vascular surgery constituted one of the groups consuming the smallest quantity of opioids, despite having the highest level of opioid prescription; patients who underwent ENT surgery had similarly low consumption. In contrast, patients who underwent urological and gynecological surgeries had the highest median proportions of MME consumed.

We identified discharge prescription quantity, opioid consumption during the 24 hours before discharge, BMI, and LOS as statistically significant predictors of opioid consumption. However, the linear regression model, which had a smaller sample size, identified only 1 factor. Specifically, in that model, the number of doses prescribed at discharge was significantly associated with the number of opioid doses consumed, as observed in other studies.[8] This finding suggests that patients with larger opioid prescriptions are more inclined to start using the prescribed medication and to consume more pills. Given that discharge prescriptions can be tailored to individual patients' characteristics, larger opioid prescriptions may be explained by the prescriber's anticipation of higher needs. Opioid consumption during the 24 hours before discharge has been well documented as a potential predictor of postdischarge opioid requirements,[24,38-40] which is consistent with our findings. Longer postoperative LOS was associated with no opioid consumption after discharge, which may be explained by a decrease in surgical site pain over time. Although no studies have evaluated the impact of LOS on opioid consumption in adults, a study involving younger patients (1–21 years of age) found that longer LOS was associated with increased opioid consumption.[26] The contrast between those findings and ours may be attributed to the different populations and different types of surgery performed. Higher BMI has been associated with a higher level of pain following surgery,[26] but no association between BMI and opioid consumption has been found in previous studies.

Age was not a significant predictor of opioid consumption in our study, but younger participants tended to consume more opioids, as reported previously.[20] Coanalgesia after discharge was another potential predictor identified a priori, based on studies suggesting a reduction in pain and opioid consumption with multimodal analgesia.[23,39] In our study, coanalgesia was used by nearly all patients, so was not considered a factor in opioid consumption.

In our study, we explored the perception of pain using the FPQ. Interestingly, the mean FPQ score resembled

the score of the medical outpatient population involved in the original FPQ validation study.[14] This suggests that the perception of pain is similar for surgical inpatients and general medical outpatients. The FPQ was tested in the regression models but was not found to be a significant predictor of opioid consumption.

A potential concern for clinicians when prescribing opioids postoperatively is the need for patients to renew their prescription if the initial quantity is insufficient. In this study, 13.4% of participants requested a prescription renewal, likely because initial prescription size was smaller than reported in previous studies. For these patients, the median number of pills and the median MME on the prescription renewal were more than double the quantities prescribed at discharge. Clinicians may still be reassured that a relatively small proportion (only 13.4%) of participants requested an additional prescription, despite the smaller quantity of opioids prescribed at discharge.

Another notable finding in our study was the high proportion of participants with opioid pills remaining who did not dispose of them properly. Only 7.0% of participants who had pills remaining after they stopped taking their opioid medication returned the leftover pills to the pharmacy. This finding was consistent with that of Bicket and others,[5] who reported that only 4% to 9% of patients considered disposing or had disposed of their remaining opioids. In addition, we found that 58.2% of all the pills prescribed were left unused. The improper disposal of opioids can contribute to the harmful effects associated with opioid misuse. According to a 2017 report, about half of those who misused prescription pain relievers in the previous year reported obtaining the prescription from a friend or relative for free.[40] Patient education could be an important factor in encouraging proper disposal of unused pills.

This study had some limitations. The measurement of opioid consumption relied on telephone follow-ups, meaning that the data were subject to recall bias. Other potential variables that could influence pain and opioid consumption, such as chronic pain associated with comorbidities, were not assessed in this study. As a single-centre study, this investigation may have generated results that reflect only the reality within our community. Furthermore, our conclusions may not be applicable to other surgical procedures. The study population was limited to patients who received an opioid prescription at discharge, without prior long-term opioid use. Patients discharged without an opioid prescription were not studied.

