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Long-term Prescription Opioid Utilization, Substance Use Disorders, and Opioid Overdoses after Adolescent Trauma

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Abstract

BACKGROUND ——Injured adolescents have a 56% increased risk of developing a substance use disorder (SUD) within 3 years of their injury. The transition from medical prescription opioid use to nonmedical use in adolescent trauma patients has not been longitudinally studied long-term. The aim of this study is to describe 5-year patterns of opioid use in a cohort of injured adolescents as well as the proportion of patients experiencing overdose and SUD diagnoses.

METHODS ——Our retrospective cohort study consisted of 736 patients 12–18 years old who were admitted for trauma from 2011–2013. We examined up to 5 years of regional health information exchange data containing information on prescription fills as well as diagnoses from inpatient, outpatient, and emergency department encounters.

RESULTS ——At 1 year, over 20% of adolescents filled more than 2 opioid prescriptions after being discharged for their injury; and at 4 years, over 13% had received more than 8 opioid fills. Over the 5 year period, 11% received an opioid antagonist injection, 14% received an SUD diagnosis, and 8% had an overdose diagnosis. Relatively few patients had diagnoses for other mental health conditions including depression (5.5%), post-traumatic stress disorder (PTSD) (2.1%), and chronic pain (3.6%).

CONCLUSIONS ——Opioid usage remains high for multiple years in a subset of the adolescent trauma population. Mental health diagnosis rates were substantially lower in injured adolescents than what has been reported in adults. However, overdose and SUD diagnoses occur in over 1 in 10 adolescents within 5 years of their injury.

LEVEL OF EVIDENCE: Prognostic and Epidemiological Study, Level IV

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Author Contributions:

Dr. Bell was responsible for study conception and design, obtaining funding, data acquisition, data analysis, results interpretation, drafting of manuscript, critical revisions of manuscript. Ms. Raymond and Vetor were responsible for data acquisition, analysis, and results interpretation. Mr Mongalo and Dr. Adams were responsible for drafting and critical revisions of the manuscript. Drs. Rouse and Carroll were responsible for results interpretation and critical manuscript revisions.

Conflicts of Interest: None

Keywords

Adolescent Trauma; Opioid Prescribing; Substance Use Disorder; Overdose

INTRODUCTION

In 2014, nearly 500,000 adolescents ages 12 to 17 were nonmedical prescription opioid users and approximately 170,000 had a pain reliever use disorder—indicating that a substantial portion of adolescents who use opioids become addicted or dependent.[1] The Centers for Disease Control (CDC) reported that over 5 million adolescents are being treated for injuries at U.S. hospitals annually.[2] Acute pain resulting from traumatic injury generally requires treatment with opioids; however, opioid therapy can lead to recurrent opioid use and prescription opioid misuse.[3–7] It has been reported that 80% of high school students misusing prescription opioids were initially prescribed opioids by a physician and 56% of injured adolescents have an increased risk of developing a substance use disorder (SUD) within 3 years of their injury.[6,8] Due to biological and psychosocial factors, traumatically injured adolescents are at higher risk of SUD development than the general population.[9–13]

Many risk factors for traumatic injury overlap with those for addiction, indicating that young trauma patients without a history of opioid use may be more likely to develop SUDs.[12,14–19] Studies in adults have found that trauma patients have high drug dependency rates, suggesting seriously injured patients manifest more severe forms of SUD than the general population.[13] Finally, traumatic injuries are associated with the development of mental health conditions such as chronic pain, PTSD, and depression.[8,20,21] Adolescents with these conditions often use drugs to cope with symptoms, which increases the risk for SUDs and other adverse outcomes including opioid overdoses.[22–24] To date, no studies have examined long-term opioid use or the prevalence of SUD and future overdoses in adolescent trauma patients from the time of injury to young adulthood.

This study aims to quantify the number of opioid prescriptions injured adolescents fill in the five years following their injury using a regional health information exchange. It also seeks to determine the prevalence of mental health diagnoses, including substance use disorders, following their injury. Finally, it examines the percentage of patients who are treated for opioid overdoses in the five years following their hospital discharge for their initial injury. Understanding how a largely opioid naïve population transitions from a point of clinically initiated opioid use to the development of an SUD, while accounting for medically prescribed opioids, is important to determine what role acute care providers can play in preventing future, potentially life-threatening opioid use disorders in injured adolescents.

