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Children And The Opioid Epidemic: Age-Stratified Exposures And Harms

KW Brown¹, K Carlisle², SR Raman³, P Shrader⁴, M Jiao¹, MJ Smith⁵, LM Einhorn⁶, CA Wong^{1,2,5}

¹Duke-Margolis Center for Health Policy, Duke University School of Medicine, Durham, North Carolina.

²Children's Health and Discovery Initiative, Duke University School of Medicine

³Department of Population Health Sciences, Duke University School of Medicine

⁴Duke Clinical Research Institute, Durham, North Carolina

⁵Department of Pediatrics, Duke University School of Medicine

⁶Department of Anesthesiology, Duke University School of Medicine

Abstract

Using North Carolina Medicaid 2016–18 claims data, we found that approximately one in ten adolescents (10.8 percent) filled at least one opioid prescription per year. Dentists, advanced practice providers, and surgeons were common prescribers of opioids to children. In addition, half of children who experienced opioid-related adverse events had filled opioid prescriptions in the prior six months.

Among adult patients admitted for opioid use disorder treatment, a third report having their first opioid exposure in childhood, highlighting the importance of addressing early opioid exposures.^{1,2} Children's opioid-related hospitalizations and deaths have doubled or tripled in recent decades.^{3,4} Opioid exposures in childhood are responsible for the majority of drug-related pediatric fatalities and are potentially linked to opioid misuse in adulthood.^{1,5}

Up to 15 percent of children fill at least one opioid prescription each year, and prescriptions to children have been linked to subsequent opioid-related adverse events.⁶ Disparities in pediatric opioid exposures and opioid-related harms have been reported by age, race, urban/rural status, and medical complexity.^{3,6–9}

In this study, we characterize age-stratified opioid exposures, opioid-related harms, and disparities for North Carolina Medicaid-insured children. As shown in exhibit 1, we found that the yearly prevalence of exposures and harms among children was highest among older adolescents, with one in ten (10.8 percent) adolescents ages 15–17 filling at least one opioid

prescription per year and nearly 280 of every hundred thousand children that age experiencing one or more opioid-related harms each year.

Study Data And Methods

We conducted a cross-sectional analysis of 2016–18 North Carolina Medicaid enrollment and medical/pharmacy claims data. Children ages 1–17 enrolled during the study period were included.

Outpatient opioid prescription fills (exposures) were identified in pharmacy claims data, using National Drug Codes for opioid type and National Provider Identification codes for prescriber type, categorized as physicians by specialty or as dentists or advanced practice providers, which includes nurse practitioners and physician assistants. See the online appendix for prescriber categories.¹⁰

Opioid-related harms were identified from inpatient and outpatient medical claims using *International Statistical Classification of Diseases and Related Health Problems*, Tenth Revision (ICD-10), codes and were classified as opioid-related adverse events (for example, T40.0X, “poisoning by, adverse effect of and underdosing of opium”) or other opioid-related harms (F11.X “opioid abuse,” “opioid dependence,” or “opioid use, unspecified”), as shown in appendix exhibit A1.¹⁰ We included “opioid use, unspecified” under the harms category because most “opioid use, unspecified” subcategories include descriptors of harms (for example, “opioid use, unspecified with intoxication”) and because documentation of an opioid use diagnosis, although potentially nonspecific, is likely associated with increased risk for opioid-related harm (that is, risk for poisonings or withdrawal) even if opioids are indicated. Enrollment data were used to characterize child age, sex, race, and urban–rural status. Chronic disease status was defined according to complex chronic conditions methodology among children with six months of continuous enrollment.⁹

The prevalence of opioid exposures and harms for children ages 1–17 was calculated using midyear enrollment as the denominator, presented for 2016–18. For index harms (that is, without a harm in the previous six months) in children ages 6–17, the most recent opioid prescription fill was identified in the six months before diagnosis; results for children ages 1–5 were not reported because of small cell sizes. The sociodemographic and clinical characteristics of children with opioid exposures and harms were compared using chi-square tests.

