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Trends in Emergency Department Visits for Unsupervised Pediatric Medication Exposures

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Abstract

Introduction: Emergency department (ED) visits and hospitalizations for unsupervised medication exposures among young children increased in the early 2000s. Prevention efforts were initiated in response.

Methods: Nationally-representative data from the National Electronic Injury Surveillance System–Cooperative Adverse Drug Event Surveillance project collected from 2009–2020 were analyzed in 2022 to assess overall and medication-specific trends in ED visits for unsupervised exposures among children aged 5 years.

Results: From 2009–2020, there were an estimated 677,968 (95% CI, 550,089–805,846) ED visits for unsupervised medication exposures among children aged 5 years in the United States. Most visits involved children aged 1–2 years (2009–2012 [70.3%]; 2017–2020 [67.4%]), and nearly one-half involved prescription solid medications (2009–2012 [49.4%]; 2017–2020 [48.1%]). The largest declines in estimated numbers of annual visits from 2009–2012 to 2017–2020 were for exposures involving prescription solid benzodiazepines (–2,636 visits; –72.0%) and opioids (–2,596 visits; –53.6%), and over-the-counter liquid cough and cold medications (–1,954 visits; –71.6%) and acetaminophen (–1,418 visits; –53.4%). The estimated number of annual visits increased for exposures involving over-the-counter solid herbals/alternative remedies (+1,028 visits; +65.6%), with the largest increase for melatonin exposures (+1,440 visits; +421.1%). Overall, the estimated number of visits for unsupervised medication exposures decreased from 66,416 in 2009 to 36,564 in 2020 (annual percentage change [APC] –6.0%). Emergent hospitalizations for unsupervised exposures also declined (APC –4.5%).

Conclusions: Declines in estimated ED visits and hospitalizations for unsupervised medication exposures from 2009–2020 coincided with renewed prevention efforts. Targeted approaches may be needed to achieve continued declines in unsupervised medication exposures among young children.

INTRODUCTION

Child-resistant (CR) packaging is required for nearly all medications in the United States and is designed to prevent, or at least delay, access to medications by young children.¹ Nonetheless, during the early 2000s, emergency department (ED) visits and hospitalizations for unsupervised medication exposures among young children increased approximately 30%; poison center calls for unsupervised exposures also increased.^{2, 3} In response, efforts to reduce pediatric medication exposures through packaging and labeling improvements and updated safe storage educational messages were initiated,⁴⁻⁶ and estimated ED visits among children aged 5 years declined from a peak of 76,000 visits in 2010 to 59,000 in 2013.³

Throughout the 2010s, prevention efforts continued and expanded to target additional medications and additional caregivers (e.g., grandparents).⁷ Further reducing ED visits for unintentional medication overdoses among young children is a *Healthy People 2030* goal for the nation.⁸ Nationally-representative surveillance data were used to assess overall and medication-specific trends in ED visits for unsupervised medication exposures from 2009 to 2020 to help target interventions.

METHODS

Study Sample

National estimates of ED visits were based on data from the National Electronic Injury Surveillance System's Cooperative Adverse Drug Event Surveillance project (NEISS-CADES; unsupervised medication exposures) and All Injury Program (NEISS-AIP; other unintentional injuries), which have been described previously.⁹⁻¹¹ NEISS-CADES and NEISS-AIP are active public health surveillance systems based on the same size-stratified nationally-representative sample of approximately 60 hospitals with 6 beds and 24-hour EDs in the United States and its territories, with 4 strata based on size (number of annual ED visits), and 1 pediatric hospital stratum. For NEISS-CADES, trained abstractors review medical records for all ED visits at participating hospitals to identify clinician-diagnosed adverse drug events and the medications implicated in each adverse event (2 medications from 2004-2015; 4 after 2015). Abstractors record patient demographics, verbatim clinical diagnoses (rather than International Classification of Diseases administrative codes), information about implicated medications, intent of medication use, and discharge disposition. Abstractors also record documented narrative details of the event, including precipitating circumstances, clinical manifestations, laboratory testing results, and treatments administered. For NEISS-AIP, abstractors identify ED visits for all types of injuries and record patient demographics, cause and intent of injury, and narrative details. This activity was reviewed by CDC and conducted consistent with applicable federal law and CDC policy.¹²

Measures

For this analysis (conducted in 2022), unsupervised medication exposure cases were defined as ED visits from January 1, 2009 through December 31, 2020 by a child aged 5 years for accessing medication on their own. Medications included prescription or

over-the-counter (OTC) medications, herbals/dietary supplements, homeopathic products, or vaccines. Hospitalizations included ED visits that resulted in inpatient admission or transfer to another hospital (e.g., for specialized care or pediatric expertise).