METHODS

Data Source

Our retrospective cohort consisted of 736 patients between ages 12 and 18 who were admitted for trauma from 2011–2013 at one pediatric and one adult level I trauma center. Only patients residing within the county containing the trauma centers and the surrounding

counties were included. Demographic and clinical data contained in the trauma registry were available for the cohort, including alcohol and drug use screening data collected upon admission for injury. We examined post-discharge healthcare utilization data for up to 5 years using a regional health information exchange, the Indiana Network for Patient Care (INPC), that contains information on prescription medications filled (in both healthcare facilities and commercial outpatient pharmacies) and ICD-9/10 diagnoses associated with inpatient, outpatient, and emergency department encounters in healthcare facilities throughout the state. This dataset has been used previously to assess long-term healthcare utilization in trauma patients.[25,26] The INPC also contains prescription data from Surescripts, which includes data on prescriptions filled by major pharmacy chains such as Walgreens, CVS, and Rite Aid, among others.[27] We were able to link 668 patients of our trauma cohort to the INPC. Our study received expedited approval by the Indiana University Institutional Review Board.

Outcome Variables

Our primary outcome of interest was the number of outpatient opioid prescriptions filled post injury. Prescriptions filled by inpatient pharmacies on the date of hospital discharge with instructions to take medication for at least two more days were considered outpatient opioid prescriptions. Medications filled by commercial pharmacies were also considered outpatient opioid prescriptions. We examined the number of opioid prescriptions filled in the outpatient setting following hospital discharge. Secondary outcomes we evaluated were the prevalence of mental health diagnoses included in healthcare encounters following injury. Specifically we identified patients with substance use disorder (SUD), depression, anxiety, and PTSD diagnoses based on ICD-9/10 codes for inpatient, emergency department, and outpatient encounters during the follow-up period. We also examined the number of patients who were administered opioid antagonists such as naloxone in the emergency department (ED) setting or who had diagnoses for overdose.

Analysis

Only patients with data in the regional health information exchange were included in the analysis. We examined the number of outpatient opioid prescriptions filled each year following a patient's discharge and report the percentage of patients with multiple outpatient opioid prescriptions filled each year. We also evaluated the proportion of patients with SUD, depression, anxiety, and PTSD diagnoses, as well as ED encounters for overdose. Finally, we analyzed the association between SUD and overdose outcomes with demographic and clinical data included in the trauma registry from the time of injury. We used chi square tests to examine the association between two outcomes of interest (SUD and overdose) and age, gender, race, hospital type (adult or pediatric), injury severity (minor/moderate [injury severity score less than 15] or major [injury severity score 15 or greater]), injury type (blunt, penetrating, or "other", which primarily includes burns), insurance (Medicaid, self-pay, private, other/unknown), positive alcohol screening at hospital admission, and positive drug screening on admission. Missing data on trauma registry variables were coded as "unknown" so that all linked cases could be included. Less than 5% of patients had no information reported on any of the independent variables in our analysis. All tests were two-sided and alpha was set at 0.05.

RESULTS

The majority of the cohort was treated at the pediatric trauma center (76.9%), had sustained blunt injuries (75.1%), and were white (70.5%). The mean age of patients at the time of injury was 14.6. The largest proportion of patients had commercial insurance (44.9%), slightly over a third had Medicaid (36.3%), and 19.1% of patients had no insurance. Most patients had a length of stay of 2 days or less (44.9%), while only 10.9% stayed one week or more. Approximately 84% had a routine discharge home. Only 15.4% screened positive for alcohol use and 5.2% screened positive for drug use at the time of admission. (Table 1)

At 1 year, over 20% of adolescents filled more than 2 opioid prescriptions after being discharged for their injury; and at 4 years, over 13% had received more than 8 opioid fills, with at least two new opioid fills per year. Over the 5 year period, 11% received an opioid antagonist injection, 14% received an SUD diagnosis, and 8% had an overdose diagnosis. Relatively few patients had diagnoses for other mental health conditions including depression (5.5%), PTSD (2.1%), and chronic pain (3.6%). (Table 2)

We found that older adolescents; males; black patients; patients treated at adult hospitals; injury types that included penetrating and “other”; insurance statuses of “other/unknown”, Medicaid, and self-pay; and positive alcohol and drug screenings were all significantly associated with a future SUD diagnosis after hospital discharge. Additionally, older adolescents, black patients, patients treated at adult hospitals, penetrating injuries, and “other/unknown” insurance status were all significantly associated with a future overdose after hospital discharge. Injury severity was not associated with SUD or overdose outcomes. (Table 3)