Medicaid pharmacy claims for filled opioid prescriptions likely underestimate children’s opioid exposures, as other sources of exposure such as illicit opioids and household members’ prescriptions are not captured.¹¹ Claims data also lack the clinical information necessary to assess prescription appropriateness or validate the inclusion of diagnoses captured. The inclusion of more ambiguous ICD-10 codes such as “opioid use, unspecified” may overestimate harms. Although approximately two-thirds of our study population was eligible for the cohort requiring six months of continuous enrollment, results for the total study population (data not shown) were similar in direction and significance to those for the continuous enrollment cohort. Our Medicaid-specific findings from a single state may not be

directly generalizable to all children, although 38 percent of US children are insured by Medicaid.¹² Finally, this cross-sectional analysis cannot evaluate the causal association between opioid prescriptions and subsequent opioid-related harms as an adult.

Study Results

Prevalence Of Exposures And Harms

Among 3,242,196 children enrolled in North Carolina Medicaid from 2016 to 2018, each year 3.3 percent filled one or more opioid prescriptions, 24.4/100,000 experienced adverse events, and 52.2/100,000 experienced other opioid-related harms (exhibit 1). Significant differences between age groups were identified for all exposure and harm categories ($p < 0.001$), with adolescents ages 15–17 experiencing the highest prevalence of opioid prescription fills (10.8 percent), adverse events (54.9/100,000), and other opioid-related harms (223.5/100,000). Across all ages, the prevalence of one or more prescription fills per year decreased during the study period, as shown in appendix exhibit A2.¹⁰

Characteristics Of Pediatric Exposures And Harms

Of 137,710 opioid prescription fills among children from 2016 to 2018, prescribers were most commonly physicians (35.5 percent; most common specialty surgeons, at 17.3 percent), dentists (33.3 percent), and advanced practice providers (17.7 percent) (exhibit 2). The most common prescription opioid prescription fill types were hydrocodone (44.9 percent), oxycodone (28.7 percent), and codeine (20.0 percent) (data not shown).

The prevalence of pediatric opioid prescription fills in the cohort of children with six months of continuous enrollment ($n = 2,019,211$) increased significantly with the number of complex chronic conditions (going from 2.7 percent for zero conditions to 15.8 percent for four or more conditions; exhibit 3). The prevalence of opioid prescription fills also was higher for White (3.1 percent versus 2.7 percent Black) and rural-dwelling (3.4 percent versus 3.1 percent suburban and 2.7 percent urban) children. Opioid-related adverse events were more common in girls (26.2/100,000 versus 22.7/100,000 boys) and White children (27.5/100,000 versus 24.0/100,000 Black), whereas other opioid-related harms were more common in boys (58.1/100,000 versus 45.9/100,000 girls) and Black (60.2/100,000 versus 51.7/100,000 White) and urban-dwelling (58.1/100,000 versus 49.0/100,000 suburban and 38.7 rural) children (exhibit 4).

For children ages 6–17, 48.4 percent of opioid adverse events were preceded by opioid prescription fills within the previous six months—and often within three days—with a higher proportion of Black versus White children having had a recent opioid prescription fill (exhibit 5). Oxycodone (26.6 percent) and hydrocodone (11.3 percent) were the most common opioid types.

Discussion

The results of this study further quantify how children have been impacted by opioids and identify disparities by sociodemographic and clinical characteristics. Our findings that more than half the adverse events reported were preceded by a recent opioid prescription fill

suggest a role the children's own prescriptions may play in subsequent harms. Finally, we identified that children are prescribed opioids by many distinct types of clinicians.

