Opioid Prescribing at Hospital Discharge Contributes to Chronic Opioid Use

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BACKGROUND: Chronic opioid therapy for chronic pain treatment has increased. Hospital physicians, including hospitalists and medical/surgical resident physicians, care for many hospitalized patients, yet little is known about opioid prescribing at hospital discharge and future chronic opioid use.

OBJECTIVE: We aimed to characterize opioid prescribing at hospital discharge among 'opioid naïve' patients. Opioid naïve patients had not filled an opioid prescription at an affiliated pharmacy 1 year preceding their hospital discharge. We also set out to quantify the risk of chronic opioid use and opioid refills 1 year post discharge among opioid naïve patients with and without opioid receipt at discharge.

DESIGN: This was a retrospective cohort study.

PARTICIPANTS: From 1 January 2011 to 31 December 2011, 6,689 opioid naïve patients were discharged from a safety-net hospital.

MAIN MEASURE: Chronic opioid use 1 year post discharge.

KEY RESULTS: Twenty-five percent of opioid naïve patients (n=1,688) had opioid receipt within 72 hours of discharge. Patients with opioid receipt were more likely to have diagnoses including neoplasm (6.3 % versus 3.5 %, p<0.001), acute pain (2.7 % versus 1.0 %, p<0.001), chronic pain at admission (12.1 % versus 3.3 %, p<0.001) or surgery during their hospitalization (65.1 % versus 18.4 %, p<0.001) compared to patients without opioid receipt. Patients with opioid receipt were less likely to have alcohol use disorders (15.7 % versus 20.7 %, p<0.001) and mental health disorders (23.9 % versus 31.4 %, p<0.001) compared to patients without opioid receipt. Chronic opioid use 1 year post discharge was more common among patients with opioid receipt (4.1 % versus 1.3 %, p<0.0001) compared to patients without opioid receipt. Opioid receipt was associated with increased odds of chronic opioid use (AOR=4.90, 95 % CI 3.22-7.45) and greater subsequent opioid refills (AOR=2.67, 95 % CI 2.29-3.13) 1 year post discharge compared to no opioid receipt.

CONCLUSION: Opioid receipt at hospital discharge among opioid naïve patients increased future chronic opioid use. Physicians should inform patients of this risk prior to prescribing opioids at discharge.

KEY WORDS: pain; hospital medicine; substance abuse.
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INTRODUCTION

The use of opioids to treat pain escalated over the last decade and pharmaceutical opioid-related overdose deaths increased fourfold.[1–11] Greater opioid prescribing contributed to increased opioid availability for abuse and overdose.[12–14] Primary care physicians (PCPs) and internists prescribe the majority of opioids.[15,16] PCPs have long-standing patient relationships and know when their patients have substance use disorders or ongoing psychosocial stressors that may increase their risk of opioid misuse.[17–19]

Increasingly, PCPs do not care for their patients when they are hospitalized. Commonly, hospital-based physicians, including hospitalists, and medical and surgical residents in academic institutions, work exclusively in the hospital and care for the majority of hospitalized patients.[20–26] Oftentimes, the hospital physician is first introduced to their patient at hospital admission and must rely on the history, physical exam and medical record when making medical decisions.[27–31] For this reason, the hospital physician may be unaware of a patient's drug or alcohol use or mental illness, all risk factors for opioid misuse.[32–34] Unfamiliarity between the hospital physician and the patient, and variability in opioid prescribing by hospital physicians, may contribute to chronic opioid use.

Both pain[35–37] and substance use disorders are common among hospitalized patients.[3,38–43] When a patient endorses pain, the physician must first determine the etiology of the pain and then decipher if the patient has risk factors for aberrant opioid use. The physician must then identify an appropriate treatment strategy for pain control, which may or may not include opioids. Lastly, when patients with an opioid

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use disorder require opioids for pain control, the physician must adequately control the pain while managing the opioid use disorder.