The first two medications documented as being implicated in ED visits for unsupervised exposures were categorized by dosage form and prescription status and used to assess trends over time. Dosage forms were categorized as oral solids (e.g., tablets, capsules), oral liquids (e.g., suspensions, syrups), and non-oral medications (e.g., ointments, ophthalmic drops).^{13, 14} If medications could have been oral solids or oral liquids (e.g., “ingested acetaminophen”), they were categorized as unspecified oral dosage form. If medications could have been oral or non-oral dosage forms (e.g., “ingested grandma’s meds”), they were categorized as unspecified dosage form. Medications available either OTC or by prescription were categorized based on case details such as brand name or dosage strength (e.g., “ibuprofen 800 mg tabs”); in the absence of clarifying details, they were categorized as OTC. Medications described generally (e.g., “eye drops,” “pain pills”) were categorized as unspecified prescription status. OTC medications were further categorized as pediatric products, adult/family products, or unspecified age group products based on product name, dosage form, or narrative details (e.g., “children’s acetaminophen”). Other types of unintentional injuries were identified and categorized using a publicly available online query system.¹⁵

Statistical Analysis

NEISS-CADES and NEISS-AIP cases are weighted by the US Consumer Product Safety Commission based on the hospital sampling design and inverse probability of selection. Weights were adjusted for nonresponse, and post-stratified to adjust for the total number of hospital ED visits annually.^{16, 17} For NEISS-CADES data, based on these cases, national estimates (weighted numbers and percentages) of ED visits and corresponding 95% confidence intervals (CIs) were calculated using the SAS SURVEYMEANS procedure to account for weighting and complex sample design. Annualized estimates for the first and last quadrennial periods (2009-2012 and 2017-2020) were calculated by dividing the estimated number of visits and 95% CIs by four. For NEISS-AIP data, a publicly available online query system was used to calculate national estimates and corresponding standard errors.¹⁵

NEISS-CADES and NEISS-AIP estimates based on <20 cases or total estimates <1200 for the period of interest (i.e., prior to annualization) are considered statistically unstable and are not shown. Estimates with coefficient of variations >30% may be statistically unstable and are noted.

Annual trends in estimated numbers of ED visits and hospitalizations for unsupervised medication exposures (NEISS-CADES) and the top four other types of unintentional injuries leading to ED visits and subsequent hospitalizations (NEISS-AIP) were assessed using linear regression. Joinpoint statistical software was used to account for estimate variances, with the natural logarithm of the annual national estimate as the dependent variable, year as the independent variable, and zero inflection points specified.¹⁸ Two-sided *P* values <.05 were considered statistically significant. Since single-year estimates may not be stable for

individual medications or classes, medication-specific trends were assessed by comparing annualized estimates for the first and last quadrennial periods.

RESULTS

Over the 12-year period from 2009-2020, based on 14,716 surveillance cases, there were an estimated 677,968 (95% CI, 550,089-805,846) ED visits for unsupervised medication exposures among children aged 5 years in the United States. From 2009-2012 to 2017-2020, the estimated number of annual ED visits for unsupervised medication exposures declined 38.6% (95% CI, -49.5% - -27.7%), from 70,119 estimated visits annually (95% CI, 56,118-84,120) to 43,070 visits annually (95% CI, 34,521-51,620) (Table 1). Patient and case characteristics were similar in 2009-2012 and 2017-2020. In both periods, over two-thirds of estimated visits were made by children aged 1 or 2 years (70.3% and 67.4%, respectively), approximately one-half of visits were made by boys (51.5% and 54.8%, respectively), and nine-tenths involved accessing a single medication (90.4% and 87.7%, respectively). For both periods, at least one-tenth of visits resulted in hospitalization (11.7% and 13.2%, respectively).

In 2009-2012 and 2017-2020, nearly one-half of ED visits for unsupervised medication exposures involved oral prescription solid medications (49.4% and 48.1%, respectively) (Table 2). The estimated number of visits involving prescription solids declined by 40.3% (95% CI, -50.4% - -30.2%), from 34,656 visits annually in 2009-2012 to 20,697 visits annually in 2017-2020. Oral OTC solid medications were implicated in nearly one-quarter (23.1%) of ED visits for unsupervised medication exposures in 2009-2012, but nearly one-third (30.8%) in 2017-2020. The estimated number of exposure visits involving OTC solids was 16,218 visits annually in 2009-2012 and 13,283 visits annually in 2017-2020, a nominal decline of 18.1% (95% CI, -36.4% - 0.2%).

