Diagnosis of Opioid Use Disorder by Youths Assessed in Acute Care Settings in British Columbia, Canada

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Objectives To describe trends in the number of youths diagnosed with opioid use disorder (OUD) and to identify factors associated with OUD diagnosis in acute care settings.

Study design Data from a population-based retrospective cohort study with linkage of 6 health administrative databases for 13 009 youth age 12-24 years identified with OUD between 2001 and 2018 in British Columbia, Canada were used to describe annual diagnoses. Using a multiple logistic regression model, we estimated the association between past-year health care utilization and OUD diagnosis in acute settings, controlling for sociodemographic and OUD-related comorbid conditions.

Results Annual OUD diagnoses quadrupled between 2003 and 2017 (from 326 to 1473). Among the 6579 youth diagnosed with OUD between April 1, 2013 and September 30, 2018, 88.1% had past-year health system contacts. Youth age 12-18 had higher odds of OUD diagnosis in acute care (aOR 2.04; 95% CI 1.78, 2.34). Compared with no health care contact, youth receiving outpatient care only were less likely to be diagnosed with OUD in acute care (aOR 0.69; 95% CI 0.56, 0.84) and those with >1 urgent hospitalization were more likely to be diagnosed with OUD in acute care (aOR 1.87; 95% CI 1.40,2.49).

Conclusions More than 88% of youth had past-year health system contacts prior to diagnosis**.** Those age 12-18 years and with urgent hospitalizations in the year prior to diagnosis were more likely to have OUD diagnosed in acute care settings. Establishing an effective evidence-based system for early detection and intervention among youth with OUD must be a priority. *(J Pediatr 2021;232:243-50)*.

In Canada, youth (adolescents and young adults) have had the fastest growing rates of opioid-related hospitalizations over the past decade.[1] Youth with opioid use disorder (OUD) in the province of British Columbia had the highest relative risk of mortality of all people with OUD, with standardized mortality ratios greater than those of any other age group.[2] In the US, the diagnosis rate of OUD among youth increased more than 5-fold in recent years[3] and initiation of substance use at a young age is associated with greater severity of detrimental long-term outcomes.[4-8] One out of 3 adults receiving treatment for OUD used illicit opioids for the first time before turning 18 years old and 2 out of 3 before they turned 25 years old.[9] As a result of substantial increases in opioid-related emergency department visits, hospitalizations, and deaths,[10-12] OUD is a leading cause of morbidity and mortality among youth according to the American Academy of Pediatrics.[13]

Effectively addressing the North American overdose epidemic will require a strategy to help improve early detection of OUD as substance use disorders are one of the most frequently missed diagnoses among youth.[14] Use of the substance use screening, brief intervention, and referral to treatment model in pediatric primary care has been associated with improved health care use and reduced subsequent diagnoses for mental health and substance use disorders.[15] Nonetheless, and despite recommendation by the American Academy of Pediatrics for incorporating screening, brief intervention, and referral to treatment into routine care,[16,17] utilization remains low among pediatric providers.[18] Timely detection of OUD in nonacute settings is important given that youth are likely to fail in recognizing their need for treatment.[19,20] Primary care providers can use long-term relationships to facilitate open discussions and more effective screening, reducing stigma associated with substance use and improving access to medication for OUD and to overdose-reversing naloxone.[21] By emphasizing early intervention and providing evidence-based care for youth with OUD, we can move from a crisis-driven system to prevention of life-long consequences of early illicit opioid use.[22,23]

Furthermore, as the use of comprehensive administrative databases have been shown to offer significantly higher prevalence estimates for OUD than survey-based estimates[24,25] and are rare[26,27] compared with studies based on a single

ICD-9	*International Classification of Diseases, Ninth Revision*
ICD-10	*International Classification of Diseases, Tenth Revision*
OUD	Opioid use disorder

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database,[3,28-33] especially for adolescents age 12-18 years, population-based trends in OUD diagnoses are needed to help guide the public health response.[24,34]

Using comprehensive, population-level linked administrative databases for British Columbia, Canada, our objectives were to describe trends in the number of adolescents age 12-18 years and young adults age 19-24 years diagnosed with OUD and identify how health care utilization prior to OUD diagnosis is associated with first presenting to the health system with OUD in acute care settings.

Methods

This population-based retrospective cohort study used a provincial-level linkage of 6 health administrative databases to identify all residents of British Columbia with OUD from January 1, 1996 to September 30, 2018. These databases captured all medication dispensations[35] and hospitalizations,[36] visits to urban, high-volume emergency departments,[37] complete physician billing records,[38] perinatal medical records,[39] and deaths[40] (databases are described in the **Supplementary Table I** [available at www.jpeds.com]). Data were linked using anonymized individual study identifiers with complete data for all databases with the exception of emergency department visits captured from April 1, 2012 to September 30, 2018.

Study Population

We used case-finding algorithms to identify the population of individuals diagnosed with OUD using *International Classification of Diseases, Ninth Revision* (ICD-9) and *Tenth Revision* (ICD-10) codes (for opioid-related poisoning or mental and behavioral opioid-related disorder) and Drug Identification Numbers and Product Identification Numbers specifically assigned for opioid agonist treatment (**Supplementary Table II**; available at www.jpeds.com).[41] We included youth diagnosed with OUD between January 1, 2001 (to allow for 5 years of data capture to establish OUD diagnosis) and September 30, 2018. We classified youths as either adolescents (age 12-18 years) or young adults (age 19-24 years) in accordance with a provincial initiative aiming to provide integrated mental health care and substance use services for youth, and through their transition to young adults.[23] We defined age on the date of initial detection of OUD (OUD diagnosis hereafter).