Changes in hospital reimbursement may influence opioid prescribing.[44–47] Patient perceived pain control is a key quality indicator for hospitals. Some providers are financially incentivized to aggressively treat pain because their salaries are tied to patient satisfaction scores that encompass pain control metrics.[48–55] Balancing the risks and benefits of opioid prescribing is difficult when the physician faces pressure from the patient and healthcare system.[18,56]

We characterized opioid receipt at hospital discharge among opioid naïve medical and surgical patients. We quantified the risk of chronic opioid use 1 year post hospital discharge among patients with and without opioid receipt at discharge. We determined if opioid receipt increased the odds of greater opioid refills 1 year post discharge. We included patients with medical and surgical conditions to investigate the role of surgery on opioid prescribing at discharge and chronic opioid use 1 year post discharge. This research has implications for opioid prescribing at hospital discharge.

METHODS

Study Design and Setting

We conducted a retrospective cohort study of all patients presenting to an academic safety-net medical center in Denver, Colorado. The medical center includes an emergency department, hospital, primary care and subspecialty clinics, federally qualified community health centers, behavioral health clinics, and drug use disorder clinics. The hospital does not employ a dedicated inpatient pain management specialist. The University of Colorado Multiple Institutional Review Board approved this study.

Data Source and Participants

We examined all surgical and medical hospital discharges between 1 January 2011 and 31 December 2011 via an electronic query of health records compiled in a data warehouse. The data warehouse pools demographic, pharmacy, laboratory data and International Classification of Diseases and Procedures, Ninth Revision (ICD-9) diagnosis codes obtained during patient care delivery. Pharmacy data included medication dose, number of days prescribed and the quantity dispensed. We did not capture data describing opioid doses and frequencies.

We examined all patients discharged during 2011. The discharging physician may have been a medical or surgical resident physician, or a hospitalist. The first discharge for each patient was categorized as the 'index discharge.' From these patients, we excluded patients who filled opioid prescriptions at a Denver Health-affiliated pharmacy 12 months preceding their index discharge. We also excluded the following patients: < 15 years old, in correctional care (prison, jail, or police custody), who died during the index hospitalization, hadmore that two healthcare visits to Denver Health 3 years preceding their index discharge, were on hemodialysis, or were undocumented persons. We excluded patients with less than two healthcare visits to Denver Health because they were less likely to receive follow-up healthcare in this system. Similar criteria were used in studies using this data source.[57–59] We excluded correctional care patients because ongoing healthcare and medication dispensing occurs within the correctional system.

Exposure Variable

The study sample included 'opioid naïve' patients who had not filled an opioid prescription at a Denver Health-affiliated pharmacy in the 12 months preceding their index discharge. Patients were categorized into the 'opioid receipt' cohort if they filled an opioid prescription at a Denver Health-affiliated pharmacy within 72 hours of their index discharge. They were categorized into the 'no opioid receipt' cohort if they did not fill an opioid prescription following discharge (Fig. 1). We did not identify non-opioid medications prescribed at discharge.

Outcome Variables

The primary outcome variable was chronic opioid use 1 year post hospital discharge. We defined chronic opioid use as "an opioid use episode lasting > 90 days with a total of 120+ day supply of opioids or > 10 opioid prescriptions dispensed over 1 year" consistent with prior definitions.[60–62] "Opioid day supply" 1 year post discharge was calculated by summing opioid fills in 90-day increments per the definition of chronic use. A secondary outcome variable described subsequent opioid refills 1 year post index discharge. Opioid refills were ordinally categorized as 0; 1–2; 3–5; 6–10; > 10 refills. Outcome variables excluded opioids dispensed at the index discharge.