The results of this study demonstrate that it remains a challenge for clinicians to achieve adequate pain control with opioid therapy while limiting opioid misuse due to excess prescribing. However, our results also show that a vast proportion of opioid prescription could have been avoided. Aside from patient education, one possible strategy to limit the large number of unused opioids could be to standardize the subdivision of opioid prescriptions by limiting the quantity that can be dispensed at one time, either mandated by the prescriber or suggested by the dispensing pharmacist. This would allow an adequate prescription size for the 21.5% of patients who consumed the entire quantity of opioids in the discharge prescription but would limit circulation of excess opioids in the community for the 44.3% of patients who did not use any of the opioids prescribed. Further studies will be needed to evaluate whether specific prescribing strategies, such as subdividing discharge opioid prescriptions and tailoring prescription size to identified predictors, can reduce opioid consumption and the circulation of unused opioids while adequately controlling patients' pain.

CONCLUSION

In this study, more than half of opioid pills prescribed at discharge were left unused by surgical patients. Although for most patients the quantity of opioids prescribed at discharge was small, only a median of 10% of the prescribed pills were consumed. The minimal proportion of patients who properly disposed of unused pills is concerning, given the current opioid crisis. Patient education and standardized prescribing strategies are needed to limit the accumulation of opioids in the community while maintaining adequate pain control.

References

1. *Opioid prescribing in Canada: how are practices changing?* Canadian Institute for Health Information; 2019 [cited 2020 Oct 30]. Available from: https://www.cihi.ca/sites/default/files/document/opioid-prescribing-canada-trends-en-web.pdf
2. Federal, Provincial, and Territorial Special Advisory Committee on the Epidemic of Opioid Overdoses. *Opioid- and stimulant-related harms in Canada*. Public Health Agency of Canada; updated 2024 Jun 28 [cited 2024 Jul 29]. Available from: https://health-infobase.canada.ca/substance-related-harms/opioids-stimulants/
3. *Narcotic drugs 2017: estimated world requirements for 2018, statistics for 2016*. International Narcotics Control Board; 2017 [cited 2020 Oct 30]. Available from: https://www.incb.org/documents/Narcotic-Drugs/Technical-Publications/2017/Narcotic_drugs_technical_publication_2017.pdf
4. Belzak L, Halverson J. Evidence synthesis – the opioid crisis in Canada: a national perspective. *Health Promot Chron Dis Prev Can*. 2018; 38(6):224-33.
5. Bicket MC, Long JJ, Pronovost PJ, Alexander GC, Wu CL. Prescription opioid analgesics commonly unused after surgery: a systematic review. *JAMA Surg*. 2017;152(11):1066-71.
6. Hill MV, McMahon ML, Stucke RS, Barth RJ Jr. Wide variation and excessive dosage of opioid prescriptions for common general surgical procedures. *Ann Surg*. 2017;265(4):709-14.
7. Howard R, Fry B, Gunaseelan V, Lee J, Waljee J, Brummett C, et al. Association of opioid prescribing with opioid consumption after surgery in Michigan. *JAMA Surg*. 2019;154(1):e184234.
8. Thiels CA, Anderson SS, Ubl DS, Hanson KT, Bergquist WJ, Gray RJ, et al. Wide variation and overprescription of opioids after elective surgery. *Ann Surg*. 2017;266(4):564-73.