Variables

Our primary outcome in this analysis was the setting of OUD diagnosis. We classified the setting of OUD diagnosis as either acute care (defined as an urgent OUD-related hospitalization, an urgent OUD-related emergency department visit, or an indication of OUD-related death) or outpatient care (defined as an OUD-related physician billing record, a medication for OUD dispensation, an elective hospitalization with a secondary OUD-related diagnosis code, a nonurgent emergency department visit with a secondary OUD-related diagnosis code, or an OUD-related perinatal care record). We identified urgent OUD-related hospitalizations and emergency department visits as those with opioid-related diagnosis codes that were classified as urgent hospital admission or triage level, respectively. Finally, we identified death records specific to opioid from the underlying cause of death and nature of injury code in the Vital Statistics database (**Supplementary Table I**) using ICD-10 codes assigned for opioid poisoning or OUD (**Supplementary Table II**). Causes of death are initially determined by a physician, coroner, or medical examiner and subsequently abstracted by professionals and coded into the Vital Statistics database.

Our key exposure of interest was health system engagement for non-OUD related receipt of care prior to OUD diagnosis. We examined the year prior to the first OUD diagnosis, and classified 5 distinct patterns of health service use in that year: (1) no health care contact (no record in any of our databases); (2) outpatient care only, including visits to the emergency department classified as non-urgent and elective hospitalizations; (3) outpatient care with one or more emergency department visit classified as urgent; (4) outpatient care with one hospitalization classified as urgent; and (5) outpatient care with more than one hospitalization classified as urgent.

We included key sociodemographic factors known to influence engagement in health care, including sex, rurality, and being a member of a household receiving income assistance. Clinical covariates included any indication of OUD-related comorbid conditions (including alcohol use disorder, other substance use disorders, mental health disorders, HIV, hepatitis C virus, and noncancer chronic pain). We determined comorbid conditions at the time of OUD diagnosis using ICD-9 and ICD-10 diagnosis codes in physician billing and hospitalization records (**Supplementary Table III**; available at www.jpeds.com).

Statistical Analyses

We first described the annual number of adolescents and young adults diagnosed with OUD from January 1, 2001 to September 30, 2018. To identify contacts with the health system prior to OUD diagnosis, we measured all health service utilization in the year prior to OUD diagnosis for youth diagnosed from April 1, 2013 to September 30, 2018, and described past 12-month resource use patterns among those diagnosed in each calendar year. This period was chosen as emergency department visits were available only from April 1, 2012. Differences in characteristics were assessed with χ^2 tests or Fisher exact tests.

We then constructed a multiple logistic regression model to identify characteristics associated with OUD diagnosis in acute or outpatient care settings from April 1, 2013 to September 30, 2018. The primary independent variable was the categorical health care utilization covariate and the model included all sociodemographic and clinical variables. In addition, we included a covariate indicating the year of OUD diagnosis in the model, capturing underlying changes in

the characteristics of the opioid epidemic. Analyses were conducted using SAS v 9.4 (SAS Institute Inc), and R, version 3.6.2 (R Foundation for Statistical Computing).

Results

Between January 1, 2001, and September 30, 2018, there were 13 009 youths age 12-24 years in British Columbia diagnosed with OUD. The annual number of diagnoses among adolescents decreased by more than one-half between 2001 and 2007, from 109 to 53 (a 51.4% decline), and then increased each subsequent year, rising more than 5-fold, to 285 in 2017 (a 437.7% increase). Following a decrease in diagnoses among young adults from 493 to 263 between 2001 and 2003 (a 46.7% decline), the number of yearly diagnoses then increased more than 4-fold, to 1188 in 2017 (a 351.7% increase). In total, yearly diagnoses more than quadrupled between 2003 and 2017 (from 326 to 1473, a 351.8% increase) (Figure 1).

Among the 6579 youths diagnosed with OUD from April 1, 2013 to September 30, 2018, 18.1% (n = 1190) were adolescents age 12-18 years and most adolescents were female

