Trends in Emergency Department Visits for Unsupervised Pediatric Medication Exposures, 2004–2013

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abstract

BACKGROUND: After reports of increasing emergency department (ED) visits for unsupervised pediatric medication exposures in the 2000s, renewed efforts to improve safety packaging and education were initiated. National data on current trends can help further target interventions.

METHODS: We used nationally representative data from the National Electronic Injury Surveillance System–Cooperative Adverse Drug Event Surveillance project (2004–2013) to assess trends in ED visits for unsupervised medication exposures in children aged <6 years. For 2010 through 2013, the dosage form and prescription status of implicated medications were identified.

RESULTS: Based on 13 268 cases, there were an estimated 640 161 ED visits (95% confidence interval: 512 885 to 767 436) for unsupervised medication exposures from 2004 through 2013. From 2004 through 2010, ED visits for unsupervised exposures increased by an average of 5.7% annually, peaking at 75 842. After 2010, this trend reversed, and visits decreased by an average of 6.7% annually to 59 092 in 2013. From 2010 through 2013, 91.0% of unsupervised exposure visits involved 1 medication, most commonly an oral prescription solid (45.9%), oral over-the-counter (OTC) solid (22.3%), or oral OTC liquid (12.4%). More than 260 different prescription solids were implicated; opioids (13.8%) and benzodiazepines (12.7%) were the most common classes. Four medications were implicated in 91.2% of OTC liquid exposure visits: acetaminophen (32.9%), cough and cold remedies (27.5%), ibuprofen (15.7%), and diphenhydramine (15.6%).

CONCLUSIONS: Targeting prevention efforts based on harm frequency and intervention feasibility can lead to continued reductions in ED visits for pediatric medication exposures.

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WHAT'S KNOWN ON THIS SUBJECT: Unsupervised medication exposures increased during the previous decade, despite child-resistant packaging and caregiver education. To achieve the Healthy People 2020 objective of reducing emergency department visits for unintentional pediatric medication overdoses, targeted interventions including improved safety packaging may be needed.

WHAT THIS STUDY ADDS: Since 2010, emergency department visits for unsupervised medication exposures started to decrease. Most visits involved solid dose medications, typically for adult use. Most liquid medication exposure visits involved 4 over-the-counter pediatric products and may be more readily amenable for interventions.

Unsupervised medication exposures remain a significant but preventable cause of pediatric harm. For decades, the cornerstones of primary prevention have been child-resistant (CR) packaging (required for most medications in the United States)[1] and education regarding safe medication storage. Despite great success in reducing the numbers of pediatric poisoning deaths,[2] each year ~500 000 calls are made to poison centers after a young child accesses medication without adult supervision,[3–5] and from 2001 through 2008, the number of pediatric exposure calls that resulted in emergency department (ED) evaluation increased 24% to 32% depending on medication type.[6] Since then, renewed efforts have been made to improve child safety packaging and education,[7,8] and reducing ED visits for unintentional medication overdoses among young children was adopted as a Healthy People 2020 goal for the nation.[9]

Nationally representative surveillance data were used to assess trends in ED visits for unsupervised medication exposures among children aged <6 years from 2004 through 2013. To help target prevention efforts, the medications implicated in ED visits from 2010 through 2013 were characterized according to dosage form and prescription status, and those most commonly implicated were identified.

METHODS

Data Sources

National estimates of ED visits for unsupervised pediatric medication exposures were based on data from the National Electronic Injury Surveillance System–Cooperative Adverse Drug Event Surveillance (NEISS-CADES) project. Initiated in 2004, NEISS-CADES is an active public health surveillance system based on a nationally representative sample of hospitals with at least 6 beds and a 24-hour ED in the United States and its territories; the project has been described elsewhere in detail.[10,11] Briefly, trained abstractors at 57 to 63 participating hospitals (depending on the year) review the clinical diagnoses and supporting documentation in all ED visit medical records to identify clinician-diagnosed adverse drug events (ADEs) and up to 2 medications implicated in each adverse event. Abstractors record patient demographic characteristics, verbatim clinical diagnoses, information about implicated medications, and discharge disposition. When documented, abstractors also record narrative details, including precipitating circumstances, clinical manifestations, laboratory testing, and treatments administered.

Definitions

Unsupervised exposure cases were defined as ED visits from January 1, 2004, through December 31, 2013, by a child aged <6 years for accessing medication without caregiver permission or oversight, as documented by treating clinicians. Medications included any prescription or over-the-counter (OTC) medication, herbal/dietary supplement, or vaccine. Hospitalizations included inpatient admissions, transfers to other hospitals, and observation admissions.

