Conversion to Persistent or High-Risk Opioid Use After a New Prescription From the Emergency Department: Evidence From Washington Medicaid Beneficiaries

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Study objective: We describe the overall risk and factors associated with transitioning to persistent opioid or high-risk use after an initial emergency department (ED) opioid prescription.

Methods: A retrospective cohort study of Washington Medicaid beneficiaries was performed with linked Medicaid and prescription drug monitoring program files. We identified adults who had no record of opioid prescriptions in the previous 12 months, and who filled a new opioid prescription within 1 day of an ED discharge in 2014. We assessed the risk of persistent opioid use or high-risk prescription fills within 12 months after the index visit. Logistic regression was used to assess the association between pertinent variables and conversion to persistent or high-risk use.

Results: Among 202,807 index ED visits, 23,381 resulted in a new opioid prescription. Of these, 13.7% led to persistent or high-risk opioid prescription fills within 12 months compared with 3.2% for patients who received no opioids at the index visit. Factors associated with increased likelihood of persistent opioid or high-risk prescription fills included a history of skeletal or connective-tissue disorder; neck, back, or dental pain; and a history of prescribed benzodiazepines. The highest conversion rates (37.3%) were observed among visits in which greater than or equal to 350 morphine milligram equivalents were prescribed. Conversion rates remained greater than 10% even among visits resulting in lower-dose opioid prescriptions.

Conclusion: Medicaid recipients are at moderate risk for conversion to persistent or high-risk opioid use after a new ED prescription. Longer or higher-dose prescriptions are associated with increased risk for conversion; however, even visits that lead to guideline-concordant prescriptions bear some risk for long-term or high-risk use. [Ann Emerg Med. 2019;■:1-11.]

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INTRODUCTION

Background

The United States is experiencing an epidemic of prescription drug abuse, according to the Centers for Disease Control and Prevention (CDC), with deaths from opioid use now exceeding that from motor vehicle crashes.[1,2] Deaths from prescription opioids have quadrupled since 1999.[3] This epidemic has been associated with increases in opioid sales and prescribing by health care providers, resulting in opioids' expanded availability and frequent diversion for nonmedical use.[4-6] This epidemic influences metropolitan and nonmetropolitan areas, as well as all racial and ethnic groups.[7]

Long-term opioid use often starts with treatment for an acute, painful injury or condition.[8] In a large representative national sample of patients without cancer who received a new opioid prescription (opioid naive), the likelihood of persistent opioid use increased with each additional day of medication supplied, starting with the third day.[9] Approximately 8% of opioid-naive patients who were prescribed opioids within 7 days of short-stay surgery were still receiving opioids 1 year later.[10] After a new opioid prescription for wisdom tooth extraction, conversion to persistent use occurred at a rate of 13 per 1,000 patients with private medical insurance.[11] Until recently, it was believed that patients prescribed opioids for an acute problem were unlikely to develop drug abuse or addiction.[12,13] Systematic reviews indicate that the evidence for that opinion would not meet current scientific standards.[14,15]

Acute care settings, including emergency departments (EDs), are those in which clinicians and their patients must

Editor's Capsule Summary

What is already known on this topic

Initial opioid exposure may trigger later use and misuse.

What question this study addressed

How often do factors relate to later high-risk opioid use after emergency department (ED) discharge, and what are they?

What this study adds to our knowledge

According to 2013 to 2015 Washington State Medicaid data, for the 11.5% of patients receiving an opioid prescription within 1 day of discharge, 13.7% received ongoing or high-risk opioid prescribing in the next 12 months compared with 3.2% without initial exposure. Larger initial dosing (starting at a prescription $\geq$150 morphine milligram equivalents) had the most effect.

How this is relevant to clinical practice

Candidates for opioids at ED discharge, especially in higher doses, are at higher risk of later use, although the appropriate response to this observation is uncertain.

navigate between addressing pain and preventing the misuse of opioid pain medication. Prevention may be the key to addressing the epidemic because once opioid use disorder occurs, only 1 in 10 Americans receives treatment, and current treatment approaches demonstrate low rates of success.[16] Emergency providers care for victims of opioid overdose, abuse, and misuse every day. Paradoxically, in terms of number of prescriptions they are also among the top prescribers of opioid medication for patients younger than 40 years.[17] The risk of long-term opioid use after a first prescription for acute pain from the ED has been explored: Hoppe et al[18] demonstrated that among opioid-naive patients receiving an ED opioid prescription, 12% had more opioids prescribed at 1 year. Barnett et al[19] analyzed a cohort of Medicare patient visits and documented a conversion rate to persistent use between 1.2% and 1.5% after a new ED prescription. Among young adults, use of opioids through a single legitimate prescrition in high school was associated with a 33% increase in the risk of subsequent opioid misuse in a cohort followed to adulthood.[20] Additional studies have identified that ED overdose patients and heroin users frequently report that their initial exposure to opioids came from an ED prescription.[21] With 42% of ED visits related to pain—combined with provider quality measures that include adequacy of pain treatment and patient satisfaction—there has been documented pressure for emergency providers to prescribe opioids to their patients.[22] As safety-net providers for a vulnerable population without primary care access or continuity of care, emergency providers have embraced the responsibility for bridging patients from acute injury to follow-up care, including providing pain medications when patients cannot access traditional primary care providers for treatment of pain.