Our findings that opioid exposures and harms disproportionately affect older adolescents compared with younger children are consistent with previous literature.⁶ The increased prevalence of opioid exposures among youth with chronic conditions (for example, cancer and sickle cell anemia) may reflect opioids being appropriately prescribed, as previously reported.⁹

Our findings that Black and urban children were less likely than their counterparts to fill opioid prescriptions or experience adverse events, but more likely to experience other opioid-related harms (for example, abuse and dependence), increase the call for future studies to explore racial and geographic opioid-related inequities in children.^{3,7,8,13}

We identified preceding opioid prescription fills in almost 50 percent of adverse events, which may suggest a temporal relationship between children's own prescriptions and subsequent harms. In a 1999–2014 study in Tennessee, 89 percent of chart-adjudicated opioid adverse events were linked to children's prescriptions.⁶ Other adverse events may involve sources of opioids not captured in our data set; exposure to family members' prescriptions, for example, puts adolescents at increased risk for opioid overdose.¹¹ Relative to adverse events, fewer recent prescriptions were identified among youth with other opioid-related harms; these findings are similar to national data that indicate that about a quarter of adolescents ages 12–17 years reported the source of their misused opioids as legitimate prescriptions.¹⁴

In addition to dentists, who prescribed approximately one-third of opioids to children,¹⁵ advanced practice providers and surgeons together accounted for another third of prescriptions. These three groups often prescribe opioids to children for postprocedural pain.^{15,16} The distinct and separate groups of clinicians who prescribe opioids to children suggest the need for pediatric opioid prescribing guidelines, particularly for postprocedural pain. Professional societies are well-positioned to tailor general guidance for their clinicians and patients.¹⁷

Policy Implications

There is an urgent need for federal and state public health and policy measures that address the opioid epidemic to prioritize children. In addition to pediatric-specific opioid prescribing guidelines, opioid-related harms may be reduced by the dissemination of best practices on opioid safe storage and disposal, naloxone prescribing, and substance use screening and treatment among youth.^{2,18} Stratifying population-level opioid surveillance reports by age and race is needed, given the distinct patterns of exposures and harms in different groups of children. Expected opioid pharmaceutical settlement payouts should support child-centered strategies that are racially and geographically equitable.

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Biography

Notes

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Exhibit 1.

Yearly prevalence of opioid exposures and harms among Medicaid-insured children, North Carolina, 2016–18

Source/Notes: SOURCE Authors' analysis of North Carolina Medicaid prescription claims, enrollment, inpatient and outpatient encounter, and provider files for 3,242,196 beneficiaries ages 1–17 enrolled at any point from 2016 to 2018. NOTES Data from 2016 to 2018 are combined. Yearly prevalence of opioid exposures is presented as percentages; yearly prevalence of harms is presented as rates per hundred thousand children. "1 fill" and "2+ fills" are opioid prescription fills per year. Significant differences between age groups were identified for one fill, two or more fills, any fill, opioid-related adverse events (that is, "poisonings by, adverse effects of, or underdosing of opium"), and other opioid-related harms (that is, "opioid abuse," "opioid dependence," or "opioid use, unspecified"; $p < 0.001$) using chi-square tests.

Exhibit 2.

Prescribers of opioids to Medicaid-insured children, North Carolina, 2016–18

Source/Notes: SOURCE Authors' analysis of North Carolina Medicaid claims data for 137,710 opioid prescription fills for beneficiaries ages 1–17, 2016–18. NOTES The APP category includes nurse practitioners and physician assistants. Significant differences between prescriber types and between physician specialties were identified ($p < 0.001$) using chi-square tests. APP is advanced practice provider.

Exhibit 3:

Yearly prevalence of prescription opioid fill exposures among Medicaid-insured children by age, sociodemographic, and clinical characteristics, North Carolina, 2017–18

	All ages (N = 2,019,211) (%)	Age (years)			
		1–5 (N = 661,169) (%)	6–11 (N = 790,539) (%)	12–14 (N = 347,255) (%)	15–17 (N = 220,248) (%)
Sex					
Male	2.9	1.3	1.7	4.5	9.3
Female	3.0	0.8	1.6	4.9	11.6
Race					
White	3.1	1.0	1.9	5.2	11.6
Black	2.7	1.1	1.5	4.4	9.3
Other	3.0	1.2	1.6	4.0	9.7
Urban/rural status					
Urban	2.7	1.0	1.5	4.3	9.8
Suburban	3.1	0.9	1.8	5.0	11.2
Rural	3.4	1.3	2.0	5.4	11.5
Complex chronic conditions					
0	2.7	0.9	1.5	4.4	10.0
1	6.5	3.0	4.4	7.7	14.6
2	9.9	5.5	9.3	12.2	17.6
3	12.8	8.0	13.9	16.5	20.4
4+	15.8	11.2	16.6	21.1	30.4