From 2010 through 2013, ED visits for unsupervised exposures were categorized according to dosage form and prescription status (medication type). Dosage forms were categorized as oral liquids (eg, suspensions, syrups), oral solids (eg, tablets, capsules), and nonoral medications (eg, ointments, inhalers) based on details provided in case narratives or by searching drug databases and manufacturer Web sites for available dosage forms.[12,13] If medications could have been oral solids or oral liquids (eg, "ingested acetaminophen"), they were categorized as unspecified oral dosage form. If medications could have been oral or nonoral dosage forms (eg, "ingested grandma's meds"), they were categorized as unspecified dosage form.

For this analysis, medications available only by prescription were categorized as prescription. Medications available either by prescription or OTC were categorized based on case details such as brand name or dosage strength (eg, "ibuprofen 800-mg tablets"); in the absence of clarifying details, they were categorized as available OTC. Medications available only OTC were categorized as OTC. OTC medications were further categorized as pediatric products, adult/family products, or unspecified age group products based on the product name, dosage form, or narrative details (eg, "children's acetaminophen"). Medications described generally (eg, "eye drops," "white pill") were categorized as unspecified prescription status.

For ED visits without specific documentation of pediatric self-administration, caregiver administration was assumed. These included adverse reactions, allergic reactions, supratherapeutic effects, medication errors, and secondary effects (eg, choking).

Statistical Analysis

NEISS-CADES cases are weighted based on the inverse probability of selection, adjusted for nonresponse and poststratified to adjust for the number of annual hospital ED visits.[14] National estimates of ED visits and corresponding 95% confidence intervals (CIs) were calculated by using the SURVEYMEANS procedure in SAS version 9.3 (SAS Institute, Inc, Cary, NC) to account for weighting and complex sample design. Population-based rates were calculated by using intercensal estimates from the US Census Bureau.

NEISS-CADES estimates based on <20 cases or total estimates <1200 for the study period are considered statistically unreliable and are not shown. Similarly, estimates with a coefficient of variation >30% are noted.

Trend analyses were conducted by using piecewise (segmented) regression with the natural logarithm of the annual national estimate or the estimated annual rate as the dependent variable and year as the independent variable. Joinpoint Regression software version 4.1.1 (National Cancer Institute, Bethesda, MD) was used to identify potential inflection points and to test for significant trends, accounting for variances of estimates.[15] Two-sided *P* values <.05 were considered statistically significant.

For detailed analysis of implicated medications (2010–2013), average annual estimates of ED visits for the 4-year period were calculated. Analysis of types of implicated medications (dosage form and prescription status) was limited to visits involving 1 medication.

RESULTS

Patient and Case Characteristics, 2004 through 2013

Based on 13 268 cases, an estimated 640 161 ED visits (95% CI: 512 885 to 767 436) were made from 2004 through 2013 after a child aged <6 years accessed medication without caregiver oversight (Table 1). During this time, there were a similar number of ED visits for ADEs after caregiver administration (623 381 [95% CI: 445 931 to 800 831]) in this age group. Two-thirds of ED visits (69.8% [95% CI: 68.5 to 71.0]) for unsupervised medication exposure involved 1- or 2-year-old children, whereas most visits for ADEs after caregiver administration involved children aged ≤1 year (57.1% [95% CI: 54.5 to 59.7]). ED visits for unsupervised exposures were 3 times more likely to result in hospitalization (18.5% vs 6.0%) compared with visits for ADEs after caregiver administration. Nearly all unsupervised exposure visits involved oral intake (97.9% [95% CI: 97.6 to 98.3]).

Trends, 2004 through 2013

From 2004 through 2010, the number of estimated ED visits for unsupervised medication exposures among children aged <6 years increased by an annual percentage change (APC) of 5.7% (95% CI: 4.4 to 7.1), from 54 140 visits (95% CI: 42 277 to 66 002) in 2004 to 75 842 visits (95% CI: 58 228 to 93 455) in 2010 (Fig 1A). After 2010, the APC in estimated ED visits for unsupervised exposures significantly decreased by 6.7% (95% CI: –9.9 to –3.3) each year to 59 092 visits (95% CI: 44 912 to 73 272) in 2013. In contrast, the number of estimated visits for ADEs after caregiver administration increased over the entire 10-year period with an estimated APC of 5.8% (95% CI: 3.5 to 8.1), from 46 779 visits (95% CI: 28 818 to 64 741) in 2004 to 70 390 visits (95% CI: 48 436 to 92 343) in 2013 (Fig 1B). Population changes did not alter these trends, with the rate of ED visits for unsupervised medication exposures increasing by an APC of 5.2% (95% CI: 4.0 to 6.5) from 2004 through 2010, then decreasing by 6.2% (95% CI: –9.2 to –3.0); the rate of ED visits for ADEs after caregiver administration increased by an APC of 5.6% (95% CI: 3.4 to 7.8) throughout the period.