Current policies and guidelines include placing absolute limits on opioid prescription quantities and mandating provider use or enrollment with prescription drug monitoring programs to identify previous, overlapping, or high-risk prescription fills.[23] However, these policies do not consider new or low-dose opioid prescriptions. And for some individuals, even small-quantity prescriptions can lead to long-term or high-risk opioid use.[9] Therefore, such policy interventions may not identify or protect patients for whom a new prescription for opioids may pose increased risk for conversion to long-term opioid use.

Goals of This Investigation

We sought to describe independent risk factors for transitioning to persistent opioid or high-risk prescription fills after an initial ED opioid prescription.

MATERIALS AND METHODS

Study Design and Setting

A retrospective cohort study of Washington State Medicaid beneficiaries was performed with data collected between January 1, 2013, and December 31, 2015. Data included enrollment and medical claims for Medicaid enrollees in Washington State linked to prescription drug monitoring program files containing information about all dispensed controlled substances. The creation of this data set has been described elsewhere.[24]

Selection of Participants

The study population included residents of Washington State who were enrolled in Medicaid between January 1, 2014, and December 31, 2014. We excluded observations for enrollees with a 1-year history of cancer, those who were also enrolled in Medicare or older than 64 years, children younger than 13 years, and enrollees who received any hospice or nursing home care at any time during the study period. We also excluded members who were enrolled for less than 3 of the previous 12 months to ensure sufficient

data for assessing health history. Figure 1 describes the approach to including patient visits in the analyzed sample.

We analyzed ED visits made by enrollees during 2014 if they met the following criteria: the ED visit did not result in an inpatient admission, and the patient was opioid naive at the visit, defined as no history of opioid dispensing during the previous 12 months. As a third criterion, if multiple ED visits occurred for a given opioid-naive patient during the study period, we selected the earliest visit after which the patient filled an opioid prescription, defined as any pharmacy-dispensed outpatient prescription for an opioid written within 1 day of the ED visit (defined as prescriptions written on the day of registration or the following calendar day to account for ED visits that might span midnight). The definition of opioid naive used was based on the most conservative approach taken by national and international studies, which have defined opioid naive as no prescribed opioids between 60 and 365 days before the index visit.[25-27]

Methods of Measurement

Opioid prescriptions included buprenorphine, codeine, fentanyl, hydrocodone, hydromorphone, levorphanol, meperidine, methadone, morphine, oxycodone, oxymorphone, tapentadol, and tramadol, as well as any combination formulation that included these drugs. We included tablets, syrups or suspensions, films, and transdermal patches, and we excluded other formulations (eg, sprays). Additionally, we recorded the total outpatient dispensed morphine milligram equivalents prescribed within 1 day of the index visit registration (to account for ED visits that spanned midnight). Total morphine milligram equivalents were calculated by multiplying tablet number by the opioid dose per tablet. We used the following conversion factors (milligram:milligram) to calculate morphine milligram equivalents: buprenorphine patch 12.6, buprenorphine tablet 30, codeine 0.15, fentanyl patch 7.2 (micrograms/hour), hydrocodone 1, hydromorphone 4, levorphanol 11, meperidine 0.1, methadone 3, morphine 1, oxycodone 1.5, oxymorphone 3, tapentadol 0.4, and tramadol 0.1.[28]

Covariates were selected according to relevant demographic characteristics and previously described patient- and visit-level risk factors associated with conversion to persistent opioid or high-risk prescription fills. We also selected variables that would be available to a