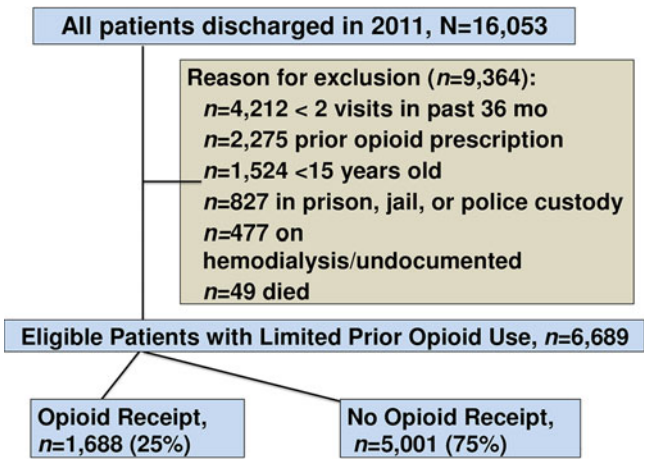

Fig. 1 Patient flow chart

Baseline Measures

Gender, race/ethnicity, age, and insurance status were determined from registration data collected at the index hospitalization. Insurance status was classified as discount payment plan (Child Health Plan Plus; Colorado Indigent Care Program; Denver Health Financial Assistance Program); Medicare; Medicaid; commercial; or unknown/other/self-pay.

Medical diagnoses, including chronic pain, mental health and substance use disorders, were identified by querying patient encounters in the 3 years preceding the index hospitalization (Jan 2008 through Dec 2011) using ICD-9 codes (Table 1; Appendix 1 [available online]).[63] From these diagnoses, we calculated a Charlson Comorbidity Index score.[64,65] Admission and discharge diagnoses of chronic pain, acute pain and neoplasm were reported (Table 1; Appendix 1 [available online]). Occurrence of surgery during the index hospitalization was determined by querying our database using ICD-9 surgical/procedural codes (Appendix 1 [available online]). Cannabis use was not examined because medical marijuana was legal in Colorado during the study.[66]

Statistical Analyses

Analyses were performed using SAS Version 9.3 (SAS Institute, Inc., Cary, North Carolina). Means and standard deviations (SDs) were reported for continuous data (also quartile values for some variables), and frequencies and proportions were reported for categorical data. 'Opioid receipt' and 'no opioid receipt' characteristics were compared using *t*-tests for continuous variables, chi-square or Fisher's exact tests for categorical variables, and Cochran-Mantel-Haenszel tests for ordinal variables. Unadjusted associations between variables and chronic opioid use were assessed by chi-square tests provided by logistic regression models. Potential covariates ($p<0.1$) in Table 1 were included in the preliminary multivariable logistic regression model to estimate the effect of opioid receipt on chronic opioid use. Covariates that were not significantly ($p\geq0.05$) associated with the outcome were sequentially deleted from the model using backward elimination to result in the final multivariable logistic regression model. Odds ratio (OR) estimates and 95 % confidence intervals (CIs) for opioid receipt were adjusted for insurance, chronic pain or malignancy 3 years preceding the index discharge, Charlson comorbidity index, admission and discharge diagnoses of chronic pain and number of subsequent hospital readmissions in 2011 (Appendix 1 [available online]). Using the same model building process, we estimated the odds of increased opioid refills in the 'opioid receipt' versus 'no opioid receipt' groups. Logistic regression modeling with ordinal outcomes (number of fills=0; 1–2; 3–5; 6–10; >10) was used to estimate the odds of increased opioid refills 1 year post hospital discharge. Odds ratio estimates and 95 % CI for opioid receipt were adjusted for gender, insurance, history of mental health disorders, chronic medical conditions, chronic pain, Charlson Comorbidity Index, admission diagnosis of chronic pain, surgery during index hospitalization, and number of hospital readmissions in 2011.

We stratified patients by surgery during the index hospitalization to investigate the effects of opioid receipt on chronic opioid use and number of opioid refills 1 year post discharge.