Most ED visits for ADEs were attributed to unsupervised exposures during the first part of the study period. However, joinpoint regression identified a significant decline in the proportion of visits attributed to

TABLE 1 Number of Cases and National Estimates of ED Visits for ADEs by Children Aged <6 Years, United States, 2004–2013

Characteristic	ED Visits: Unsupervised Medication Exposures				ED Visits: ADEs After Caregiver Administration			
	Cases	10-Year National Estimate			Cases	10-Year National Estimate		
	N	No.	%	95% CI	*N*	No.	%	95% CI
Age, y								
<1	764	36 529	5.7	5.0–6.4	4129	194 641	31.2	29.5–33.0
1	4158	202 952	31.7	30.2–33.2	3520	161 309	25.9	24.1–27.7
2	5016	243 598	38.1	37.0–39.1	1612	74 104	11.9	11.2–12.6
3	2094	102 109	16.0	14.9–17.0	1284	58 157	9.3	8.5–10.2
4	874	39 535	6.2	5.6–6.7	1655	75 448	12.1	10.8–13.4
5	362	15 438	2.4	2.0–2.8	1344	59 722	9.6	8.3–10.9
Gender[a]								
Female	6279	304 203	47.5	46.3–48.7	6226	291 222	46.7	45.6–47.8
Male	6986	335 731	52.4	51.3–53.6	7316	332 009	53.3	52.1–54.4
Disposition[b]								
Admitted, transferred, or held for observation	3530	118 739	18.5	14.1–23.0	1634	37 672[c]	6.0	2.7–9.4
Treated and released or left against medical advice	9735	521 314	81.4	77.0–85.9	11 908	585 693	94.0	90.6–97.3
Total 10-year estimate	13 268	640 161	100.0		13 544	623 381	100.0	

Estimates are based on the NEISS-CADES project, 2004 through 2013.

[a] Patient gender was missing for 3 cases involving unsupervised exposure and 2 cases of ADEs after caregiver administration.

[b] Disposition was missing for 3 cases involving unsupervised exposure and 2 cases of ADEs after caregiver administration.

[c] Coefficient of variation = 31.1%.