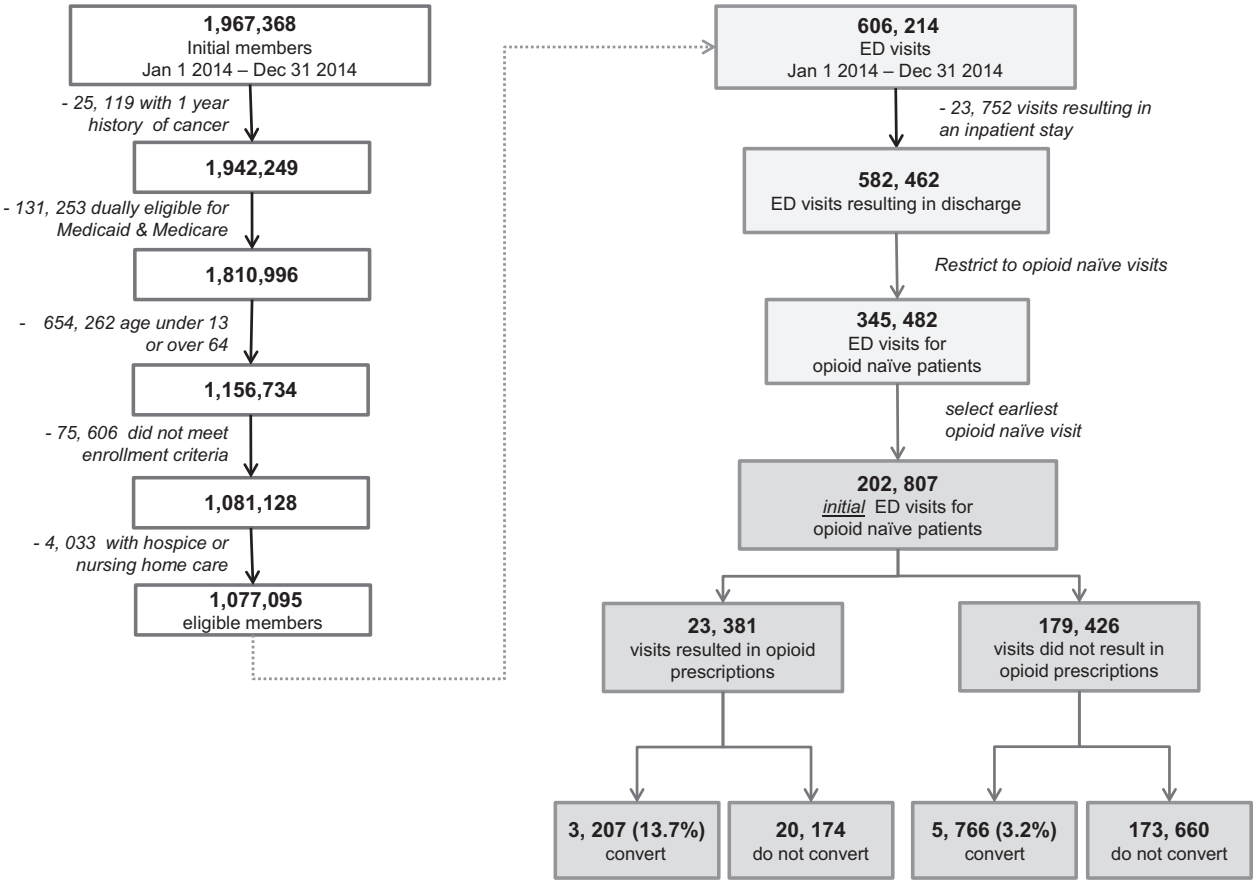

Figure 1. Cohort selection flowchart.

clinician during an ED visit to maximize the potential ease of use during clinical care. Covariates included patient age, sex, race, managed care or fee-for-service Medicaid coverage, and whether the enrollee qualified for Medicaid according to disability or expansion under the Patient Protection and Affordable Care Act. We assessed 1-year history of physical health conditions, behavioral health conditions, substance use disorder, and benzodiazepine (prescription) use. We also created indicators for the presence of pain conditions at the ED visit[29] and quantity of morphine milligram equivalents prescribed at the index visit. Break points for morphine milligram equivalent size were determined, starting with the high-dose category as 350 morphine milligram equivalents (based on CDC recommendations of no more than 7 days of opioids at 50 morphine milligram equivalents/day for acute pain) and, working backwards, assigning categories for each 50 morphine milligram equivalent prescribed.

Outcome Measures

The primary outcome was a composite measure of any indicator of long-term opioid use or high-risk prescription fills within 12 months after the index visit. Each measure in the composite has been associated with long-term use, opioid use disorder, or overdose.[30-36] The composite measure was defined as the presence of at least 1 of the following criteria during the 12 months after the index ED visit: at least 1 opioid prescription in every calendar quarter, more than 3 prescribers, more than 4 prescriptions for a Drug Enforcement Administration scheduled opioid, any prescription for long-acting opioids, any prescription medicine for opioid use disorder, or any prescription for an average of 100 morphine milligram equivalents per day or greater. For the 1% of opioid prescription visits in which the days' supply was missing in the prescription drug monitoring program data set, imputation was used to estimate the days' supply by calculating the average morphine milligram equivalents per day with all other prescriptions in the data set where it was not missing. Prescriptions attributed to the index ED visit were not included in subsequent calculations of high-risk use.