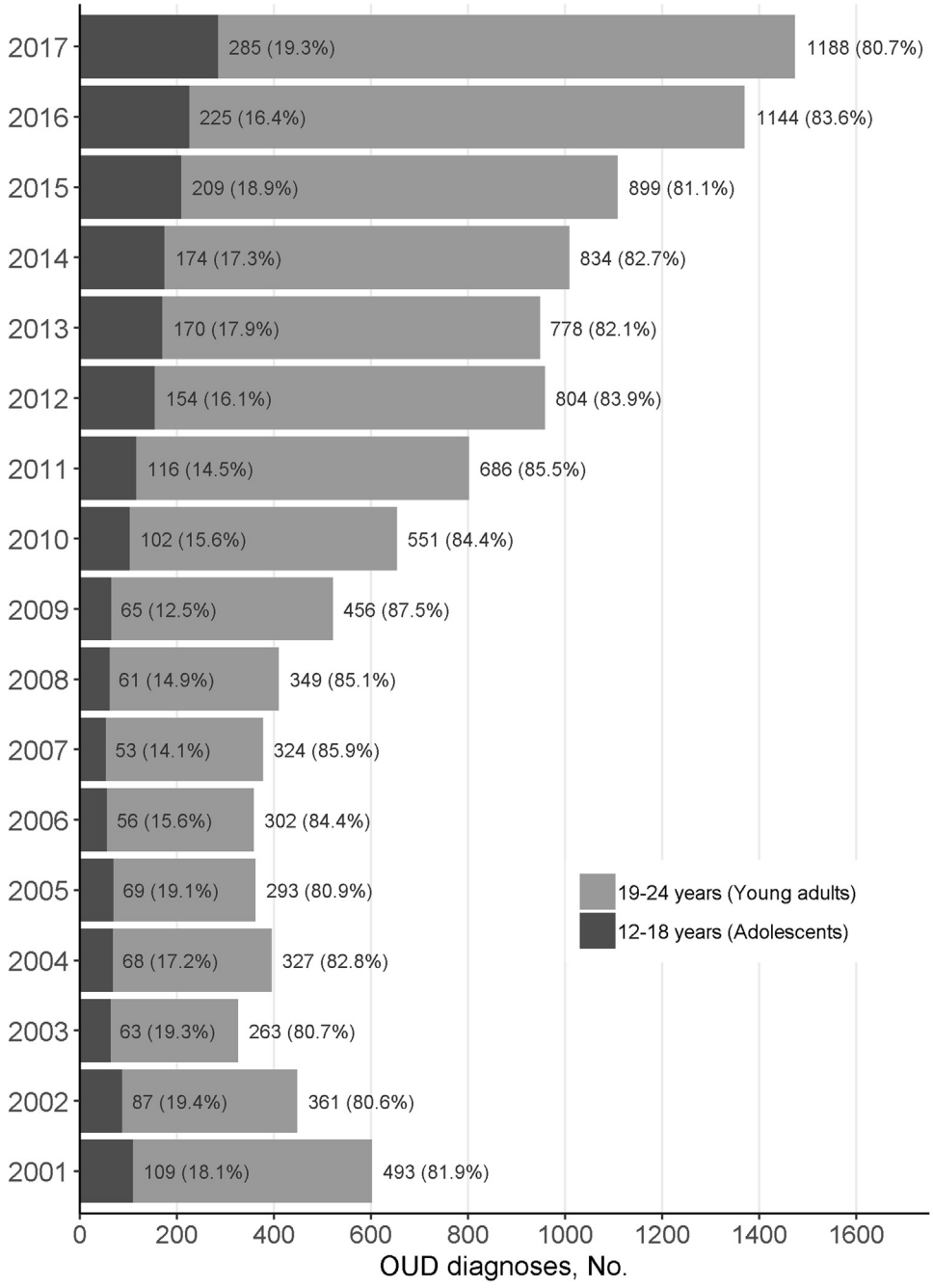

Figure 1. Annual number of OUD among adolescents and young adults in British Columbia, 2001-2017.

(58.8%) (Table I). In contrast, a majority of the 5389 (81.9%) young adults with OUD age 19-24 years were male (61.1%). Compared with young adults, more adolescents had 1 or more OUD-related comorbid condition (91.5% vs 83.9%), another substance use disorder besides alcohol (69.7% vs 62.2%), or a concurrent mental health disorder (79.2% vs 68.0%), but fewer had chronic pain (36.3% vs 45.1%). Hepatitis C virus and HIV prevalence were low among all youths with OUD (<1%). A greater proportion of adolescents with OUD were identified in acute care compared with young adults (50.3% vs 31.7%). Among youths identified in acute care settings, 26 (4.3%) adolescents and 124 (2.3%) young adults had an OUD-related death as the first instance of OUD identification in our data.

Compared with health care utilization in the year prior to diagnosis for young adults, fewer adolescents with OUD had no contact (5.2% vs 13.4%) but more had 1 or more urgent hospitalization (22.1% vs 13.7%). Nearly one-third of all youths had at least 1 urgent emergency department visit (adolescents: 32.3%; young adults: 29.8%). The proportion of adolescents with any urgent hospitalization more than doubled from 2013, the year with the lowest percentage (13.5%), to 2017, the year with the highest percentage (28.4%) (Figure 2). For 2018, the percentage was 23.2%. Among young adults, the proportion with any urgent hospitalizations also doubled from 2013, the lowest percentage year (7.9%), to 2018, the year with the highest percentage (16.0%).

In our multiple logistic regression analysis, being in the adolescent age group compared with the young adult age group was independently associated with identification of OUD in acute care (aOR 2.04; 95% CI 1.78, 2.34) (Table II). Compared with no health care contact in the year prior to diagnosis, youths receiving outpatient care only had lower odd of being identified in acute care (aOR 0.69; 95% CI 0.56, 0.84) and those with >1 urgent hospitalization were associated with higher odds of being identified with OUD in acute care (aOR 1.87; 95% CI 1.40, 2.49). Indication of concurrent non-OUD substance use disorders was associated with higher odds of identification in acute care (aOR1.65; 95% CI 1.45, 1.87), as was having an alcohol use disorder (aOR 1.55; 95% CI 1.36, 1.77), whereas youths from households identified as receiving income assistance had lower odds of being diagnosed in acute care settings (aOR 0.74; 95% CI 0.67, 0.83). Finally, subsequent years of diagnosis were not independently associated with diagnosis in acute care when compared with 2013.