In 2009-2012 and 2017-2020, oral OTC liquid medications were implicated in fewer ED visits for unsupervised medication exposures (12.6% and 10.1%, respectively) than oral solid medications. The estimated number of visits involving OTC liquid exposures declined 50.9% (95% CI, -63.4% - -38.5%), from 8,863 visits annually in 2009-2012 to 4,348 visits annually in 2017-2020. Oral prescription liquid medications were implicated in significantly fewer ED visits for unsupervised exposures than OTC liquids in both 2009-2012 and 2017-2020 (2.1% and 1.1%, respectively). In 2017-2020, 62.1% (95% CI, 54.6%-69.6%) of ED visits for OTC liquid medication exposures involved children aged 2 years, while 78.9% (95% CI, 75.7%-82.0%) of visits for prescription solid medication exposures involved this age group.

Trends in the estimated numbers of ED visits for unsupervised medication exposures from 2009-2012 to 2017-2020 varied by medication (Table 3). Estimated numbers of visits for prescription solid exposures declined for nearly all medication classes. The largest significant declines in estimated numbers of annual ED visits for prescription solid exposures were for benzodiazepines (-2,636 visits; -72.0%), opioids (-2,596 visits; -53.6%), antidepressants (-1,354 visits; -35.6%), and skeletal muscle relaxants (-1,106 visits; -72.0%). Declines in ED visits for medication exposures were smaller

and not statistically significant for classes commonly used to treat attention-deficit hyperactivity disorder (ADHD), such as amphetamine-related stimulants (−22.1%; 95% CI, −52.1% - 7.9%) and centrally-acting antiadrenergics (−9.1%; 95% CI, −38.1% - 19.8%). In 2017-2020, the most commonly implicated prescription solid medications were antidepressants (5.7%), opioids (5.2%), and amphetamine-related stimulants (3.7%).

Estimated numbers of ED visits for unsupervised OTC solid medication exposures declined for some medications and increased for others from 2009-2012 to 2017-2020. The largest declines in estimated numbers of annual visits for OTC solid exposures were for vitamins/minerals (−1,038 visits; −36.3%), acetaminophen- or aspirin-containing analgesic combination products (−726 visits; −58.9%), and single-ingredient aspirin (−453 visits; −44.8%). For OTC solid cough and cold medications (CCMs), the estimated number of annual visits for unsupervised exposures in 2017-2020 was too low to be considered statistically stable, suggesting a substantial decline. The estimated number of annual visits increased significantly for exposures involving herbals/alternative remedies (+1,028 visits; +65.6%). Most of the increase in exposure visits involving OTC solid herbals/alternative remedies was attributed to increased melatonin exposures (+1,440 visits; +421.1%; 95% CI, 68.3%-774.0%), of which 56.5% involved children aged 3-5 years in 2017-2020. In 2017-2020, the three OTC solid products implicated in the highest numbers of annual ED visits for unsupervised medication exposures were acetaminophen (2,533; 95% CI, 1,588-3,479), melatonin (1,782; 95% CI, 1,152-2,412), and ibuprofen (1,737; 95% CI, 1,078-2,396).

The most commonly implicated oral OTC liquid medications in ED visits for unsupervised exposures were the same in 2009-2012 and 2017-2020 (acetaminophen, diphenhydramine, ibuprofen, and CCMs). The largest declines in estimated numbers of annual ED visits for OTC liquid exposures were for CCMs (−1,954 visits; −71.6%) and acetaminophen (−1,418 visits; −53.4%). For exposure visits involving OTC CCMs, 54.4% (95% CI, 38.8%-70.1%) involved pediatric products in 2009-2012; in 2017-2020, the estimated number of visits involving pediatric products was too low to be considered statistically stable. In 2017-2020 the most commonly implicated OTC liquid medications were acetaminophen (2.9%) and diphenhydramine (2.8%).

In 2017-2020, at least one of these four OTC liquid products (acetaminophen, diphenhydramine, ibuprofen, or CCMs) was implicated in 9.2% (95% CI, 7.8%-10.6%) of ED visits for unsupervised medication exposures overall; most of these visits involved pediatric products (85.2%; 95% CI, 79.6%-90.8%). The OTC solid dosage forms of these four medications were implicated in 12.7% (95% CI, 10.4%-15.1%) of all unsupervised medication exposure visits, and unspecified oral dosage forms of these four medications were implicated in 1.4% (95% CI, 0.7%-2.1%) of visits.