Primary Data Analysis

A logistic regression model was used to assess the association between measures described above and conversion to persistent or high-risk use. All model results are presented as marginal effects (ie, percentage-point change in the likelihood of conversion to persistent or high-risk use associated with each measure). All data management and statistical analyses were performed in R (version 3.3.2) and Stata MP (version 14.0; StataCorp, College Station, TX). The Washington State Health Care Authority provided Medicaid beneficiary-level medical and pharmacy claims data. The intuitional review boards of Washington State and of Oregon Health & Science University approved this study. Sensitivity analyses were conducted with alternative definitions of index visits and primary outcome measurements.

RESULTS

We identified 23,381 ED visits made by qualifying opioid-naive Medicaid patients who filled an opioid prescription that was written within 1 day of the ED visit. Table 1 describes patient- and visit-level characteristics stratified by conversion to persistent or high-risk opioid use. The population studied was young (median age 32 years), aged predominantly between 18 and 39 years (57.5%), women (57.6%), white (62.0%), and covered by a Medicaid managed care insurance plan (91.7%). A specific pain-related or injury diagnosis was recorded for 59.7% of the index ED visits (N=13,965). Injuries were the most common diagnostic category within the cohort of index visits. This population exhibited moderately high rates of a history of tobacco use (10.0%), anxiety (15.4%), and major depression (7.3%). The majority of index ED visits that resulted in an opioid prescription (83.2%) were for less than 150 morphine milligram equivalents (mean 97.2; SD 83.3). The index prescriptions are described in Table 2. The majority of opioid prescriptions filled from the index visit were for short-acting hydrocodone (70%) and oxycodone (21%) tablets. Long-acting or nontablet formulations of opioids composed less than 0.0016% of the total number. The overall conversion rate to persistent opioid or high-risk prescription fills in this cohort after an ED index visit opioid prescription was 13.7%, significantly higher ($P<.001$) than the 3.2% conversion rate among the cohort of index ED visits in which no opioid was prescribed (Figure 1). Table 3 describes the frequency at which each component of the main composite outcome occurred among patients who received an opioid at the index visit. The conversion rate of 13.7% was relatively robust to multiple sensitivity analyses, including (1) using an exact match of the index ED visit date and prescription date to indicate prescriptions written at the index visit (13.8%); (2) removing the criteria of greater than 4 prescriptions for opioids filled in the year after the index visit from the composite outcome measure (11.7%); (3) removing the criteria of greater than 3 prescribers in the subsequent 12 months (12.3%); (4) limiting index ED visits to only those with a pain-related diagnosis (14.9%); and (5) combining

Table 1. Characteristics of ED visits for opioid-naive patients who received an opioid prescription.