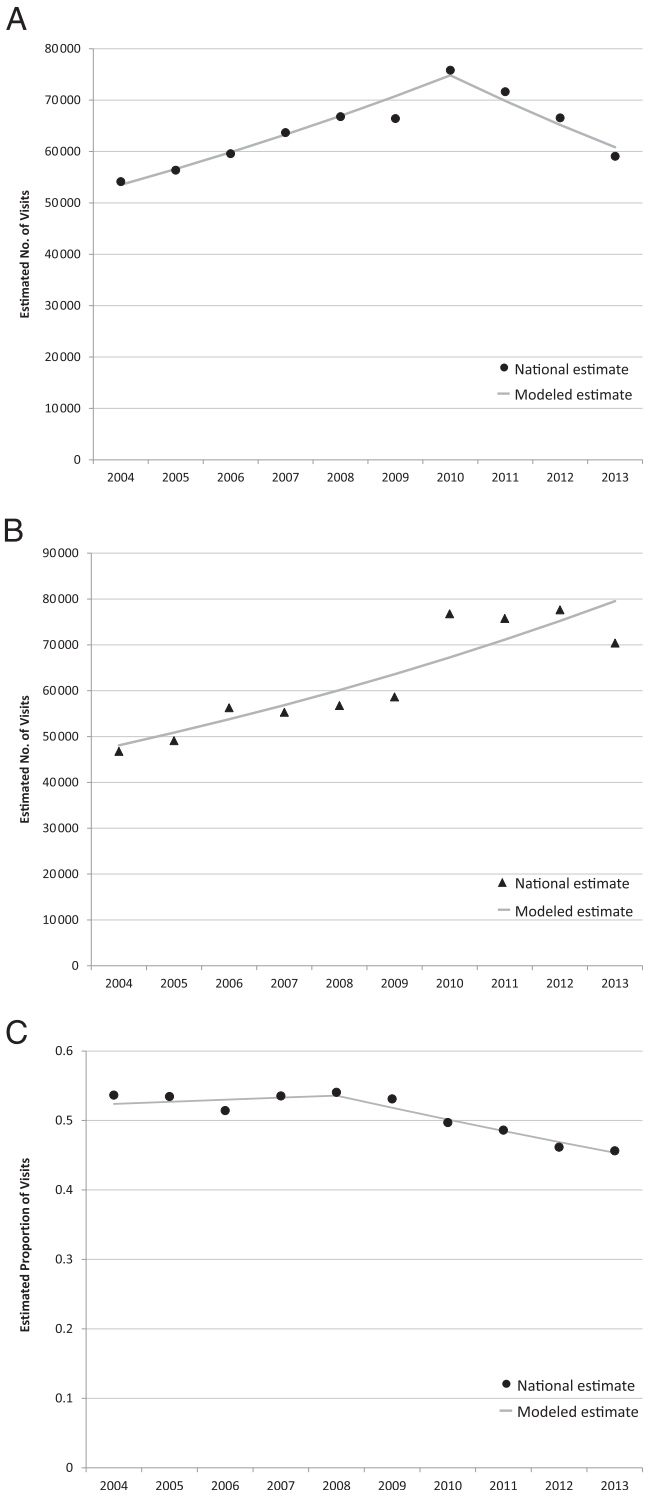

FIGURE 1

Trends in ED visits for ADEs in children aged <6 years, United States, 2004–2013. A, Estimated number of ED visits for unsupervised medication exposures. B, Estimated number of ED visits for ADEs after caregiver administration. C, Estimated proportion of ED visits for ADEs attributed to unsupervised exposures.

unsupervised exposures after 2008, with an APC of −3.3% (95% CI: −4.9 to −1.7) through 2013 ($P < .001$) (Fig 1C). In 2013, 45.6% (95% CI: 41.0 to 50.3) of ED visits for ADEs among children aged <6 years were attributed to unsupervised exposures.

Types of Implicated Medications, 2010 through 2013

Based on 5524 cases, 1 medication was accessed in 91.0% (95% CI: 89.7 to 92.3) of ED visits for unsupervised exposures from 2010 through 2013. Of visits involving 1 medication, nearly three-fourths (72.5%) involved an oral solid medication and 15.4% involved an oral liquid medication (Table 2). Approximately one-half of these visits (51.2%) were attributed to a prescription medication and 43.4% were attributed to an OTC medication. Among the 9.0% of visits (95% CI: 7.7 to 10.3) for unsupervised exposures attributed to >1 medication, 91.5% (95% CI: 87.2 to 95.8) involved 2 oral solid medications.

Oral prescription solid medications (45.9%), oral OTC solids (22.3%), and oral OTC liquids (12.4%) accounted for four-fifths of ED visits for unsupervised exposures attributed to 1 medication (Table 3). Among ED visits for unsupervised exposure to a solid dose medication, twice as many annual visits were attributed to a prescription product as an OTC product (28 540 [95% CI: 22 517 to 34 563] vs 13 870 [95% CI: 10 850 to 16 889]). In contrast, among visits for unsupervised exposure to a liquid medication, an OTC liquid was implicated in 5.3 times as many annual visits as a prescription liquid (7736 [95% CI: 6067 to 9405] vs 1448 [95% CI: 968 to 1929]).

Frequently Implicated Medications, 2010 through 2013

Pediatric products were involved in more than four-fifths of ED visits for OTC liquid medication exposures (85.2% [95% CI: 80.3 to 90.1]), whereas adult/family products were involved in more than two-thirds of visits for OTC solid medication exposures (70.1% [95% CI: 66.5 to 73.6]).

Children aged ≤2 years were involved in 79.9% (95% CI: 77.5 to 82.4) of visits for oral prescription solid medication exposures; children aged ≤1 year were involved in 42.3% (95%

TABLE 2 National Estimates of Types of Medications Implicated in ED Visits for Unsupervised Exposures Involving a Single Medication by Children Aged <6 Years, United States, 2010–2013

Medication Type	ED Visits: Annual National Estimate		
	No.	%	95% CI
Medication dosage form			
Oral solid (eg, tablet)	45 079	72.5	70.1–74.9
Oral liquid	9546	15.4	13.5–17.2
Unspecified oral[a]	2134	3.4	2.0–4.8
Nonoral medication	5104	8.2	7.2–9.3
Unspecified dosage form	305[b]	0.5	0.2–0.8
Medication prescription status			
Prescription	31 802	51.2	49.2–53.1
OTC	26 967	43.4	41.6–45.2
Unspecified prescription status	3399	5.5	4.3–6.7

Estimates based on the NEISS-CADES project, 2010 through 2013.