Estimated numbers of annual ED visits involving prescription non-oral medications were similar in 2009-2012 (1,216 visits) and 2017-2020 (926 visits); however, ED visits for unsupervised epinephrine needlestick injuries increased nominally (49.8%; 95% CI, −13.2%-112.8%). In 2017-2020, 78.7% (95% CI, 66.3%-91.1%) of ED visits for unsupervised exposures involving prescription non-oral medications were for unintended

epinephrine needlesticks and 87.5% (95% CI, 74.5%-100.0%) of these visits were made by children aged 3 years.

From 2009-2020, the estimated number of ED visits for unsupervised medication exposures among children aged 5 years decreased, with an annual percentage change (APC) of -6.0%, from 66,416 (95% CI, 50,119-82,713) in 2009 to 36,564 (95% CI, 27,520-45,609) in 2020 (Table 4; Appendix Figure 1). During this time, there were similar decreases in ED visits for other types of common unintentional injuries among children aged 5 years, including falls (APC -5.4%), injuries from being struck by/against objects (APC -6.2%), foreign body exposures (APC -3.3%), and fire/burn-related injuries (APC -5.3%). The estimated number of ED visits for unsupervised medication exposures resulting in hospitalization also declined across the 12-year study period (APC -4.5%), from 6,909 (95% CI, 4,131-9,686) in 2009 to 5,813 (95% CI, 3,392-8,235) in 2020; however, the estimated number of emergent hospitalizations did not change significantly for other common unintentional injuries among young children except for struck-by/against object injuries (APC -3.0%) (Table 4; Appendix Figure 2).

DISCUSSION

The estimated number of ED visits for unsupervised medication exposures among children aged 5 years declined significantly from 66,416 in 2009 to 36,564 in 2020 (the lowest annual estimate since surveillance was initiated in 2004),³ with a corresponding significant decline in emergent hospitalizations. Patient and case characteristics were similar throughout 2009-2020, but trends in estimated numbers of visits varied by medication.

The decline in ED visits for medication exposures among young children from 2009-2020 is consistent with reported declines in calls to US poison centers for medication exposures among young children over the same period.^{19, 20} However, a decline from 2009-2020 in estimated ED visits for other common unintentional injuries among children aged 5 years suggests that a secular trend of declining numbers of ED visits among this age group could be a contributing factor to the decline in ED visits for unsupervised medication exposures. On the other hand, the number of hospitalizations did not decline significantly for other unintentional injuries (except for injuries from being struck by/against objects), suggesting that declines in ED visits for other injuries may reflect a shift in treatment of less severe cases to other settings (e.g., urgent care centers, telehealth visits), while both ED visits and hospitalizations declined for unsupervised medication exposures, suggesting a decline in incidence of unsupervised medication exposures. In addition, trends in ED visits for unsupervised exposures differed by medication, suggesting that the decline in ED visits was not solely related to a secular trend of fewer unintentional injury ED visits among young children.

Following reports of increases in unsupervised medication exposures in the early 2000s, renewed prevention efforts were initiated through the CDC Prevention of Overdoses and Treatment Errors in Children Taskforce (PROTECT) Initiative and partner organizations.²¹ In the 2010s, voluntary addition of flow restrictors on OTC pediatric liquid products containing acetaminophen, including CCMs, withdrawal of infant CCM products, and

labeling warning against CCM use in children aged <4 years coincided with reductions in ED visits and poison center calls for pediatric exposures, including those involving potentially toxic doses.²²⁻²⁴ In this study, from 2009-2012 to 2017-2020, ED visits for OTC liquid medication exposures declined significantly, except for exposures involving diphenhydramine. Notably, flow restrictors have not been broadly implemented for liquid diphenhydramine (or CCMs not containing acetaminophen), but studies have suggested that their use on these products would help further reduce pediatric ingestions,²⁵ and draft FDA Guidance identifies diphenhydramine and several CCM ingredients in recommendations for flow restrictors.²⁶