9. Fujii MH, Hodges AC, Russell RL, Roensch K, Beynnon B, Ahern TP, et al. Post-discharge opioid prescribing and use after common surgical procedure. *J Am Coll Surg.* 2018;226(6):1004-12.
10. Manchikanti L, Helm S 2nd, Fellows B, Janata JW, Pampati V, Grider JS, et al. Opioid epidemic in the United States. *Pain Physician*. 2012;15(3 Suppl):ES9-38.
11. Han B, Compton WM, Blanco C, Crane E, Lee J, Jones CM. Prescription opioid use, misuse, and use disorders in U.S. adults: 2015 National Survey on Drug Use and Health. *Ann Intern Med*. 2017;167(5):293-301.
12. Alam A, Gomes T, Zheng H, Mamdami MM, Juurlink DN, Bell CM. Long-term analgesic use after low-risk surgery: a retrospective cohort study. *Arch Intern Med.* 2012;172(5):425-30.
13. Howard R, Vu J, Lee J, Brummett C, Englesbe M, Waljee J. A pathway for developing postoperative opioid prescribing best practices. *Ann Surg*. 2020;271(1):86-93.
14. McNeil DW, Rainwater AJ 3rd. Development of the Fear of Pain Questionnaire--III. *J Behav Med*. 1998;21(4):389-410.
15. Kahan M, Mailis-Gagnon A, Wilson L, Srivastava A. Canadian guideline for safe and effective use of opioids for chronic noncancer pain: clinical summary for family physicians. Part 1: general population. *Can Fam Physician*. 2011;57(11):1257-66, e407-18.
16. Dechêne G, Dubuc B, Ladouceur R, Néron A. Connaître les équivalences analgésiques des divers opioïdes. In : *Les soins medicaux dans les derniers jours de la vie*. Collège des médecins du Québec; 2015 [cited 2024 Jul 30]. pp. 14-5. Available from: https://medfam.umontreal.ca/wp-content/uploads/sites/16/2019/08/CMQ-LES-SOINS-M%C3%89DICAUX-DANS-LES-DERNIERS-JOURS-DE-LA-VIE.pdf
17. Gagliese L, Weizblit N, Ellis W, Chan VW. The measurement of postoperative pain: a comparison of intensity scales in younger and older surgical patients. *Pain*. 2005;117(3):412-20.
18. Li L, Liu X, Herr K. Postoperative pain intensity assessment: a comparison of four scales in Chinese adults. *Pain Med.* 2007;8(3):223-34.
19. Storage and disposal of opioids [patient information brochure]. Institute for Safe Medication Practices Canada; 2016 [cited 2020 Oct 30]. Available from: https://www.ismp-canada.org/download/OpioidStewardship/OpioidStorageDisposal-patient.pdf
20. Kim N, Matzon JL, Abboudi J, Jones C, Kirkpatrick W, Leinberry CF, et al. A prospective evaluation of opioid utilization after upper-extremity surgical procedures: identifying consumption patterns and determining prescribing guidelines. *J Bone Joint Surg Am.* 2016;98(20):e89.
21. Hill MV, Stucke RS, Billmeier SE, Kelly JL, Barth RJ Jr. Guideline for discharge opioid prescriptions after inpatient general surgical procedures. *J Am Coll Surg*. 2018;226(6):996-1003.
22. Tamboli M, Mariano ER, Gustafson KE, Briones BL, Hunter OO, Wang RR, et al. A multidisciplinary patient-specific opioid prescribing and tapering protocol is associated with a decrease in total opioid dose prescribed for six weeks after total hip arthroplasty. *Pain Med*. 2019;21(7):1474-81.
23. Desai K, Carroll I, Asch SM, Seto T, McDonald KM, Curtin C, et al. Utilization and effectiveness of multimodal discharge analgesia for postoperative pain management. *J Surg Res.* 2018;228:160-9.
24. Rodgers J, Cunningham K, Fitzgerald K, Finnerty E. Opioid consumption following outpatient upper extremity surgery. *J Hand Surg Am*. 2012;37(4):645-50.