Patient and Visit Characteristics	Converted to Persistent or High-Risk Use, N = 3,207 (13.7%)	Did Not Convert, N = 20,174 (86.3%)
Patient demographics		
Age, No. (%), y		
13–17	78 (2.4)	2,468 (12.2)
18–39	1,826 (56.9)	11,616 (57.6)
40–64	1,303 (40.6)	6,090 (30.2)
Female sex, No. (%)	1,783 (55.6)	11,676 (57.9)
Race/ethnicity, No. (%)		
White	2,215 (69.1)	12,288 (60.9)
Hispanic	302 (9.4)	2,668 (13.2)
Black	243 (7.6)	1,738 (8.6)
American Indian/Alaska Native	110 (3.4)	582 (2.9)
Asian/Hawaiian or other Pacific Islander	67 (2.1)	714 (3.5)
Other/unknown	270 (8.4)	2,184 (10.8)
Insurance		
Qualified for Medicaid under disability, No. (%)	858 (26.8)	3,532 (17.5)
Qualified for Medicaid by income under expansion, No. (%)	916 (28.6)	4,900 (24.3)
Coverage type, No. (%)		
Managed care	2,928 (91.3)	18,515 (91.8)
Fee for service	279 (8.7)	1,659 (8.2)
History of physical health conditions, No. (%)		
Skeletal and connective	1,086 (33.9)	4,212 (20.9)
Cardiovascular	759 (23.7)	3,039 (15.1)
Pulmonary	582 (18.1)	2,597 (12.9)
Gastrointestinal	541 (16.9)	2,260 (11.2)
Skin	432 (13.5)	2,357 (11.7)
Diabetes	282 (8.8)	1,180 (5.8)
Nervous system	230 (7.2)	845 (4.2)
Genital	219 (6.8)	1,046 (5.2)
Pregnancy	172 (5.4)	1,261 (6.3)
Metabolic	174 (5.4)	676 (3.4)
Infectious	193 (6.0)	672 (3.3)
Renal	124 (3.9)	481 (2.4)
Hematologic	52 (1.6)	210 (1.0)
Other*	66 (2.1)	400 (2.0)
History of substance use disorder, No. (%)		
Opioids	81 (2.5)	212 (1.1)
Cannabis	69 (2.2)	313 (1.6)
Amphetamines	74 (2.3)	288 (1.4)
Tobacco	477 (14.9)	1,860 (9.2)
Other†	261 (8.1)	1,066 (5.3)
History of other behavioral health disorder, No. (%)		
Anxiety	730 (22.8)	2,863 (14.2)
Dysthymia or other depression	579 (18.1)	2,467 (12.2)
Major depression	351 (10.9)	1,360 (6.7)
Alcohol disorder	287 (8.9)	1,100 (5.5)
Bipolar disorder	189 (5.9)	779 (3.9)
Disorders originating in childhood	108 (3.4)	820 (4.1)
Schizophrenia or other nonmood disorder	79 (2.5)	343 (1.7)
Other‡	744 (23.2)	2,981 (14.8)
Pain-related or injury diagnoses at visit, No. (%)		
Any pain or injury diagnosis	2,080 (64.9)	11,885 (58.9)
Arthritis/joint pain	479 (14.9)	2,135 (10.6)
Back pain	488 (15.2)	2,316 (11.5)
Nontraumatic dental pain	331 (10.3)	1,967 (9.8)
Neck pain	190 (5.9)	909 (4.5)
Kidney stone	87 (2.7)	609 (3.0)
Injury	1,222 (38.1)	7,600 (37.7)
Other§	210 (6.5)	1,107 (5.5)
Medications		
History of benzodiazepine use, No. (%)	115 (3.6)	302 (1.5)
Total MMEs prescribed at visit, No. (%)		
<150	2,416 (75.3)	17,029 (84.4)
150–350	665 (20.7)	2,933 (14.5)
≥350	126 (3.9)	212 (1.1)

MME, Morphine milligram equivalent.

History of physical, behavioral, and substance use disorders, as well as history of benzodiazepine use, was evaluated with the previous year of claims data. Pain-related and injury diagnoses were assessed at the index visit, and total prescribed MMEs were evaluated for prescriptions written within 1 day of the index visit.

*Eye, cerebrovascular, and developmental disability.

†Barbiturate, cocaine, hallucinogen, and antidepressant abuse, and miscellaneous.

‡Personality disorder, adjustment disorder, and miscellaneous.

§Gallstone, headache, and miscellaneous.

Table 2. Opioid prescriptions from initial ED visit for opioid-naive patients.

Form	Opioid Class	Frequency	Percentage
Tablet	Hydrocodone SA	16,699	69.55
Tablet	Oxycodone SA	5,080	21.16
Tablet	Codeine	956	3.98
Tablet	Tramadol SA	861	3.59
Solution	Codeine	130	0.54
Tablet	Hydromorphone SA	122	0.51
Solution	Hydrocodone SA	83	0.35
Solution	Oxycodone SA	26	0.11
Capsule	Codeine	16	0.07
Film	Buprenorphine	9	0.04
Tablet, extended release	Morphine LA	6	0.02
Tablet, extended release	Oxycodone LA	6	0.02
Capsule	Oxycodone SA	6	0.02
Tablet	Morphine SA	4	0.02
Tablet	Methadone	3	0.01
Tablet	Meperidine	1	0.00
Tablet	Tapentadol SA	1	0.00
Tablet, extended release	Tramadol LA	1	0.00

all of the above analytic approaches (7.8%) (Table E1, available online at http://www.annemergmed.com).The highest conversion rates were observed among visits in which 350 morphine milligram equivalents or more were prescribed (37.3%; 95% confidence interval [CI] 32.3% to 42.5%) and for patients with a history of any substance use disorder, including tobacco (20.4%; 95% CI 18.8% to 22.1%), and any nonsubstance-related behavioral health disorder (17.8%; 95% CI 17.1% to 18.5%).

The marginal effects for each covariate, adjusting for all other factors, are presented in Table 4. For Washington State Medicaid patients prescribed opioids at the index ED visit, notable factors associated with an independent increased likelihood of persistent opioid or high-risk prescription fills use included a history of skeletal and connective tissue disorder (7.9-percentage-point increase; 95% CI 6.6 to 9.1), history of opioid use disorder (4.6-percentage-point increase; 95% CI 0.5 to 8.6), history of anxiety (3.0-percentage-point increase; 95% CI 1.6 to 4.4), an index visit diagnosis of neck pain (2.7-percentage-point increase; 95% CI 0.6 to 4.9), diagnosis of nontraumatic dental pain (2.5-percentage-point increase; 95% CI 0.9 to 4.2), and history of prescribed benzodiazepines before the index visit (7.1-percentage-point increase; 95% CI 3.6 to 10.5).