Other public health interventions may have also impacted trends in pediatric medication exposures. Some of the largest declines in visits for prescription solid exposures involved medication classes for which there have been interventions to reduce overdose among adults and adolescents (e.g., opioids, benzodiazepines) by reducing the amount of these products available through judicious prescribing, use of alternate therapies, take-back programs, and education.²⁷ Studies from the 2000s found increases in pediatric prescription opioid exposures corresponding to increases in opioid prescribing.²⁸ Similarly, recent declines in ED visits for pediatric opioid and benzodiazepine exposures correspond to decreases in prescribing, including coprescribing.^{29, 30}

While flow restrictors have the potential to prevent or limit unsupervised exposures involving most liquid medications, identifying interventions to address prescription solid medication exposures is more challenging since these medications are often taken out of CR packaging by adults (e.g., transferred to pill organizers or other easy-open containers) before being accessed by young children.^{31, 32} Indeed, nearly 80% of ED visits for unsupervised exposures involving prescription solids involved children aged 2 years who are unlikely able to open CR packaging.

While it is recommended to always keep medications in their original CR containers, eliciting behavior change is complex, and engineering or packaging solutions may have the greatest impact. Many of the most frequently implicated prescription solids can be harmful to children in low doses, and CR unit-dose packaging has been suggested to protect each dose until taken.^{7, 33-35} Development of adult-friendly, child-deterrent pill organizers may also provide safer options for those who use these devices to aid medication adherence.^{7, 36} Nonetheless, even with better engineering or packaging solutions, it is essential to keep all medications out of young children's sight and reach.⁵

Trends in medication use or availability of some products may have affected unsupervised pediatric exposure trends. Notably, ED visits for OTC solid melatonin exposures increased >400% and ED visits for epinephrine needlestick injuries increased nominally during the study period. Indeed, studies have found a rise in melatonin use³⁷ and allergy prevalence among children during this period.³⁸ Additionally, although we were not always able to determine the exact formulation of melatonin implicated in ED visits, its common availability in gummy formulations may be enticing to young children. While over two-thirds of ED visits for medication exposures overall involved children aged 2 years, these melatonin and epinephrine exposures most commonly involved children aged 3-5 years. To

help prevent these exposures, it may help to teach young children that they should never access medications on their own, in addition to reminding caregivers about safe storage.

Limitations

Public health surveillance data have limitations. First, harms related to unsupervised medication exposures among children aged 5 years are likely underestimated, as caregivers may have sought care in other settings or opted not to seek treatment. Second, detailed information about medication dosage strength or brand name was not always available, and thus there is potential for misclassification of medication type. Third, the specific circumstances surrounding exposures (e.g., type of container from which children accessed medication) were not always documented but could help further target interventions. Fourth, medication utilization was not assessed; future studies could assess pediatric exposure trends for specific medications relative to trends in use. Fifth, illicit substance exposures were not included, but should be assessed in future studies. Lastly, this study includes the first 10 months of the COVID-19 pandemic. Continued surveillance will be important to determine the ongoing pandemic's effects on ED visits for unsupervised medication exposures and other types of injury among young children.

CONCLUSIONS

Significant declines in ED visits and hospitalizations for unsupervised medication exposures among young children from 2009-2020 coincided with renewed prevention efforts. Targeted approaches may be needed to achieve continued declines and reach the *Healthy People 2030* goal of further reducing unintentional medication overdoses among young children.⁸

Supplementary Material

Refer to Web version on PubMed Central for supplementary material.

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Abbreviations and Acronyms:

APC	annual percentage change
CCM	cough and cold medication
CI	confidence interval
CR	child-resistant
ED	emergency department

NEISS-AIP	National Electronic Injury Surveillance System-All Injury Program
NEISS-CADES	National Electronic Injury Surveillance System-Cooperative Adverse Drug Event Surveillance
OTC	over-the-counter
PROTECT	PREvention of Overdoses and Treatment Errors in Children Taskforce

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Table 1.

Emergency Department Visits for Unsupervised Medication Exposures Among Children Aged 5 Years, by Case Characteristics^a