RESULTS

During 2011, 16,053 patients had an index discharge. Of these patients, 6,689 (42 %) met eligibility criteria for study sample inclusion. Among opioid naïve patients, 1,688 (25 %) had opioid receipt within 72 hours of hospital discharge (Fig. 1). Table 1 describes patients' baseline characteristics obtained at the index visit and in the 3 years preceding the index discharge. Patients with opioid receipt were more likely to be female (72.3 % versus 67.7 % male) and enrolled in a discount payment plan (23.1 % versus 15.8 %) compared to patients without opioid receipt. They were more likely to have a history of neoplasm (6.3 % versus 3.5 %), an admission diagnosis of chronic pain (12.1 % versus 3.3 %), a discharge diagnosis of acute (2.7 % versus 1.0 %) or chronic pain (4.7 % versus 3.6 %), and to have undergone a surgical procedure during their index visit (65.1 % versus 18.4 %) compared to patients without opioid receipt. Patients with opioid receipt were less likely to have a 3 year history of alcohol use disorder (15.7 % versus 20.7 %), any mental health disorder (23.9 % versus 31.4 %), chronic medical conditions (40.0 % versus 43.6 %) and had fewer hospital readmissions 1 year post discharge (mean of 0.2 versus 0.3) compared to patients without opioid receipt.

The most frequently prescribed opioids were hydrocodone/acetaminophen (n=910, 50 %), oxycodone/acetaminophen (n=342, 19 %) and short-acting oxycodone (n=334, 18 %). Of the 1,688 patients with opioid receipt, 141 (8.4 %) received ≥ 2 opioids at discharge. Patients prescribed ≥ 2 opioids often received two separate prescriptions for short-acting opioids or both a short-acting opioid plus tramadol (n=6); methadone (n=2); fentanyl (n=2); Oxycontin (n=2); or long-acting morphine (n=16) (data not shown).

Seventy patients (4.1 %) with opioid receipt met criteria for chronic opioid use 1 year post discharge. Of these, 64 (3.8 %) had > 10 opioid refills and 34 (2.0 %) had an episode of opioid use>90 days. Sixty-three patients without opioid receipt (1.3 %) met criteria for chronic opioid use 1 year post discharge ($p<0.001$ compared to patients with opioid receipt). Of these, 59 (1.2 %, $p<0.001$) had > 10 opioid refills and 41 (0.8 %, $p<0.001$) had an episode of opioid use>90 days.

Table 2 describes the unadjusted and adjusted odds of chronic opioid use 1 year post discharge and the odds ratios for covariates significantly associated with chronic opioid use. The unadjusted OR of chronic opioid use for patients with opioid receipt was 3.39 (95 % CI 2.40–4.79) compared to patients without opioid receipt. The adjusted OR (AOR) of chronic opioid use was 4.90 (95 % CI 3.22–7.45). The AOR