Table 3. Breakdown of individual components in the composite measure of long-term or high-risk use.

Criteria	Frequency (%), N = 3,207
≥1 opioid prescription in every calendar quarter	1,032 (32.2)
>3 prescribers	1,969 (61.4)
>4 prescriptions for a DEA scheduled opioid	2,432 (75.8)
Any prescription for long-acting opioids	294 (9.2)
Any prescription medicine for opioid use disorder	147 (4.6)
Any prescription for an average of ≥100 MMEs/day	734 (22.9)

DEA, Drug Enforcement Administration.

The size (total morphine milligram equivalents) of the index opioid prescription was associated with the largest significant increase in conversion rates to persistent opioid or high-risk filled prescriptions. After adjustment, patient index visits in which greater than 350 morphine milligram equivalents of opioids were prescribed were associated with a 19.3-percentage-point increase in the likelihood of conversion compared with those visits with less than 150 morphine milligram equivalents. Figure 2 displays the unadjusted conversion rates for index visits with opioid prescriptions of differing sizes. Although patients who received greater than 350 morphine milligram equivalents had the highest conversion rate, there did not appear to be a threshold effect, and patients who received lower-dose opioid prescriptions (<50, 50 to 100, and 100 to 150 morphine milligram equivalents) also had relatively high conversion rates (all >10%).

LIMITATIONS

We sought to limit the study to opioid-naive ED visits during which a new opioid prescription was written and subsequently filled. It is possible some of the index ED visit prescriptions did not originate at that time. We attempted to minimize this potential misclassification by limiting index prescriptions to those that were written within 1 day after the ED visit and by conducting sensitivity analyses that included exact match on index prescription date (Table E1, available online at http://www.annemergmed.com). We had access to only outpatient prescription data, so it is possible that patients were misclassified and were not truly opioid naive; for example, if they were receiving diverted prescription opioids that were not prescribed to them or illicit opioids, such as heroin or fentanyl. In determining associations with conversion to high-risk prescriptions, administrative data cannot capture all clinically and socially relevant data. Moreover, the linkage of the Medicaid claims and prescription drug monitoring program data, although highly specific, demonstrates modest sensitivity. The false-negative matching is thought to occur at random because

Table 4. Regression marginal effects estimates.

Characteristic	Marginal Effect Estimate (95% CI)
Age, y	
13 to 17	−10.83 (−11.87 to −9.80)
18 to 39	[Reference]
40 to 64	0.27 (−0.84 to 1.38)
Male sex	1.15 (0.19 to 2.11)
Race	
White	[Reference]
Black	−2.4 (−3.92 to −0.88)
Hispanic	−2.48 (−3.86 to −1.11)
Asian/Hawaiian or other Pacific Islander	−5.47 (−7.59 to −3.35)
American Indian/Alaska Native	−0.18 (−2.86 to 2.49)
Other/unknown	−3.03 (−4.42 to −1.63)
Qualified for Medicaid under disability	1.78 (0.53 to 3.04)
Qualified for Medicaid under expansion	1.68 (0.55 to 2.80)
Coverage type	
Fee for service	[Reference]
Managed care	−2.43 (−4.24 to −0.62)
History of physical health conditions	
Cardiovascular	1.78 (0.51 to 3.04)
Skeletal and connective tissue	7.85 (6.59 to 9.11)
Nervous system	0.98 (−0.92 to 2.87)
Pulmonary	2.1 (0.81 to 3.40)
Gastrointestinal	1.46 (0.13 to 2.78)
Diabetes	1.34 (−0.45 to 3.14)
Skin	1.45 (0.05 to 2.85)
Renal	2.27 (−0.42 to 4.96)
Genital	4.77 (2.56 to 6.98)
Metabolic	1.94 (−0.32 to 4.20)
Pregnancy	0.31 (−1.68 to 2.30)
Hematologic	1.9 (−2.11 to 5.90)
Infectious	1.93 (−0.27 to 4.14)
Other physical health condition	−3.86 (−6.26 to −1.47)
History of other behavioral health	
Alcohol disorder	1.51 (−0.28 to 3.30)
Anxiety	3.03 (1.62 to 4.44)
Bipolar disorder	−0.39 (−2.34 to 1.56)
Disorders originating in childhood	−2.16 (−4.29 to −0.02)
Dysthymia or other depression	0.8 (−0.53 to 2.14)
Major depression	0.84 (−0.81 to 2.49)
Schizophrenia or other nonmood disorder	−1.92 (−4.57 to 0.73)
Other behavioral health disorders	3.28 (2.00 to 4.57)
Pain-related or injury diagnoses at visit	
Kidney stone	−1.87 (−4.27 to 0.54)
Injury	−0.83 (−1.83 to 0.18)
Back pain	2.28 (0.91 to 3.65)
Neck pain	2.74 (0.56 to 4.92)
Arthritis/joint pain	2.57 (1.16 to 3.99)
Nontraumatic dental pain	2.5 (0.85 to 4.16)
Other pain	0.95 (−0.93 to 2.82)
History of substance use disorder	
Opioids	4.56 (0.53 to 8.59)
Cannabis	−1.72 (−4.62 to 1.19)
Amphetamines	−1.79 (−4.70 to 1.12)
Tobacco	2.01 (0.56 to 3.46)
Other substance use disorders	1.09 (−0.86 to 3.05)
Medications	
History of prescribed benzodiazepines	7.05 (3.56 to 10.54)
Total MMEs prescribed at visit	
<150	[Reference]
150 to 350	4.47 (3.20 to 5.74)
≥350	19.32 (14.64 to 24.00)