Case Characteristics	2009-2012				2017-2020			
	Cases	Annual National Estimate			Cases	Annual National Estimate		
	No.	No.	%	95% CI	No.	No.	%	95% CI
Patient Age (Years)								
<1	343	4,022	5.7	(4.5 - 6.9)	256	2,211	5.1	(4.3 - 5.9)
1	1,862	22,839	32.6	(30.1 - 35)	1,338	13,594	31.6	(28.3 - 34.8)
2	2,195	26,482	37.8	(35.9 - 39.7)	1,504	15,429	35.8	(33.5 - 38.2)
3	838	10,183	14.5	(13.1 - 15.9)	702	7,573	17.6	(15.9 - 19.2)
4	419	4,946	7.1	(6.1 - 8)	276	2,818	6.5	(5.1 - 8)
5	156	1,648	2.3	(1.6 - 3.1)	150	1,446	3.4	(2.5 - 4.2)
Patient Sex								
Female	2,794	33,988	48.5	(46.3 - 50.7)	1,981	19,454	45.2	(42.7 - 47.7)
Male	3,019	36,132	51.5	(49.3 - 53.7)	2,245	23,617	54.8	(52.3 - 57.3)
No. Implicated Medications								
1	5,171	63,370	90.4	(88.9 - 91.8)	3,711	37,863	87.9	(86.5 - 89.3)
2 or more	642	6,749	9.6	(8.2 - 11.1)	515	5,208	12.1	(10.7 - 13.5)
Disposition								
Hospitalized ^b	692	8,174	11.7	(9.5 - 13.9)	661	5,689	13.2	(11.1 - 15.3)
Observation ^c	1,056	5,351	7.6	(3.2 - 12.1)	291	2,155	5.0	(2.2 - 7.8)
Not Hospitalized	4,063	56,570	80.7	(76.0 - 85.3)	3,274	35,227	81.8	(79.1 - 84.5)
Total	5,813	70,119	100.0		4,226	43,070	100.0	

Abbreviation(s): CI, confidence interval

^aData from the National Electronic Injury Surveillance System–Cooperative Adverse Drug Event Surveillance project, Centers for Disease Control and Prevention.

^bHospital admission or transfer to another hospital. Not recorded for 2 cases in 2009-2012.

^cTime-limited assessment, treatment, and reassessment, nearly always lasting <48 hours (usually <24 hours).

Table 2. Emergency Department Visits for Unsupervised Medication Exposures Among Children Aged 5 Years, by Medication Type^a

Medication Type	2009-2012			2017-2020			Difference in Estimate 2009-2012 to 2017-2020		% Change 2009-2012 to 2017-2020	
	Annual National Estimate			Annual National Estimate			%	95% CI	%	95% CI
	No.	%	95% CI	No.	%	95% CI				
Solid Dosage Form Oral Medications										
Prescription	34,656	49.4	(47.2 - 51.6)	20,697	48.1	(45.3 - 50.8)	-13,958	-40.3	(-50.4 - -30.2)	
OTC	16,218	23.1	(21.6 - 24.6)	13,283	30.8	(28.2 - 33.5)	-2,935	-18.1	(-36.4 - 0.2)	
Unspecified Prescription Status	2,711	3.9	(3.0 - 4.7)	1,111	2.6	(1.8 - 3.3)	-1,600	-59.0	(-78.2 - -39.9)	
Liquid Dosage Form Oral Medications										
Prescription	1,457	2.1	(1.6 - 2.5)	465	1.1	(0.6 - 1.6)	-992	-68.1	(-82.2 - -53.9)	
OTC	8,863	12.6	(11.0 - 14.3)	4,348	10.1	(8.6 - 11.6)	-4,515	-50.9	(-63.4 - -38.5)	
Unspecified Dosage Form Oral Medications^b										
Prescription	447	0.6	(0.3 - 1.0)	--	--	--	--	--	--	--
OTC	2,000	2.9	(1.8 - 3.9)	803	1.9	(1.2 - 2.6)	-1,197	-59.8	(-80.4 - -39.3)	
Non-oral Medications										
Prescription	1,216	1.7	(1.3 - 2.1)	926	2.2	(1.4 - 2.9)	-290	-23.8	(-54.0 - 6.4)	
OTC	3,379	4.8	(4.2 - 5.4)	2,003	4.6	(3.7 - 5.6)	-1,376	-40.7	(-59.6 - -21.9)	

Abbreviation(s): ED, emergency department; CI, confidence interval; OTC, over-the-counter

^aData from the National Electronic Injury Surveillance System—Cooperative Adverse Drug Event Surveillance project, Centers for Disease Control and Prevention. Estimates of ED visits for exposures involving liquid dosage form oral medications with unspecified prescription status (n=14 cases in 2009-2012; n=6 cases in 2017-2020); unspecified dosage form oral medications with unspecified prescription status (n=9 cases in 2009-2012; n=6 cases in 2017-2020), non-oral medications with unspecified prescription status (n=12 cases in 2009-2012; n=8 cases in 2017-2020), unspecified dosage form prescription medications (n=6 cases in 2009-2012; n=1 case in 2017-2020), unspecified dosage form OTC medications (n=7 cases in 2009-2012), and unspecified dosage form medications with unspecified prescription status (n=16 cases in 2009-2012; n=15 cases in 2017-2020) are not shown since they are based on <20 cases and therefore considered statistically unstable. Estimates <1200 for the study period (prior to annualization) are considered statistically unstable and are also not shown (-). Cases which involved multiple implicated medication types (e.g., a solid dosage form oral prescription medication and a solid dosage form oral OTC medication) and are included in the estimate for each corresponding medication type.