Table 1 Baseline Characteristics

	Opioid Receipt (*N*=1688)	No Opioid Receipt (*N*=5001)	*p**
Sex, *n* (%)			
Female	1220 (72.3)	3383 (67.7)	< 0.001
Race, *n* (%)			0.38
Non-Hispanic White	472 (28.0)	1419 (28.4)	
African American	247 (14.6)	799 (16.0)	
Hispanic	896 (53.1)	2547 (50.9)	
Other or Unknown	73 (4.3)	236 (4.7)	
Age (Years)			
Mean (SD)	39.7 (15.5)	39.5 (18.2)	0.57
Median	36.0	34.0	
Insurance Status, *n* (%)			< 0.001
Discount Payment Plan	389 (23.1)	788 (15.8)	
Medicaid	798 (47.3)	2750 (55.0)	
Medicare	172 (10.2)	906 (18.1)	
Commercial	126 (7.5)	324 (6.5)	
Other/Unknown/Self-Pay	203 (12.0)	233 (4.7)	
Three-Year History Of, *n* (%)			
Alcohol Use Disorder	265 (15.7)	1035 (20.7)	< 0.001
Opioid Use Disorder	30 (1.8)	115 (2.3)	0.20
Stimulant Use Disorder	73 (4.3)	278 (5.6)	0.05
Tobacco Use Disorder	433 (25.7)	1387 (27.7)	0.10
Mental Health Disorder			
Schizophrenia	22 (1.3)	290 (5.8)	< 0.001
Bipolar	70 (4.2)	419 (8.4)	< 0.001
Anxiety	151 (9.0)	571 (11.4)	0.005
Depression	308 (18.3)	1024 (20.5)	0.05
Personality Disorder	17 (1.0)	114 (2.3)	0.001
Any Mental Health Disorder	403 (23.9)	1570 (31.4)	< 0.001
Top Three Chronic Medical Conditions			
Diabetes	214 (12.7)	688 (13.8)	0.26
Hypertensive/Cardiac Disease	446 (26.4)	1552 (31.0)	< 0.001
Respiratory Disease	304 (18.0)	1124 (22.5)	< 0.001
Any Chronic Medical Condition	675 (40.0)	2179 (43.6)	0.01
Chronic Pain‡	730 (43.3)	1981 (39.6)	0.09
Neoplasm§	107 (6.3)	173 (3.5)	< 0.001
Charlson Index From 3-Year Diagnosis History	*N*=1687	*N*=5000	
Mean (SD)	0.88 (1.8)	1.00 (1.9)	0.02
Median	0.0	0.0	
Chronic Pain‡ at Index Admission, *n* (%)			
	204 (12.1)	165 (3.3)	< 0.001
Discharge Diagnoses, *n* (%)			
Chronic Pain ‡	79 (4.7)	178 (3.6)	0.04
Neoplasm §	3 (0.2)	3 (0.1)	0.17
Acute Pain Diagnoses	45 (2.7)	52 (1.0)	< 0.001
Top Three Surgical Procedures During Initial Hospitalization, *n* (%)			
Female Genital Organs	393 (23.3)	180 (3.6)	< 0.001
Digestive System	288 (17.1)	234 (4.7)	< 0.001
Musculoskeletal System	228 (13.5)	154 (3.1)	< 0.001
Patients Who Had Surgical Procedure During Index Hospitalization, *n* (%)	1099 (65.1)	920 (18.4)	< 0.001
Number of Readmissions During 2011, *n* (%)			
0 Readmissions	1440 (85.3)	4116 (82.3)	0.001
1 Readmission	183 (10.8)	607 (12.1)	
>1 Readmissions	65 (3.9)	278 (5.6)	
Mean (SD)	0.2 (0.7)	0.3 (0.9)	0.001
Range	0 – 14	0 – 22	
Discharge Opioid, *n* (%)		N/A	
Acetaminophen-Codeine	142 (7.7)		
Codeine	5 (0.3)		
Oxycodone/Acetaminophen	342 (18.6)		
Fentanyl	2 (0.1)		
Hydrocodone/Acetaminophen	910 (49.6)		
Hydromorphone	25 (1.4)		
Methadone	2 (0.1)		
Morphine Sulfate	29 (1.6)		
Oxycodone	334 (18.2)		
Oxycontin	3 (0.2)		
Oxyir	1 (0.1)		
Roxicodone	3 (0.2)		
Tramadol	37 (2.0)		

**Groups were compared using t-tests for continuous variables, and chi-square tests for categorical variables (discharge diagnosis of neoplasm tested with Fisher's exact test due to small cell size, and the number of readmission categories were tested with Cochran-Mantel-Haenszel (CMH) test for ordinal categories)*

Discount payment plans includes: Child Health Plan Plus (CHP+), Colorado Indigent Care Program (CICP), or the Denver Health Financial Assistance Program (DFAP). Eligibility includes: Colorado residency or migrant farm worker, citizenship or legal immigrant; income/combined resources at or below 250 % of federal poverty level; not eligible for Medicaid