of mismatches for elements such as name and birth date. The high specificity of the matching increases our confidence that we correctly identified patients who filled opioid prescriptions at the index visit and on follow-up visits. The matching algorithm and limitations have been discussed elsewhere.[24] Finally, these data were derived from a single state and therefore may not be generalizable to Medicaid enrollees or patients from different regions. We attempted to account for many of these inherent limitations of observational and claims-data analyses by using recommended best practices for opioid safety research as described by Ranapurwala et al,[37] including using multiple data sources with linked prescription drug monitoring program and claims data, as well as conducting sensitivity analyses to examine the level of confounding, selection, or misclassification.[37]

DISCUSSION

In this study of a large cohort of Medicaid patients, 13.7% of those who filled a new opioid prescription within 1 day of an ED visit converted to persistent or high-risk opioid prescription fills within 12 months. This conversion rate stands in stark contrast to the 3.2% conversion rate among visits in which no opioids were prescribed. Patient-level characteristics such as a history of skeletal and connective tissue disorder, a history of opioid use disorder, a history of anxiety, a diagnosis of neck pain, a diagnosis of dental pain, and history of prescribed benzodiazepines were independently but modestly associated with increased risk

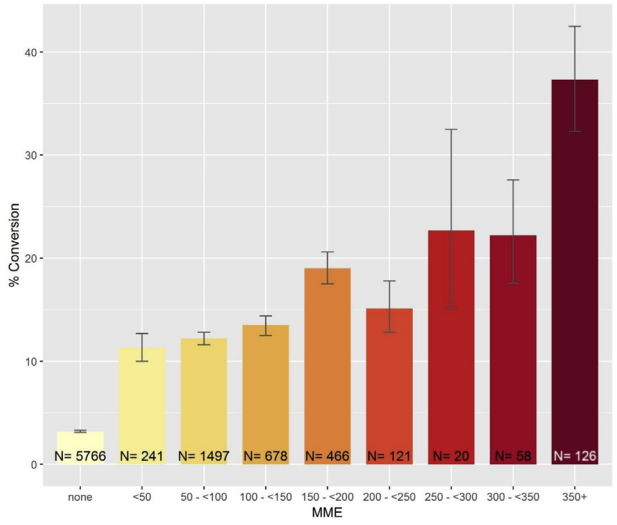

Figure 2. Frequency of persistent or high-risk opioid conversion by quantity of morphine milligram equivalents prescribed at the index ED visit.

of persistent or high-risk use. Patients with visits that resulted in higher-dose opioid prescriptions were the most likely to convert to persistent opioid or high-risk prescription fills.

Other published research demonstrated that rates of conversion to persistent opioid use after initial opioid prescriptions in multiple settings (including the ED) ranged from 1% among general Medicare recipients to 13% among disabled publicly insured patients.[19,35] These studies were limited by use of claims-only data, which does not capture uninsured and cash-purchased prescriptions. Moreover, to our knowledge conversion to persistent or high-risk prescriptions has not previously been studied in a Medicaid population that includes younger and disabled patients compared with Medicare and commercial insurance samples.