^bCases in which a child accessed an oral medication, but there was not enough information to determine whether it was an oral liquid or an oral solid dosage form.

Table 3. Medication Classes Implicated in Emergency Department Visits for Unsupervised Medication Exposures Among Children Aged 5 Years^a

Medication Class and Dosage Form Combination	2009-2012			2017-2020			Difference in Estimate 2009-2012 to 2017-2020		% Change 2009-2012 to 2017-2020		
	Annual National Estimate			Annual National Estimate			No.	%	95% CI	%	95% CI
	No.	%	95% CI	No.	%	95% CI					
Solid Dosage Form Prescription Medications											
Antidepressants	3,801	5.4	(4.6 - 6.2)	2,446	5.7	(4.6 - 6.7)					
Prescription Opioids	4,845	6.9	(5.8 - 8.0)	2,249	5.2	(4.1 - 6.3)					
Amphetamine-related Stimulants	2,031	2.9	(2.2 - 3.6)	1,582	3.7	(2.6 - 4.8)					
Anticonvulsants	1,763	2.5	(2.0 - 3.1)	1,568	3.6	(2.6 - 4.7)					
Benzodiazepines	4,165	5.9	(4.9 - 7.0)	1,529	3.5	(2.5 - 4.6)					
Centrally-acting Adrenergics	1,652	2.4	(1.8 - 2.9)	1,501	3.5	(2.3 - 4.6)					
Beta Blockers	2,265	3.2	(2.6 - 3.8)	1,490	3.5	(2.7 - 4.2)					
Angiotensin-converting Enzyme Inhibitors	1,353	1.9	(1.5 - 2.4)	1,179	2.7	(1.8 - 3.6)					
Calcium Channel Blockers	1,290	1.8	(1.2 - 2.5)	1,121	2.6	(1.8 - 3.4)					
Atypical Antipsychotics	1,603	2.3	(1.7 - 2.8)	1,058	2.5	(1.6 - 3.4)					
Oral Hypoglycemic Agents	1,525	2.2	(1.5 - 2.9)	925	2.1	(1.4 - 2.9)					
Thyroid Hormones	879	1.3	(0.8 - 1.7)	583	1.4	(0.9 - 1.8)					
Non-steroidal Anti-inflammatory Drugs	902	1.3	(0.9 - 1.7)	469	1.1	(0.5 - 1.6)					
Skeletal Muscle Relaxants	1,536	2.2	(1.8 - 2.6)	430	1.0	(0.5 - 1.4)					
Angiotensin Receptor Blockers	349	0.5	(0.2 - 0.8)	423	1.0	(0.6 - 1.4)					
Antilipemic Agents	686	1.0	(0.6 - 1.4)	365	0.8	(0.4 - 1.3)					
Diuretics	792	1.1	(0.8 - 1.5)	356	0.8	(0.4 - 1.2)					
Non-benzodiazepine Sedative/Hypnotic Agents	766	1.1	(0.6 - 1.6)	326 ^b	0.8	(0.3 - 1.2)					
Solid Dosage Form OTC Medications											
Herbals/Alternative Remedies	1,566	2.2	(1.8 - 2.7)	2,594	6.0	(4.6 - 7.5)					
Acetaminophen	3,028	4.3	(3.4 - 5.3)	2,533	5.9	(4.3 - 7.5)					
Vitamins/Minerals	2,862	4.1	(3.3 - 4.9)	1,824	4.2	(3.1 - 5.3)					
Ibuprofen	1,758	2.5	(1.9 - 3.2)	1,737	4.0	(2.8 - 5.2)					