Table I. Characteristics of youths with OUD in British Columbia, 2013-2018, by age at diagnosis

Characteristics	12-18 y, No. (%)	19-24 y, No. (%)	*P* value
No.	1190 (18.1)	5389 (81.9)	
Sex			
Female	700 (58.8)	2097 (38.9)	<.001
Male	490 (41.2)	3292 (61.1)	
Recipient of income assistance*	717 (60.3)	3340 (62.0)	.18
Geographic region			
Rural	59 (5.0)	223 (4.1)	.27
Urban	1117 (93.9)	4976 (92.3)	
Missing	14 (1.2)	190 (3.5)	
Setting of OUD diagnosis†			
Acute care	598 (50.3)	1709 (31.7)	<.001
Urgent emergency department visit	226 (37.8)	723 (42.3)	
Urgent hospitalization	346 (57.9)	862 (50.4)	
Vital statistics	26 (4.3)	124 (7.3)	
Outpatient care	592 (49.7)	3680 (68.3)	
Physician billing	151 (25.5)	829 (22.5)	
OAT dispensation	397 (67.1)	2743 (74.5)	
Nonurgent emergency department visit	18 (3.0)	60 (1.6)	
Elective hospitalization	22 (3.7)	28 (0.8)	
Perinatal data	Supp	20 (0.5)	
OUD-related comorbidity‡			
Substance use disorder§	829 (69.7)	3350 (62.2)	<.001
Alcohol use disorder	236 (19.8)	1089 (20.2)	.77
Mental health	942 (79.2)	3666 (68.0)	<.001
Chronic pain	432 (36.3)	2430 (45.1)	<.001
HCV¶	Supp	19 (0.4)	Supp
HIV¶	Supp	17 (0.3)	Supp
Number of comorbid conditions			
None	101 (8.5)	868 (16.1)	<.001
1	242 (20.3)	1031 (19.1)	
>1	847 (71.2)	3490 (64.8)	
Health care utilization in year prior to diagnosis			
No contact	62 (5.2)	724 (13.4)	<.001
Outpatient care only	481 (40.4)	2322 (43.1)	
Outpatient care with urgent ED visit	384 (32.3)	1605 (29.8)	
One urgent hospital episode	145 (12.2)	434 (8.1)	
More than one urgent hospital episode	118 (9.9)	304 (5.6)	

HCV, hepatitis C virus; *OAT*, opioid agonist treatment; *Supp*, suppressed because of small cell size <10.
*Determined for the household.
†*P* value reported for acute care and outpatient care comparison.
‡Comorbid conditions were attributed at diagnosis using ICD-9/10 codes.
§Excludes OUD and alcohol use disorder.
¶Determined by receipt of care because linkage to provincial testing databases were not available.

Discussion

In this population-based study of OUD among youth in British Columbia, Canada, we found the number of annual OUD diagnoses more than quadrupled between 2003 and 2017. More than 88% of all youth had at least 1 contact with the health care system in the year prior to OUD diagnosis, including nearly 95% of adolescents (age 12-18 years). Youth receiving outpatient care without any emergency department visits in the past 12 months had lower odds of acute OUD identification, and those with >1 urgent hospitalization had higher odds of having OUD identified in acute care settings. Finally, adolescents had twice the odds of having OUD identified in acute care compared with young adults (age 19-24 years).

Our findings of persistent increases in the number of adolescents and young adults with OUD contrast with prior studies that have focused on commercially insured youth.