‡Includes arthritis/joint, back/neck, nerve-related, psychogenic and headache pain

§Excludes benign neoplasm (210–229), carcinoma in situ (230–234), neoplasm of uncertain behavior (235–238), and neoplasm of unspecified nature (239)

1,688 patients were discharged with 1,835 opioid prescriptions; 141 of the new opioid users were prescribed two or more opioids at discharge

Table 2 Unadjusted and Adjusted Odds of Chronic Opioid Use 1 Year Post Hospital Discharge in Opioid Receipt Versus No Opioid Receipt Groups*

Odds of Chronic Opioid Use 1 Year Post Hospital Discharge	Odds Ratio	Wald 95 % Confidence Interval
Unadjusted		
Opioid Receipt (versus No Opioid Receipt)	3.39	2.40 – 4.79
Adjusted		
Opioid Receipt (versus No Opioid Receipt)	4.90	3.22 – 7.45
Insurance Status ‡		
Discount Payment Plan	1.54	0.99 – 2.41
Commercial	0.76	0.31 – 1.86
Medicare	0.50	0.28 – 0.92
Other/Unknown/Self-Pay	0.02	< 0.001 – 1.24
History of Chronic Pain	1.80	1.18 – 2.76
History of Malignancy	0.30	0.12 – 0.76
Charlson Index	1.22	1.13 – 1.33
Admission Diagnosis of Chronic Pain	2.03	1.24 – 3.45
Discharge Diagnosis of Chronic Pain	2.24	1.16 – 4.30
Number of Readmits in 2011	2.02	1.80 – 2.27

* *Two cases removed for lack of Charlson Index score availability*
‡ *Reference group: Medicaid*

Table 3 Unadjusted and Adjusted Odds of an Increased Number of Opioid Refills for Grouped Ordinal Outcomes 1 Year Post Hospital Discharge in Opioid Receipt Versus No Opioid Receipt Groups*

Odds Of Greater Number of Opioid Refills	Odds Ratio	Wald 95 % Confidence Interval
Unadjusted		
Opioid Receipt (Versus No Opioid Receipt)	2.68	2.36 – 3.05
Adjusted		
Opioid Receipt (Versus No Opioid Receipt)	2.67	2.29 – 3.13
Sex (Female)	0.74	0.64 – 0.86
Insurance Status‡		
Discount Payment Plan	1.68	1.41 – 1.99
Commercial	0.77	0.58 – 1.04
Medicare	0.75	0.62 – 0.92
Other/Unknown/Self-Pay	0.60	0.43 – 0.82
History of Mental Health Disorder	1.30	1.13 – 1.50
History of Chronic Medical Conditions	1.41	1.20 – 1.65
History Chronic Pain	1.72	1.49 – 1.99
Charlson Index	1.07	1.03 – 1.11
Admission Diagnosis of Chronic Pain	1.86	1.47 – 2.33
Surgery During Index Hospitalization	1.37	1.17 – 1.59
Number of Readmissions In 2011	2.03	1.88 – 2.18

* *Two cases removed for lack of Charlson Index score availability*
‡ *Reference group: Medicaid*

was larger than the unadjusted OR due to negative confounding between the 'number of hospital readmissions' and 'receipt of opioids at discharge.' The effect of 'opioid receipt' on 'chronic opioid use' was diminished in the adjusted analysis because both 'opioid receipt' and 'number of readmissions' had positive effects on 'chronic opioid use,' but were negatively correlated with each other (Spearman correlation −0.036, p=0.003).