Medication Class and Dosage Form Combination	2009-2012			2017-2020			Difference in Estimate 2009-2012 to 2017-2020		% Change 2009-2012 to 2017-2020		
	Annual National Estimate			Annual National Estimate			No.	%	95% CI	%	95% CI
	No.	%	95% CI	No.	%	95% CI					
Diphenhydramine	718	1.0	(0.6 - 1.4)	1,136	2.6	(1.8 - 3.5)			419	58.3	(-25.8 - 142.4)
Selective Antihistamines	970	1.4	(1 - 1.8)	776	1.8	(1.1 - 2.5)			-194	-20.0	(-66.4 - 26.4)
Aspirin	1,011	1.4	(0.8 - 2.1)	558	1.3	(0.8 - 1.8)			-453	-44.8	(-83.2 - -6.4)
Acetaminophen- or Aspirin-containing Analgesic Combinations	1,234	1.8	(1.4 - 2.2)	507	1.2	(0.8 - 1.6)			-726	-58.9	(-75.3 - -42.5)
Cough and Cold Medications	935	1.3	(0.9 - 1.8)	--	--	--			--	--	--
Liquid Dosage Form OTC Medications											
Acetaminophen	2,657	3.8	(2.8 - 4.8)	1,238	2.9	(2.0 - 3.7)			-1,418	-53.4	(-72 - -34.8)
Diphenhydramine	1,524	2.2	(1.6 - 2.7)	1,217	2.8	(2.1 - 3.6)			-307	-20.1	(-45.9 - 5.7)
Ibuprofen	1,351	1.9	(1.4 - 2.5)	797	1.9	(1.2 - 2.5)			-554	-41.0	(-69.8 - -12.2)
Cough Cold Remedies	2,730	3.9	(2.8 - 5.0)	776	1.8	(1.3 - 2.3)			-1,954	-71.6	(-84.4 - -58.8)
Unspecified Dosage Form Oral Medications ^c											
Acetaminophen	754	1.1	(0.6 - 1.6)	304 ^b	0.7 ^b	(0.3 - 1.1) ^b			-450 ^b	-59.7 ^b	(-92.7 - -26.8) ^b

Abbreviation(s): CI, confidence interval; ED, emergency department; OTC, over-the-counter

^aData from the National Electronic Injury Surveillance System-Cooperative Adverse Drug Event Surveillance project, Centers for Disease Control and Prevention. Estimates <1200 for the study period (prior to annualization) are considered statistically unstable and are not shown (-). Cases of ED visits which involved multiple implicated medication classes (e.g., an oral solid prescription opioid and an oral solid antidepressant) and are included in the estimate for each corresponding medication class. Medication classes are shown if they were implicated in at least 1% of ED visits for unsupervised medication exposures for at least one of the periods of interest.

^bCoefficient of variation >30%.

^cCases in which a child accessed an oral medication, but there was not enough information to determine whether it was an oral liquid or an oral solid dosage form.

Table 4.

Emergency Department Visits and Hospitalizations for Common Unintentional Injuries Among Children Aged 5 Years, 2009-2020^a

Type of Unintentional Injury	National Estimates of ED Visits			National Estimates of ED Visits Resulting in Hospitalization ^b		
	Annual Percentage Change			Annual Percentage Change		
	%	95% CI	P-Value	%	95% CI	P-Value
Unsupervised Medication Exposures	-6.0	(-7.2 - -4.8)	<.001	-4.5	(-6.2 - -2.7)	<.001
Falls	-5.4	(-6.5 - -4.2)	<.001	-0.7	(-2.8 - 1.4)	.455
Struck by/Against Object Injuries	-6.2	(-7.6 - -4.8)	<.001	-3.0	(-5.0 - -0.9)	.010
Foreign Body Exposures	-3.3	(-4.8 - -1.9)	<.001	-1.1	(-3.4 - 1.3)	.336
Fire/Burn-related Injuries	-5.3	(-7.4 - -3.1)	<.001	0.7	(-2.0 - 3.4)	.602

Abbreviation(s): CI, confidence interval; ED, emergency department; OTC, over-the-counter.

Note: Boldface indicates statistical significance ($p < 0.05$).

^aEstimates of ED visits and hospitalizations for unsupervised medication exposures are based on data from the National Electronic Injury Surveillance System–Cooperative Adverse Drug Event Surveillance project, Centers for Disease Control and Prevention; estimates of ED visits and hospitalizations for other types of unintentional injuries are based on data from the National Electronic Injury Surveillance System–All Injury Program, Centers for Disease Control and Prevention. Joinpoint statistical software was used to calculate annual percentage change with zero inflection points specified. Two-sided P values $< .05$ were considered statistically significant.

^bHospital admission or transfer to another hospital.