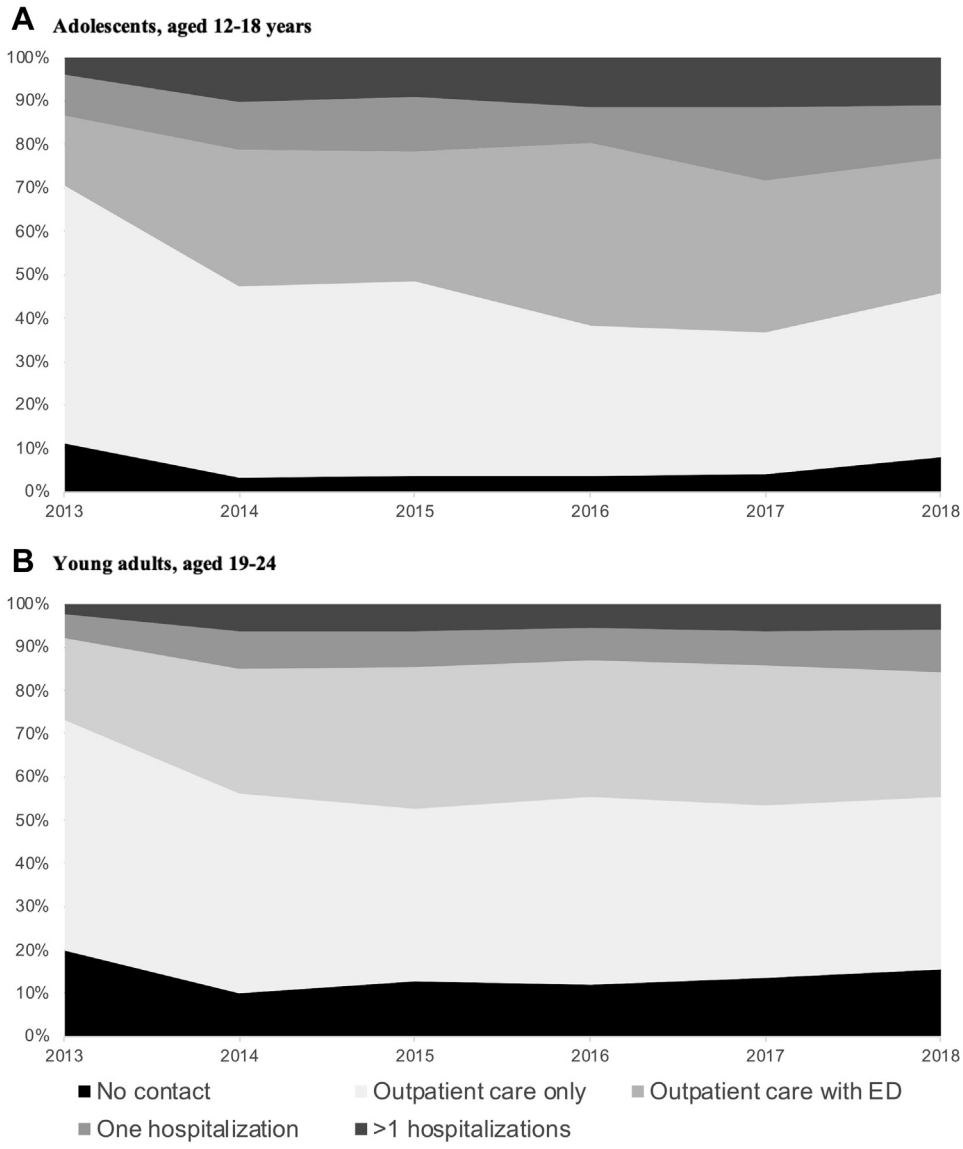

Figure 2. Health care utilization patterns in the year prior to OUD diagnosis among adolescents and young adults in British Columbia, 2013-2018.

Hadland et al found the rate of diagnosis among adolescents plateaued between 2009 and 2014[3] and Shen et al found a large decrease in the diagnosis rate among young adults between 2012 and 2017, a trend reversal not observed in any other age group.[30] Although we found OUD diagnoses for adolescents quintupled between 2007 and 2017 and quadrupled among young adults between 2003 and 2017, our findings were consistent with increasing estimated population-level prevalence among youth 11-25 years of age in Massachusetts between 2011 and 2015.[25] Furthermore, our findings add to limited evidence concerning OUD diagnosis in youth age 12-18 years. Population-level epidemiologic information is needed to quantify system capacity needs and appropriately support the public health response to the the North American overdose epidemic.

Screening and early intervention among youth is essential to reducing the public health burden of OUD. Identifying missed opportunities for early detection of OUD can help target public health interventions to prevent escalation of substance use. Consistent with prior research suggesting that youth tend to delay seeking care for problematic substance use until symptoms become severe,[42,43] our findings that 94.8% of those in the 12-18 years of age group came in contact with the health care system in the year prior to diagnosis emphasize that adolescents may particularly benefit from efforts toward earlier identification by reducing the severity of the circumstances under which OUD is ultimately identified. The greater proportion of female subjects among adolescents diagnosed with OUD we observed contrasted with the composition of the overall population of people

Table II. Factors associated with OUD diagnosis in acute care among youths in British Columbia, 2013-2018

Factors	aOR (95% CI)	*P* value
Age group		
19-24 y	Reference	
12-18 y	2.04 (1.78, 2.34)	<.001
Sex		
Female	Reference	
Male	1.03 (0.92, 1.15)	.65
Geographic region		
Rural	Reference	
Urban	1.01 (0.77, 1.31)	.97
Recipient of income assistance*		
No	Reference	
Yes	0.74 (0.67, 0.83)	<.001
Health care utilization in year prior to diagnosis		
No contact	Reference	
Outpatient care only	0.69 (0.56, 0.84)	<.001
Outpatient care with emergency department visit	0.98 (0.79, 1.21)	.85
One hospitalization episode	1.29 (0.99, 1.67)	.06
>1 hospitalization episode	1.87 (1.40, 2.49)	<.001
Substance use disorder†,‡		
No	Reference	
Yes	1.65 (1.45, 1.87)	<.001
Alcohol use disorder†,‡		
No	Reference	
Yes	1.55 (1.36, 1.77)	<.001
Mental health†		
No	Reference	
Yes	1.05 (0.91, 1.20)	.52
Chronic pain†		
No	Reference	
Yes	0.91 (0.81, 1.01)	.09
Year of OUD diagnosis		
2013	Reference	
2014	0.85 (0.69, 1.06)	.14
2015	1.01 (0.82, 1.24)	.94
2016	1.09 (0.89, 1.34)	.38
2017	1.12 (0.92, 1.37)	.25
2018	1.13 (0.91, 1.41)	.27

*Determined for the household.
†Comorbid conditions were attributed at diagnosis using ICD-9/10 codes.
‡Excludes OUD and alcohol use disorder.

with OUD in British Columbia,[41] indicating that identification at a younger age for female adolescents may have been the result of earlier and more regular engagement in primary care, notably for sexual health. Given their expertise in preventive care, pediatricians and adolescent medicine physicians are ideally positioned to integrate OUD screening and treatment into primary care.[44] However, developing the capacity for early identification may also require additional innovative approaches.[45] Recognizing this need, British Columbia is expanding its province-wide network of community-based centers providing integrated health and social service for youth.[23] By bringing care to youth and their families with service providers specializing in the use of effective screening, diagnosis, and treatment, early intervention can be improved, reducing the number of youth affected by OUD.