25. Tully A, Anderson L, Adams W, Mosier MJ. Opioid creep in burn center discharge regimens: doubled amounts and complexity of narcotic prescriptions over seven years. *Burns.* 2019;45(2):328-34.
26. Chung F, Ritchie E, Su J. Postoperative pain in ambulatory surgery. *Anesth Analg.* 1997;85(4):808-16.
27. Scully RE, Schoenfeld AJ, Jiang W, Lipsitz S, Chaudhary MA, Learn PA, et al. Defining optimal length of opioid pain medication prescription after common surgical procedures. *JAMA Surg*. 2018;153(1):37-43.
28. Chaudhary MA, Schoenfeld AJ, Harlow AF, Ranjit A, Scully R, Chowdhury R, et al. Incidence and predictors of opioid prescription at discharge after traumatic injury. *JAMA Surg.* 2017;152(10):930-6.
29. Ladha KS, Neuman MD, Broms G, Bethell J, Bateman BT, Wijeysundera DN, et al. Opioid prescribing after surgery in the United States, Canada, and Sweden. *JAMA Netw Open*. 2019;2(9):e1910734-e.
30. Castillo-Angeles M, Chaudhary MA, Sharma M, Jiang W, Schoenfeld A, Havens JM, et al. Prevalence and predictors of opioid prescription at discharge after emergency general surgery. *J Am Coll Surg*. 2017; 225(4):e92-e3.
31. Deyo RA, Hallvik SE, Hildebran C, Marino M, O'Kane N, Carson J, et al. Use of prescription opioids before and after an operation for chronic pain (lumbar fusion surgery). *Pain*. 2018;159(6):1147-54.
32. Feinberg AE, Chesney TR, Srikandarajah S, Acuna SA, McLeod RS; Best Practice in Surgery Group. Opioid use after discharge in postoperative patients: a systematic review. *Ann Surg.* 2018;267(6): 1056-62.
33. McGrath B, Elgendy H, Chung F, Kamming D, Curti B, King S. Thirty percent of patients have moderate to severe pain 24 hr after ambulatory surgery: a survey of 5,703 patients. *Can J Anaesth*. 2004;51(9):886-91.
34. Charlson ME, Pompei P, Ales KL, MacKenzie CR. A new method of classifying prognostic comorbidity in longitudinal studies: development and validation. *J Chronic Dis*. 1987;40(5):373-83.
35. Stavem K, Hoel H, Skjaker SA, Haagensen R. Charlson comorbidity index derived from chart review or administrative data: agreement and prediction of mortality in intensive care patients. *Clin Epidemiol.* 2017;9:311-20.
36. Quan H, Li B, Couris CM, Fushimi K, Graham P, Hider P, et al. Updating and validating the Charlson comorbidity index and score for risk adjustment in hospital discharge abstracts using data from 6 countries. *Am J Epidemiol*. 2011;173(6):676-82.
37. Busse JW, Craigie S, Juurlink DN, Buckley DN, Wang L, Couban RJ, et al. Guideline for opioid therapy and chronic noncancer pain. *CMAJ*. 2017;189(18):E659-E666.
38. Kahan DM. Choosing Wisely Canada recommendations. *Can Fam Physician*. 2018;64(5):368.
39. Clarke H, Page GM, McCartney CJ, Huang A, Stratford P, Andrion J, et al. Pregabalin reduces postoperative opioid consumption and pain for 1 week after hospital discharge, but does not affect function at 6 weeks or 3 months after total hip arthroplasty. *Br J Anaesth.* 2015; 115(6):903-11.
40. Lipari RN, Hughes A. How people obtain the prescription pain relievers they misuse. In: *The CBHSQ Report*. Substance Abuse and Mental Health Services Administration (US), Center for Behavioral Health Statistics and Quality; 2017 Jan 12. pp. 1-7.