This study aligns with previously reported risk factors for persistent opioid use after an initial therapeutic opioid exposure.[38] Neck pain, diagnosis or treatment for anxiety, tobacco use, and a history of substance use disorder have been described as independent risk factors for persistent opioid use after a new prescription in surgical settings.[38,39] Similarly, in primary care settings, past or current nicotine use or a history of substance use was shown to be associated with persistent opioid use after an index prescription.[40] There are limited published descriptions of independent risk factors for conversion to persistent or high-risk use for patients with acute pain in ED settings for opioid-naive patients. The Opioid Risk Tool[41] and the Screener and Opioid Assessment for Patients With Pain–Revised[42,43] both predict possible opioid use disorder for patients with chronic pain, but not for those with acute pain, for ED patients, or for opioid-naive patients. Weiner et al[44] compared Screener and Opioid Assessment for Patients With Pain–Revised scores with real-time ED prescription drug monitoring program queries and identified that high scores for the screening tool are associated with evidence of high concurrent or past high-risk use. However, this study did not assess the ability to risk stratify opioid-naive ED patients for conversion to persistent or high-risk use.

We found that the size of the initial ED opioid prescription was strongly associated with conversion to persistent opioid or high-risk filled prescriptions. This finding has been identified in previous studies broadly across many clinical settings,[45] and specifically in EDs.[19,35] Our findings suggest that the independent likelihood of persistent or high-risk opioid use increases with increasing size of the initial ED prescription, but that there is no automatically safe opioid threshold below which an ED prescription spares all patients from the hazard of risky or long-term use. Almost 1,500 opioid-naive visits in which the initial ED prescription was between 50 and 100 morphine milligram equivalents were associated with high-risk conversion. These visits, despite prescriptions' being compliant with CDC acute pain guidelines,[46] represented the largest absolute count of conversions within our sample.

Previously published work from our team has described how emergency medicine providers *and* patients seek more information about individual opioid risks when choosing a pain treatment. In those studies, we found that providers did not seem to know or explain the individual risks of opioid medications when discussing pain treatment.[47] Similarly, they expressed frustration in regard to not having good tools to understand and communicate trade-offs to patients when discussing pain management.[48,49] Providers frequently prescribe opioids to patients with known or potential risk factors for abuse[50]; therefore, an overall understanding of the general risk of conversion to persistent or high-risk opioid use for ED patients, as well as individual patient-level risk factors, could allow better understanding and communication of risk to patients during pain treatment discussions.

The policy and care delivery landscape focused on opioid prescribing in Washington State before and during the study period. Most of the prescribing policy changes occurred in the state before the study period. In Washington State, opioid prescribing increased 500% from 1997 to 2006. By 2006, 10,000 Washington patients with public health insurance were prescribed at least 100 morphine milligram equivalents per day. Between 2005 and 2012, Medicaid implemented a narcotic review

program in Washington that included communication with providers and previous authorization for some long-term prescriptions. In 2007, Washington created a prescribing guideline that recommended limits to prescriptions of morphine milligram equivalents per day and continuing medical education presentations to provider groups. In 2011, the Washington chapter of the American College of Emergency Physicians (ACEP) adopted an ED prescribing guideline that included limiting prescriptions for chronic pain, limiting intravenous opioid medication for acute pain, and using an electronic information exchange that existed across all state EDs.[51] In 2012, the Washington legislature mandated the adoption of ED prescribing guidelines and required all ED providers to register for the state prescription drug monitoring program. During the study period (2013 to 2015), no significant policy changes reflecting ED prescriptions were made; however, most of the earlier policies were still being implemented and scaled up.[52,53]

This study is, to our knowledge, the only analysis of opioid-related outcomes after an initial prescription within a cohort of Medicaid beneficiaries. Our findings of an overall 13.7% conversion rate to persistent or high-risk opioid use represents a significantly higher rate of conversion among an adult population than has been previously described among Medicare and commercial insurance populations. Medicaid recipients represent a unique and understudied population as it relates to health care delivery and outcomes. Medicaid enrollees are younger and more likely to have poorer health and disabilities than privately insured patients. It has also been demonstrated that patients with Medicaid have more difficulty accessing routine and specialty health care services.[54] Moreover, because of the Patient Protection and Affordable Care Act, Medicaid is the most rapidly expanding sector of the health insurance market nationally, and many policy initiatives are currently occurring at the state Medicaid level. Medicaid beneficiaries have a 10-fold higher rate of fatal prescription opioid overdoses compared with privately insured populations.[55] These patients may also be at risk for being undertreated for serious pain, and these findings should not prevent the use of suitable analgesia, including opioids, when appropriate. This study provides an opportunity to address prescription policies and practices for this important and vulnerable population.

In summary, Medicaid recipients are at moderate risk for conversion to persistent or high-risk opioid use after a new ED opioid prescription. Longer or higher-dose prescriptions are associated with increased risk for conversion; however, even patients who receive guideline-concordant prescriptions are at risk. Specific patient- and visit-level characteristics increase the likelihood of high-risk use and should be considered by providers, patients, and policymakers in decisionmaking for acute pain treatment.

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