Patients with opioid receipt had a mean number of 1.8 (SD 7.5) opioid refills 1 year post discharge compared to 0.6 (SD 3.7) in patients without opioid receipt (p<0.001). Among patients with opioid receipt, 297 (17.6 %) had one to two refills 1 year post discharge and 1,167 (69.2 %) had zero refills. Among patients without opioid receipt, 463 (9.3 %) had one to two opioid refills 1 year post discharge and 4,281 had zero refills. Ten (0.5 %) of the 1,835 opioids filled at discharge had refills available on the initial prescription. New opioid users filled 2,833 opioid prescriptions (excluding the aforementioned refills) 1 year post discharge. Of these, 2,038 (71.94 %) were dispensed from pharmacies co-located in primary care clinics and 795 (28.06 %) were dispensed from the hospital discharge pharmacy. The AOR of an increased number of opioid refills for grouped ordinal outcomes 1 year post discharge for patients with opioid receipt was 2.67 (95 % CI 2.29–3.13) compared to patients without opioid receipt (Table 3) .

Table 4 shows the AOR of chronic opioid use 1 year post discharge stratified by surgery at index hospitalization. Patients with opioid receipt were more likely to become chronic opioid users in both groups; however, the effect was larger for those who did not undergo surgery (AOR=7.24, 95 % CI 4.06–12.93) compared to those who did undergo surgery (AOR=3.40, 95 % CI 1.79–6.47). Opioid refills were not statistically different in the surgery versus no surgery group.

Table 4 Adjusted Odds of Chronic Opioid Use 1 Year Post Hospital Discharge Stratified by Surgery During the Index Hospitalization *,

Adjusted Odds Of Chronic Opioid Use 1 Year Post Hospital Discharge	Surgery (N=2017)	No Surgery (N=4670)
	Odds Ratio (Wald 95 % Confidence Interval)	
Opioid Receipt (Versus No Opioid Receipt)	3.40 (1.79 – 6.47)	7.24 (4.06 – 12.93)
History of Chronic Pain	1.22 (0.67 – 2.22)	2.20 (1.20 – 4.03)
History of Malignancy	0.25 (0.07 – 0.94)	0.41 (0.09 – 1.89)
Charlson Index	1.09 (0.97 – 1.24)	1.27 (1.14 – 1.41)
Admission Diagnosis of Chronic Pain	2.16 (1.13 – 4.15)	2.47 (0.96 – 6.40)
Discharge Diagnosis of Chronic Pain	2.39 (0.99 – 5.76)	1.84 (0.68 – 5.03)
Number of Readmissions in 2011	2.78 (2.21 – 3.50)	1.77 (1.54 – 2.04)

**Removed insurance status from the model because it caused quasi-separation in the logistic regression model due to insufficient numbers in the insurance groups after stratifying by surgery*
Two cases removed for lack of Charlson Index score availability

DISCUSSION

In this retrospective cohort study, 25 % of opioid naïve patients received an opioid at hospital discharge. These patients were more likely to become chronic opioid users and had an increased number of opioid refills 1 year post discharge compared to patients without opioid receipt. Prior studies examining chronic opioid use after surgery demonstrated similar findings.[61,67,68] Our study was unique because we included both surgical and medical patients in our analysis.

Surgical and medical patients with opioid receipt at discharge were more likely to progress to chronic opioid use; however, there was a larger effect for medical patients on chronic opioid use. While opioids were frequently prescribed postoperatively, the strength of association between 'opioid receipt' and 'chronic opioid use' 1 year post discharge in surgical patients was less than the strength of association seen in medical patients. Most surgical patients with acute post-operative pain who received opioids at discharge did not progress to chronic opioid use.

Among patients with a discharge diagnosis of chronic pain, we found no significant difference between 'opioid receipt' or 'no opioid receipt' at discharge. We attribute this finding to the common use of non-opioid analgesics including NSAIDs, neuropathic agents, and physical therapy or massage for pain control.[7,69–76] We did find a significant association between 'admission diagnosis of chronic pain' and 'opioid receipt at discharge.' It was possible that the acute event leading to hospitalization exacerbated one's baseline chronic pain, necessitating the use of opioids for pain control at discharge.[77–81]

Prior research shows that chronic opioid therapy is associated with hospital readmissions.[82] In our patients, increased 'number of hospital readmissions' was correlated with 'opioid receipt' at discharge. We attributed this to greater opioid exposure from increased contact with the healthcare system, resulting in more opportunity for opioid receipt. Opioids are potent analgesics with powerful rewarding properties.[83] Increased hospital readmissions with greater opioid exposure likely contributed to chronic opioid use in some patients.