Our findings reveal crucial missed opportunities for early identification of OUD, with only a minority of youth having no contacts with the publicly financed universal health care system in the year prior to diagnosis. These missed opportunities are of great concern because urgent hospitalizations more than doubled prior to diagnosis for both adolescents and young adults, and patterns of repeated urgent hospitalizations (typically admitted via the emergency department) were associated with acute care identification of OUD. That health system contacts in acute settings in the past are associated with increased likelihood of OUD identification in acute care settings in the future further underlines the pressing need to address this gap in care for youth with OUD. This may indicate an even more urgent need for adolescents and young adults in the US because they traditionally have the lowest rate of primary care use of any age group.[46] Finally, alternate prevention strategies outside health care settings are needed to reach the estimated 11.9% of youth who did not come into contact with the health care system in the year prior to their OUD diagnosis and the 2.3% of youth with an OUD-related death as their first instance of OUD identification. The broader implementation of underutilized primary prevention strategies at the individual, family, and community level may not only reduce the risk of OUD but could also improve a wide range of behavioral and health outcomes.[20]

Finally, we observed a very high prevalence of concurrent mental health and non-OUD substance use disorders among youth diagnosed with OUD. Integrated care, giving equal consideration to both OUD and mental disorders, is recommended clinical practice.[47] However, the important unmet treatment needs for adult patients with similarly complex medical needs[48] highlight barriers to treatment youth with concurrent disorders may face in addition to pediatric care capacity constraints. Furthermore, concurrent disorders have been associated with worse outcomes, including substance use treatment discontinuation[49] and risk of nonfatal overdose.[50] Despite the increased burden of disease and that the high prevalence of concurrent disorders is well-documented,[51-54] there is a dearth of evidence to guide clinical practice.[22,55,56] Clearly, there is a need to explore potential solutions for modernizing models of care, moving from fragmented services toward evidence-based integrated services that are youth-friendly, providing opportunities to engage youth with multiple, complex issues in treatment, care, and support.

There are several limitations to this study. First, the estimated number of OUD diagnoses is likely to be an underestimate of the prevalence of OUD among youth in British Columbia. Some youth with OUD may not access any services or only access services with data available at an aggregate-level, including community and harm reduction services. In addition, the ICD-9 and ICD-10 codes used to identify OUD were subject to misclassification and errors of omission. Because our study captured all detected OUD cases in the provincial health administrative databases, these limitations are unlikely to change the trends and results that we observed. Second, our databases did not include records from the Ministry of Children and Family Development and some youths classified as having no health system

engagement prior to OUD diagnosis may have received outpatient mental health services. However, given that the Ministry of Children and Family Development refers all youths identified as having a substance use issue to services captured by our databases and the relatively small proportion of youths with no contact prior to diagnosis, it is unlikely the inclusion of these records would change our findings on diagnosis of OUD in acute care. Third, although we attempted to control for relevant confounding in our analysis, the associations we found may still have been influenced by unmeasured factors. Nevertheless, given some relatively large effect sizes estimated from population-level data, we believe our results to be representative of an average association between these factors and high-risk circumstances of OUD identification. Finally, results are from a descriptive analysis conducted in a universal health care setting without out-of-pocket expenses and should be interpreted accordingly.

We observed large increases in the number of youths diagnosed with OUD between 2003 and 2017 in British Columbia, Canada. We found youth with urgent hospitalizations in the year prior to diagnosis were more likely to have OUD identified in acute care settings and that adolescents were twice as likely to be diagnosed with OUD in acute care compared with young adults. As the burden of disease because of opioid use continues to grow, establishing an effective evidence-based system for early detection and intervention among youth with OUD must be a priority. ■