DISCUSSION

Our study found that over 20% of traumatically injured adolescents fill 2 or more outpatient opioid prescriptions within 12 months of their discharge from the hospital. Additionally, we found that 1 in 8 adolescents are still taking prescription opioids at least 4 years after their injury. It has been reported that 56% of injured adolescents have an increased risk of developing an SUD within 3 years of their injury.[3,8] Previous studies found that 1 in 8 pediatric trauma patients are still using pain medication 12 months after their injury.[28] Our findings support what has been previously published in the literature and further show long-term outcomes of both prescription opioid usage and SUD/overdose outcomes in the same cohort. Our results, along with previous studies, suggest injured adolescents may be at greater risk for long-term prescription opioid use and SUD than the general pediatric trauma population.

This increased risk could be due to the fact that adolescence is a critical period of development when the brain is more vulnerable to addiction.[14,15] The peak risk for both initiating nonmedical opioid use and transitioning to opioid dependence occur during mid-adolescence, between ages 14 and 16.[16,17] Many risk factors for traumatic injury overlap with those for addiction, indicating that young trauma patients without a history of drug use may be more likely to develop SUDs.[12,18–23] Clinicians treating adolescent trauma patients

may wish to spend more time describing the risk of opioid dependence at discharge with families and ensuring caregivers clearly understand guidelines for administering opioids. Further, providers may want to encourage families to describe the risks of adolescents misusing their opioid prescription once they return home, to reduce the likelihood of nonmedical opioid use.[4]

Sustained opioid use is generally unnecessary after injury, as opioids have not been shown to reduce chronic non-cancer pain and increasing numbers of prescriptions for pain medication enable nonmedical usage.[29] More research is needed to understand why sustained opioid use occurs and delineate the pathway from medical to nonmedical opioid use over the course of injury recovery. Because opioid prescribing laws have changed multiple times in our state since this cohort's injury period, sustained prescription opioid use after an episode of acute pain will likely be lower in future cohorts. Instead, the use of prescription opioids obtained from friends and family members, in addition to the use of illicit drugs, may present a greater risk for this population.[30] Identification of risk factors for using illicit drugs, SUDs, and future overdoses will provide greater insight into providers' opportunities for SUD prevention that go beyond opioid prescribing guidelines. Partnering with mental health providers during adolescents' post-acute care period, may reduce the likelihood of SUDs in young adulthood.[31] Additionally, this may improve diagnosis of other mental health conditions, which are reported to be as high as 68% for depression following injury in adults based on studies that prospectively screen patients.[32] Administrative data, such as the one used in this study, likely underestimates the true prevalence of mental health conditions because it relies entirely on identifying disorders through ICD-9/10 codes. Historically, mental health diagnosis codes have been underutilized and this, along with the lack of mental health follow-up assessments, likely explains why the rates of depression and anxiety were so low in our cohort.

Finally our study demonstrated that rates of SUD and overdose are much higher in the adolescent trauma population than the general adolescent population.[33] We found that 1 in 8 adolescent trauma patients are diagnosed with an SUD and 1 in 10 are treated for an overdose in an emergency department setting. Because our health information exchange did not include data from other community providers that respond to overdose emergencies, such as emergency medical services (EMS) and police, the rate of overdose may be underestimated.

One of the major limitations of our study was that it relied on structured medical record data and did not assess information available in provider notes. Because of this, mental health issues are likely not as identifiable as they may be in provider notes. Additionally, data from small community-based providers of addiction services and EMS providers are not represented in our database. In future studies, we plan to address these limitations by using newly available natural language processing tools to study emergency department and social work provider notes to identify patients who overdose or are suspected of having a mental health condition based on unstructured clinical data. Another limitation is that although we were able to link the majority of patients in the trauma registry to the health information exchange, we were unable to distinguish between patients who move, who are treated by providers that do not contribute data to the health information exchange, and those who do

not have any medical encounters. Finally, because community pharmacy data on opioid fills is not linked to specific encounter and diagnosis information, we are unable to determine the reason for sustained prescription opioid use. Currently, we are conducting a longitudinal, prospective study to better address questions of causality and screen for medical conditions not captured in the health information exchange.

CONCLUSIONS

Opioid usage remained high for multiple years in a subset of our retrospective adolescent trauma cohort. Mental health diagnosis rates were much lower in injured adolescents than what has been reported in adults, indicating providers may under-assess depression and PTSD after hospital discharge. However, we found that overdose and SUD diagnoses occur in over 1 in 10 adolescents within 5 years of their injury.