Most patients with additional opioid receipt 1 year post discharge filled opioid prescriptions at pharmacies co-located in primary care clinics (~72 %). Remaining patients (~28 %) filled opioid prescriptions at the hospital discharge pharmacy where medications prescribed by hospital physicians were dispensed at hospital discharge. Hospital physicians and patients should be aware that repeated opioid prescribing for pain at hospital discharge may lead to chronic opioid use.

In 2014, hydrocodone combination products were reclassified as Schedule II, whereby refills of hydrocodone were no longer allowed by law. Some states permit practitioners to provide sequential prescriptions, which, over time, would allow a patient to receive a 90-day supply.[84] This change may prompt patients to visit their PCPs for ongoing pain management. The additional communication between patients and practitioners may curb the progression to chronic opioid use.

There were important limitations in this study. We created cohorts, 'opioid receipt' and 'no opioid receipt,' by determining if patients filled an opioid prescription at a Denver Health-affiliated pharmacy 1 year preceding their index discharge. If a patient in the 'no opioid receipt' group was rehospitalized and discharged with an opioid prescription during the same calendar year, they remained in the 'no opioid receipt' group. We adjusted for this by creating the covariate 'number of hospital readmissions' in our models. We were unable to capture patients who filled opioid prescriptions at non-affiliated pharmacies, which may have caused misclassification bias for cohort categorization and under-ascertainment bias for chronic opioid use, and would bias our findings toward the null.[85–87] Despite this, our OR for both chronic opioid use and opioid refills 1 year post discharge were quite robust. We investigated using the Colorado Prescription Drug Monitoring Program (PDMP) to verify our cohort categorization, but the use of PMDP for research is restricted to de-identified data. Opioid day supply was summed for all fills within each 90-day window following discharge to determine chronic opioid use. If a patient received two opioid prescriptions to be taken together over a 30-day period, this would have counted for a 60-day supply instead of a 30-day supply. This scenario occurred 8.4 % of the time when patients received either two short-acting opioid prescriptions, or both short-acting and long-acting opioid prescriptions. Chronic opioid use 1 year post discharge may be associated with poor continuity of primary care. Due to limitations in our data set, we were unable to adjust for continuity of care. Lastly, some patients may have not filled their opioid prescription or diverted their opioid prescription. Currently, there is no system in place to alert physicians when prescriptions with their drug enforcement agency prescribing number have been filled.

In 2007, there were approximately 34.4 million hospital discharges in the United States.[88] Our findings suggest that hospitalized patients with opioid receipt at discharge may have increased risk of future chronic opioid use. The risks versus benefits of treating chronic pain with opioids must be weighed by both physicians and patients. Recently, The Centers for Disease Control and Prevention urged clinicians to prevent opioid overdoses by following best prescribing practices, including screening patients for substance use and active mental health issues, and avoiding combinations of opioids and sedatives.[89] These guidelines are not easily integrated into current hospital practice due to a focus on pain control and the acute problem, rather than high-risk patient characteristics for opioid abuse or chronic use.

Further research is needed to develop interventions to assist physicians in making informed decisions about opioid prescribing at hospital discharge. Existing data already available in electronic medical records could alert physicians about patient-specific risk factors for opioid abuse or chronic use. Linking electronic medical records to prescription drug monitoring programs would allow physicians to verify opioid doses or other controlled substances patients are using. Such

interventions may prevent uninformed opioid prescribing in high-risk patients.

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Compliance with Ethical Standards:

Conflict of Interest: *The authors disclose no conflicts of interest.*

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