Kenzi Wassil Mokhtari, PharmD, MSc, is with the Faculty of Pharmacy, Université de Montréal, Montréal, Quebec, and the Department of Pharmacy, Hôpital Pierre-Boucher, Longueuil, Quebec.

Anna Wong, PharmD, MSc, is with the Faculty of Pharmacy, Université de Montréal, and the Department of Pharmacy, Jewish General Hospital, Montréal, Quebec.

Michelle Nguyen, PharmD, MSc, MBA, is with the Faculty of Pharmacy, Université de Montréal, and the Department of Pharmacy, Jewish General Hospital, Montréal, Quebec.

Arianne Giard, PharmD, MSc, is with the Faculty of Pharmacy, Université de Montréal, and the Department of Pharmacy, Jewish General Hospital, Montréal, Quebec.

Brian Ly, PharmD, MSc, is with the Faculty of Pharmacy, Université de Montréal, and the Department of Pharmacy, Jewish General Hospital, Montréal, Quebec.

Dana Wazzan, PharmD, MSc, is with the Faculty of Pharmacy, Université de Montréal, and the Department of Pharmacy, Jewish General Hospital, Montréal, Quebec.

David Williamson, BPharm, MSc, PhD, is with the Faculty of Pharmacy, Université de Montréal, and the Department of Pharmacy and Research Centre, Hôpital du Sacré-Coeur de Montréal, Montréal, Quebec.

Vincent Dagenais-Beaulé, PharmD, MSc, is with the Faculty of Pharmacy, Université de Montréal; and the Department of Pharmacy and Lady Davis Institute, Jewish General Hospital, Montréal, Quebec.

At the time this study was conducted, Kenzi Wassil Mokhtari, Anna Wong, Michelle Nguyen, Arianne Giard, Brian Ly, were students in the Faculty of Pharmacy, Université de Montréal. They have now graduated and are working there as clinicians.

Competing interests: For activities unrelated to the study reported here, David Williamson serves on a data safety monitoring board for a University of Ottawa study of dexmedetomidine in agitated delirium, and Vincent Dagenais-Beaulé has received consulting fees from Otsuka-Lundbeck, Abbvie, and the Institut national d'excellence en santé et services sociaux (INESSS); speaker's honoraria from Otsuka-Lundbeck, HLS Therapeutics, and Abbvie; and support for meeting attendance from Otsuka-Lundbeck. No other competing interests were declared.

Address correspondence to:
Dr David Williamson
Faculty of Pharmacy
Université de Montréal
2940, chemin de Polytechnique
Montréal QC H3T 1J4