SOURCE Authors' analysis of North Carolina Medicaid claims data for beneficiaries ages 1–17 with at least six months of continuous enrollment before January 1 of calendar years 2017 and 2018. NOTES Calendar year 2016 was not analyzed because of the six-month continuous enrollment criteria. Within each age group, subgroups are significantly different ($p < 0.001$) using chi-square tests or Cochran-Armitage test (complex chronic conditions categories). Values reflect less than 1 percent missing data for race/ethnicity and urban/rural status.

Exhibit 4:

Opioid harms among Medicaid-insured children by sociodemographic characteristics, North Carolina, 2016–18

	Total	Opioid-related adverse events		Other opioid-related harms	
		<i>n</i>	Prevalence/100,000	<i>n</i>	Prevalence/100,000
Sex			**		****
Male	1,654,687	376	22.7	962	58.1
Female	1,587,509	416	26.2	729	45.9
Age (years)			****		****
1–5	1,036,623	309	29.8	129	12.4
6–11	1,236,172	108	8.7	198	16.0
12–14	545,276	142	26.0	416	76.3
15–17	424,125	233	54.9	948	223.5
Race			****		****
White	1,586,869	436	27.5	820	51.7
Black	1,161,046	279	24.0	699	60.2
Other	489,765	77	15.7	161	32.9
Urban/rural status					****
Urban	2,038,169	472	23.2	1,185	58.1
Suburban	393,660	103	26.2	193	49.0
Rural	809,442	216	26.7	313	38.7

SOURCE Authors' analysis of North Carolina Medicaid claims data for beneficiaries ages 1–17, 2016–18. NOTES Yearly prevalence is reported per one hundred thousand patients. For each harm type (adverse event, other opioid-related harms), differences within subgroups were evaluated using chi-square tests. Values reflect less than 1 percent missing data for race/ethnicity and urban/rural status.

**
 $p < 0.05$

 $p < 0.001$

Exhibit 5:

Prescription opioid fill exposures before index opioid harms among Medicaid-insured children ages 6–17, North Carolina, 2016–18

Harms	Opioid-related adverse events (<i>N</i> = 417)	Other opioid-related harms (<i>N</i> = 1,186)
Total with opioid prescription fills in prior 6 months (%)	48.4	9.4
Age (years) (%)		
6–11	61.8	7.9
12–14	47.0	5.8
15–17	44.7	11.3
Race (%)		
White	35.7	11.1
Black	59.9	7.7
Other	53.4	<i>n</i> < 11 ^a
Most recent opioid type (for those with fill in prior 6 months) (%)		
Oxycodone	26.6	3.3
Hydrocodone	11.3	3.2
Days since last fill (for those with fill in prior 6 months)		
Median	3.0	67.0
(Q1, Q3)	(0.0, 19.0)	(5.0, 112.5)
Mean	20.0	68.5
(SD)	(36.7)	(58.4)

SOURCE Authors' analysis of North Carolina Medicaid claims data for beneficiaries ages 1–17 with at least one opioid-related harm and six months of continuous Medicaid enrollment before harm, July 2016–December 2018. NOTES Each cell in the age and race/ethnicity rows represents the proportion of children in that subgroup with an opioid prescription fill in the prior six months (for example, among 6–11-year-olds with an opioid-related adverse event, 61.8 percent had a prior opioid prescription fill). Children ages 1–5 are not presented because of low cell values.

^a“n<11” denotes suppressed values resulting from data reporting restrictions.