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Table 1.

Cohort Characteristics, n=736

Age, mean (range)	14.55 (12–18)
Gender	
Male	546 (74.2%)
Female	190 (25.8%)
Race	
White	519 (70.5%)
Black	169 (22.9%)
Other/Unknown	48 (6.6%)
Hospital Type	
Pediatric	566 (76.9%)
Adult	170 (23.1%)
Injury Type	
Blunt	553 (75.1%)
Penetrating	133 (18.1%)
Other	50 (6.8%)
Injury Severity	
Minor/Moderate	598 (85.3%)
Major	103 (14.7%)
Routine Discharge	615 (83.6%)
Length of Stay	
<2 Days	322 (44.9%)
2–7 Days	316 (42.9%)
Week or More	89 (10.9%)
Insurance Status	
Medicaid	267 (36.3%)
Self-pay	141 (19.1%)
Private	322 (43.8%)
Positive EtOH	114 (15.4%)
Positive Drug Use	39 (5.2%)

Table 1 shows demographic and clinical characteristics of the cohort during their initial hospitalization for injury.

Table 2.

Rx Opioid Outcomes and SUD/Mental Health Diagnoses

Rx Opioid Usage, n=660		Mental Health Dx/Event, n=668	
Received Opioids in Hospital	97.0%	Substance Use Disorder	13.8%
2+ Rx Opioid Fills at 3 Months	14.1%	Overdose	7.6%
2+ Rx Opioid Fills at 6 Months	16.9%	Anxiety	10.8%
2+ Rx Opioid Fills at 12 Months	20.5%	Depression	5.5%
4+ Rx Opioid Fills at 24 Months	17.0%	PTSD	2.1%
6+ Rx Opioid Fills at 36 Months	15.4%	Chronic Pain	3.6%
8+ Rx Opioid Fills at 48 Month	13.3%	Any Opioid Antagonist Injection	10.8%

Table 2 shows the percentage of patients sustaining prescription opioid use on the right side. The data includes all patients from the trauma cohort that were matched to the INPC prescription drug database, which included data from Surescripts. On the left, the percentage of patients with ICD-9/10 diagnoses relating to mental health and substance use disorders is shown. These percentages include 668 patients who had post-discharge health encounter information in the INPC and include inpatient, outpatient, and ED encounters.

Table 3.

Association between Patient Characteristics and SUD Outcomes

	SUD Dx (n=92)	p value	Overdose Dx (n=51)	p value
Age		<0.001		<0.001
14 and Under	30 (8.0%)		13 (3.5%)	
15 and Over	59 (21.7%)		35 (12.9%)	
Gender		0.021		0.376
Female	13 (7.5%)		11 (6.4%)	
Male	76 (16.0%)		37 (7.8%)	
Race		<0.001		<0.001
White	52 (11.0%)		27 (5.7%)	
Black	35 (25.0%)		21 (15.0%)	
Other	2 (5.9%)		0 (0.0%)	
Hospital		<0.001		<0.001
Adult	33 (33.3%)		18 (18.2%)	
Pediatric	56 (10.2%)		30 (5.5%)	
Injury Severity		0.368		0.355
Minor/Moderate	75 (13.8%)		39 (7.2%)	
Major	8 (10.1%)		8 (10.1%)	
Injury Type		<0.001		<0.001
Blunt	58 (10.7%)		23 (4.2%)	
Penetrating	25 (26.3%)		25 (26.3%)	
Other	6 (66.7%)		0 (0.0%)	
Insurance		0.005		0.001
Medicaid	40 (17.2%)		25 (10.8%)	
Self-Pay	21 (18.1%)		10 (8.6%)	
Private	23 (8.2%)		9 (3.2%)	
Other	5 (27.8%)		4 (22.2%)	
EtOH Positive	25 (22.9%)	0.015	10 (9.2%)	0.966
Drug Use	16 (50.0%)	<0.001	3 (9.4%)	0.106

Table 3 shows baseline characteristics of patients who have a future SUD or overdose diagnosis based on ICD-9/10 codes. The percentages reflect the row percentage of patients in each category that had an SUD diagnosis (left column) or overdose diagnosis (right column). For example, 50% of patients that screened positive for drugs during their initial hospital visit had an SUD diagnosis in the 5 years after their discharge.