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References

1. Canadian Institute for Health Information. Hospitalizations and emergency department visits due to opioid poisoning in Canada. Ottawa: Canadian Institute for Health Information; 2018.
2. Pearce LA, Min JE, Piske M, Zhou C, Homayra F, Slaunwhite A, et al. Mortality among people with opioid use disorder during an opioid overdose public health emergency in British Columbia, Canada. BMJ 2020;368:m772.
3. Hadland SE, Wharam JF, Schuster MA, Zhang F, Samet JH, Larochelle MR. Trends in receipt of buprenorphine and naltrexone for opioid use disorder among adolescents and young adults, 2001-2014. JAMA Pediatr 2017;171:747-55.
4. Chen C-Y, Storr CL, Anthony JC. Early-onset drug use and risk for drug dependence problems. Addict Behav 2009;34:319-22.
5. Wittchen HU, Behrendt S, Höfler M, Perkonigg A, Lieb R, Bühringer G, et al. What are the high risk periods for incident substance use and transitions to abuse and dependence? Implications for early intervention and prevention. Int J Methods Psychiatr Res 2008;17:S16-29.
6. Parker MA, Anthony JC. Epidemiological evidence on extra-medical use of prescription pain relievers: transitions from newly incident use to dependence among 12-21 year olds in the United States using meta-analysis, 2002-13. PeerJ 2015;3:e1340.
7. Subramaniam GA, Stitzer MA. Clinical characteristics of treatment-seeking prescription opioid vs. heroin-using adolescents with opioid use disorder. Drug Alcohol Depend 2009;101:13-9.
8. Chambers RA, Taylor JR, Potenza MN. Developmental neurocircuitry of motivation in adolescence: a critical period of addiction vulnerability. Am J Psychiatry 2003;160:1041-52.
9. Substance Abuse and Mental Health Services Administration. The TEDS report: age of substance use initiation among treatment admissions aged 18 to 30. In: Center for Behavioral Health Statistics and Quality, ed. Rockville, MD; 2014.
10. Curtin SC, Tejada-Vera B, Warner M. Drug Overdose Deaths among Adolescents Aged 15-19 in the United States: 1999-2015. NCHS Data Brief. Number 282. National Center for Health Statistics; 2017.
11. Gaither JR, Shabanova V, Leventhal JM. US National Trends in Pediatric Deaths From Prescription and Illicit Opioids, 1999-2016. JAMA Network Open 2018;1:e186558.
12. Gaither JR, Leventhal JM, Ryan SA, Camenga DR. National trends in hospitalizations for opioid poisonings among children and adolescents, 1997 to 2012. JAMA Pediatr 2016;170:1195-201.
13. American Academy of Pediatrics. Medication-assisted treatment of adolescents with opioid use disorders-Committee on Substance Use and Prevention. Pediatrics 2016;138:e20161893.
14. Beaton A, Shubkin CD, Chapman S. Addressing substance misuse in adolescents: a review of the literature on the screening, brief intervention, and referral to treatment model. Curr Opin Pediatr 2016;28:258-65.
15. Sterling S, Kline-Simon AH, Jones A, Hartman L, Saba K, Weisner C, et al. Health care use over 3 years after adolescent SBIRT. Pediatrics 2019;143:e20182803.
16. American Academy of Pediatrics. Substance use screening, brief intervention, and referral to treatment–Committee on Substance Use and Prevention. Pediatrics 2016;138:e20161211.
17. Levy SJ, Williams JF. Substance use screening, brief intervention, and referral to treatment. Pediatrics 2016;138.
18. Alinsky RH, Percy K, Adger H Jr, Fertsch D, Trent M. Substance use screening, brief intervention, and referral to treatment in pediatric practice: a quality improvement project in the Maryland Adolescent and Young Adult Health Collaborative Improvement and Innovation Network. Clin Pediatr 2020;59:429-35.
19. Carmona J, Maxwell JC, Park J-Y, Wu L-T. Prevalence and health characteristics of prescription opioid use, misuse, and use disorders among US adolescents. J Adolesc Health 2020;66:536-44.
20. Compton WM, Jones CM, Baldwin GT, Harding FM, Blanco C, Wargo EM. Targeting youth to prevent later substance use disorder: an underutilized response to the US opioid crisis. Am J Public Health 2019;109:S185-9.
21. Hadland SE. How clinicians caring for youth can address the opioid-related overdose crisis. J Adolesc Health 2019;65:177-80.
22. Blanco C, Volkow ND. Management of opioid use disorder in the USA: present status and future directions. Lancet 2019;393:1760-72.
23. British Columbia Ministry of Mental Health and Addictions. A pathway to hope: a roadmap for making mental health and addictions care better for people in British Columbia. Victoria, British Columbia, Canada: British Columbia Ministry of Mental Health and Addictions; 2019.
24. National Academies of Sciences Engineering and Medicine. Medications for opioid use disorder save lives. Washington, DC: National Academies Press; 2019.
25. Barocas JA, White LF, Wang J, Walley AY, LaRochelle MR, Bernson D, et al. Estimated prevalence of opioid use disorder in Massachusetts, 2011-2015: a capture–recapture analysis. Am J Public Health 2018;108:1675-81.
26. Bagley SM, Larochelle MR, Xuan Z, Wang N, Patel A, Bernson D, et al. Characteristics and receipt of medication treatment among young adults who experience a nonfatal opioid-related overdose. Ann Emerg Med 2020;75:29-38.
27. Chatterjee A, Larochelle MR, Xuan Z, Wang N, Bernson D, Silverstein M, et al. Non-fatal opioid-related overdoses among adolescents in Massachusetts 2012-2014. Drug Alcohol Depend 2019;194:28-31.
28. Boudreau DM, Lapham G, Johnson EA, Bobb JF, Matthews AG, McCormack J, et al. Documented opioid use disorder and its treatment