email: david.williamson@umontreal.ca

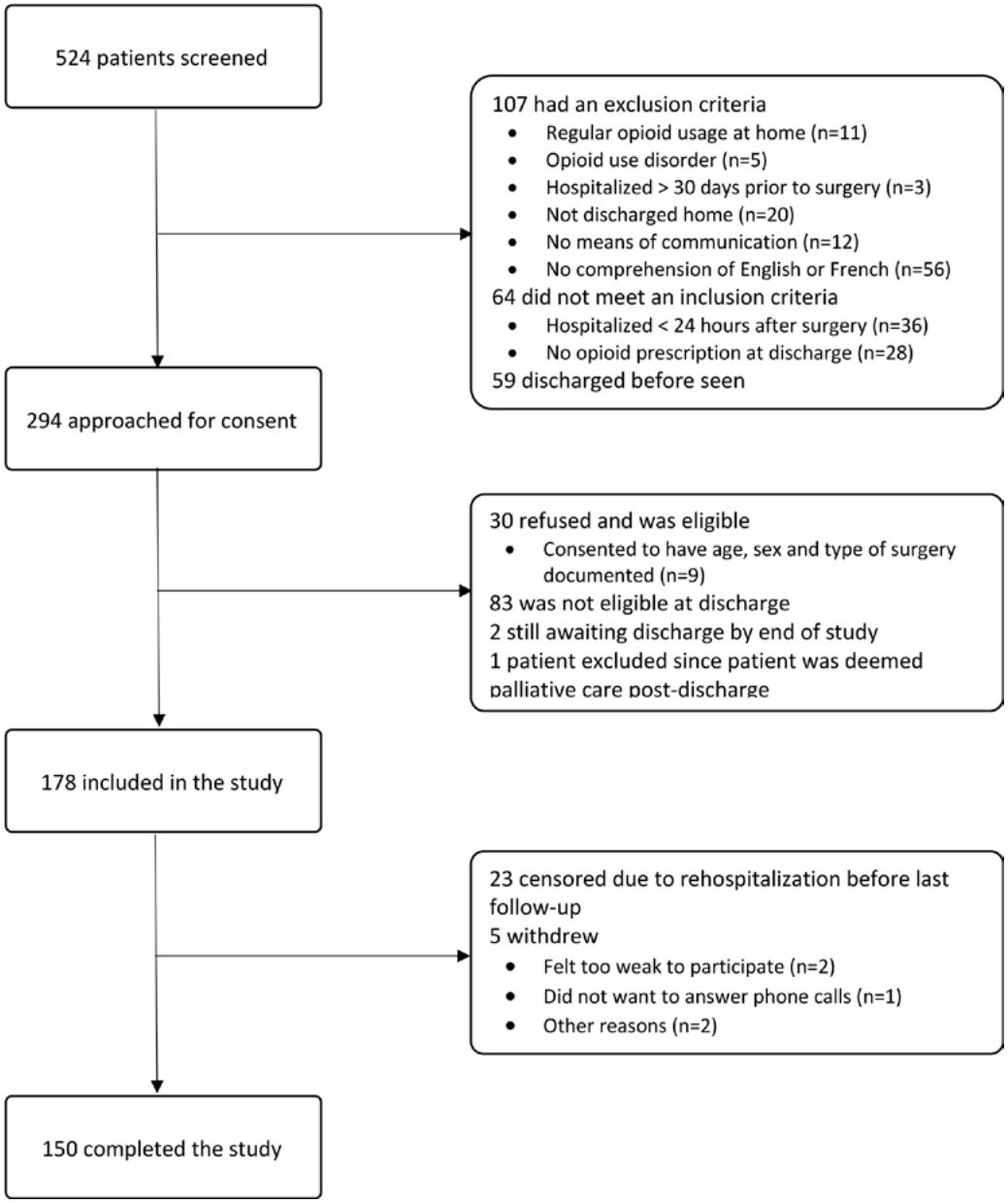
Funding: The Faculty of Pharmacy, Université de Montréal, provided support to pay the statistician's fees.

Submitted: December 19, 2023
Accepted: March 26, 2024
Published: September 11, 2024

APPENDIX 1: Information requested from patient participants.

1. Opioid prescription filled (yes/no)
2. Number of pills dispensed and consumed
3. Number of pills lost and remaining
4. Frequency of coanalgesic use (defined as non-opioid analgesia, either daily or as needed) to control pain
5. Disposal of remaining opioid pills
6. Level of pain during follow-up, according to the Numeric Rating Scale (NRS)
7. Opioids consumed from a source other than the discharge prescription
8. Opioid renewal request sent to a medical practitioner (yes/no)

APPENDIX 2: Flow diagram for study inclusion.



APPENDIX 3. Characteristics of patients excluded from analysis.

Characteristic	Patient Group; No. (%) of Patients[a]		
	Refused Participation[b] (*n* = 9)	Excluded Due to Readmission (*n* = 23)	Withdrew from Study (*n* = 5)
Age (years) (mean ± SD)	54.0 ± 18.2	59.8 ± 13.2	60.6 ± 11.3
Sex, female	6 (67)	10 (43)	1 (20)
Type of surgery			
General surgery	1 (11)	8 (35)	1 (20)
Vascular	1 (11)	2 (9)	0 (0)
Colorectal	3 (33)	7 (30)	2 (40)
Ear, nose, and throat	2 (22)	2 (9)	0 (0)
Urological	0 (0)	3 (13)	2 (40)
Gynecological	2 (22)	1 (4)	0 (0)
Elective surgery	5 (56)	19 (83)	4 (80)

SD = standard deviation.
[a]Except where indicated otherwise.
[b]Although these 9 patients refused to participate, they consented to collection of certain demographic data; an additional 21 patients refused to participate and did not consent to collection of any data.