in primary care patients across six US health systems. J Subst Abuse Treat 2020;112:41-8.
29. Chavez LJ, Bonny AE, Bradley KA, Lapham GT, Cooper J, Miller W, et al. Medication treatment and health care use among adolescents with opioid use disorder in Ohio. J Adolesc Health 2020;67:33-9.
30. Shen K, Barrette E, Dafny LS. Treatment of opioid use disorder among commercially insured US adults, 2008-17: study examines how Medicare rural add-on payments affected the number of home health agencies serving rural counties. Health Aff (Millwood) 2020;39:993-1001.
31. Salzman M, Jones CW, Rafeq R, Gaughan J, Haroz R. Epidemiology of opioid-related visits to US emergency departments, 1999-2013: a retrospective study from the NHAMCS (National Hospital Ambulatory Medical Care Survey). Am J Emerg Med 2020;38:23-7.
32. Singh JA, Cleveland JD. National US time-trends in opioid use disorder hospitalizations and associated healthcare utilization and mortality. PloS One 2020;15:e0229174.
33. Walker KS, Bonny AE, McKnight ER, Nahata MC. Impact of Office-based opioid treatment on emergency visits and hospitalization in adolescents with opioid use disorder. J Pediatr 2020;219:236-42.
34. Bharel M. The true prevalence of opioid use disorder nationally is likely underestimated. Am J Public Health 2019;109:214-5.
35. BC Ministry of Health. PharmaNet. Data Extract. MOH (2018). British Columbia Ministry of Health; 2018. Accessed September 30, 2019. http://www.health.gov.bc.ca/data/
36. BC Ministry of Health. Discharge Abstract Database (Hospital Separations). Data Extract. MOH (2018). British Columbia Ministry of Health; 2018. Accessed September 30, 2019. http://www.health.gov.bc.ca/data/
37. BC Ministry of Health. National Ambulatory Care Reporting System (NACRS). Data Extract. MOH, Columbia Ministry of Health; 2018. Accessed September 30, 2019. http://www.health.gov.bc.ca/data/
38. BC Ministry of Health. Medical Services Plan (MSP) Payment Information File. Data Extract. MOH.: British Columbia Ministry of Health; 2018. Accessed September 30, 2019. http://www.health.gov.bc.ca/data/
39. Perinatal Services BC. British Columbia Perinatal Data Registry. Data Extract. MOH. British Columbia Ministry of Health; 2018. Accessed September 30, 2019. http://www.health.gov.bc.ca/data/
40. BC Vital Statistics Agency. Vital Statistics Deaths. Data Extract. MOH (2018). British Columbia Ministry of Health; 2018. Accessed September 30, 2019. http://www.health.gov.bc.ca/data/
41. Piske M, Zhou C, Min J, Hongdilokkul N, Pearce L, Homayra F, et al. The cascade of care for opioid use disorder: a retrospective study in British Columbia, Canada. Addiction 2020;115:1482-93.
42. Corace K, Willows M, Schubert N, Overington L, Howell G. Youth Require tailored treatment for opioid use and mental health problems: a comparison with adults. Can J Addict 2018;9:15-24.
43. Shin SH, Lundgren L, Chassler D. Examining drug treatment entry patterns among young injection drug users. Am J Drug Alcohol Abuse 2007;33:217-25.
44. Robinson CA, Wilson JD. Management of opioid misuse and opioid use disorders among youth. Pediatrics 2020;145:S153-64.
45. Levy S. Youth and the opioid epidemic. Pediatrics 2019;143:e20182752.
46. American Academy of Pediatrics. Achieving quality health services for adolescents - Committee on Adolescence. Pediatrics 2016;138:e20161347.
47. Skinner WW, O'Grady C, Bartha C, Parker C. Concurrent substance use and mental health disorders. Toronto: Centre for Addiction and Mental Health; 2004.
48. Han B, Compton WM, Blanco C, Colpe LJ. Prevalence, treatment, and unmet treatment needs of US adults with mental health and substance use disorders. Health Aff (Millwood) 2017;36:1739-47.
49. Krawczyk N, Feder KA, Saloner B, Crum RM, Kealhofer M, Mojtabai R. The association of psychiatric comorbidity with treatment completion among clients admitted to substance use treatment programs in a US national sample. Drug Alcohol Depend 2017;175:157-63.
50. Bartoli F, Carrà G, Brambilla G, Carretta D, Crocamo C, Neufeind J, et al. Association between depression and non-fatal overdoses among drug users: a systematic review and meta-analysis. Drug Alcohol Depend 2014;134:12-21.
51. Canadian Centre on Substance Abuse. Substance abuse in Canada: Concurrent disorders. Ottawa, Onatario: Canadian Centre on Substance Abuse; 2009.
52. Chan Y-F, Dennis ML, Funk RR. Prevalence and comorbidity of major internalizing and externalizing problems among adolescents and adults presenting to substance abuse treatment. J Subst Abuse Treat 2008;34:14-24.
53. McGovern MP, Xie H, Segal SR, Siembab L, Drake RE. Addiction treatment services and co-occurring disorders: prevalence estimates, treatment practices, and barriers. J Subst Abuse Treat 2006;31:267-75.
54. Hunt GE, Malhi GS, Cleary M, Lai HMX, Sitharthan T. Comorbidity of bipolar and substance use disorders in national surveys of general populations, 1990–2015: systematic review and meta-analysis. J Affect Disord 2016;206:321-30.
55. Hassan AN, Howe AS, Samokhvalov AV, Le Foll B, George TP. Management of mood and anxiety disorders in patients receiving opioid agonist therapy: review and meta-analysis. Am J Addict 2017;26:551-63.
56. Murthy P, Mahadevan J, Chand PK. Treatment of substance use disorders with co-occurring severe mental health disorders. Curr Opin Psychiatry 2019;32:293-9.