[a] Denotes cases in which the 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.

[b] Coefficient of variation = 30.6%.

CI: 38.9 to 45.7). Children aged ≤2 years were involved in a similar proportion of visits for oral OTC solid medication exposures (73.4% [95% CI: 69.9 to 76.9]). However, slightly older children were involved in visits for oral OTC liquid medication exposures, with 60.3% (95% CI: 54.8 to 65.9) involving children aged ≤2 years.

More than 260 individual medications were implicated in oral prescription solid medication exposure cases. Opioids were the most commonly implicated medication class in ED visits involving prescription solid exposures (4661 annual visits [13.8%]), with 1285 buprenorphine-containing product visits (95% CI: 803 to 1767), 991 oxycodone-containing product visits (95% CI: 466 to 1515), 864 tramadol-containing product visits (95% CI: 507 to 1220), and 856 hydrocodone-containing product visits (95% CI: 482 to 1230) annually (Table 4). Benzodiazepines were the second most commonly implicated class in ED visits involving prescription solid exposures (4293 annual visits [12.7%]), with 1999 clonazepam exposure visits (95% CI: 1218 to 2780) and 905 alprazolam visits (95% CI: 456 to 1354) annually. The 10 most frequently implicated medications, alone or in combination with others, were involved in 32.2% (95% CI: 28.6 to 35.7) of visits attributed to prescription solid medication exposures.

Vitamins/minerals or herbal/alternative remedies were implicated in one-quarter of visits for OTC solid medication exposures annually (4206 [95% CI: 3334 to 5077]). Analgesic products containing acetaminophen alone or in combination were implicated in another one-quarter of visits for OTC solid medication exposures annually (4114 [95% CI: 2832 to 5397]). The specific ingredients/combinations were not always identified for ED visits attributed to vitamins/minerals; however, at least one-third of these visits involved an iron-containing product (897 annual visits [95% CI: 536 to 1258]).

Four medications, alone or in combination with others, were implicated in 91.2% (95% CI: 88.7 to 93.6) of ED visits for oral OTC liquid exposures, with 2607 visits (32.9%) involving single-ingredient acetaminophen, 2182 visits (27.5%) involving cough and cold remedies, 1248 visits (15.7%) involving single-ingredient ibuprofen, and 1235 visits (15.6%) involving single-ingredient diphenhydramine annually. Pediatric products were implicated in 86.9% (95% CI: 81.9 to 91.9) of visits involving these 4 OTC liquid medications.

Notably, these 4 medications were also implicated in 39.6% (95% CI: 35.4 to 43.8) of oral OTC solid exposure visits and 82.5% (95% CI: 75.4 to 89.6) of visits involving oral OTC medications for which solid or liquid dosage form was unspecified. Unintentional epinephrine autoinjector needle sticks were implicated in one-half of ED visits (751 annual visits [95% CI: 502 to 1000]) for nonoral prescription medication exposures, whereas topical agents were implicated in nearly two-thirds of visits (2269 annual visits [95% CI: 1675 to 2864]) for nonoral OTC medication exposures.

TABLE 3 Cross-tabulation of Types of Medications Implicated in ED Visits for Unsupervised Exposures Involving a Single Medication by Children Aged <6 Years, United States, 2010–2013

Medication Prescription Status	Medication Dosage Form											
	Oral Solid (eg, tablets)			Oral Liquid			Unspecified Oral[a]			Nonoral Medication		
	Annual National Estimate			Annual National Estimate			Annual National Estimate			Annual National Estimate		
	No.	%	95% CI	No.	%	95% CI	No.	%	95% CI	No.	%	95% CI
Prescription	28 540	45.9	43.9–47.9	1448	2.3	1.6–3.0	338	0.5	0.2–0.8	1431	2.3	1.8–2.8
OTC	13 870	22.3	20.3–24.3	7736	12.4	11.0–13.9	1763	2.8	1.6–4.1	3536	5.7	4.9–6.5
Unspecified	2670	4.3	3.3–5.3	–	–	–	–	–	–	–	–	–

Estimates are based on the NEISS-CADES project, 2010 through 2013. Estimates based on <20 cases or with a total 4-year estimate <1200 are not shown (–). Twenty-nine ED visits involving a medication in which the dosage form was unspecified are not shown.

[a] Denotes cases in which the 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 National Estimates of Medications Commonly Implicated in ED Visits for Unsupervised Exposures by Children Aged <6 Years, United States, 2010–2013

Most Commonly Implicated Medications	ED Visits: Annual National Estimate		
	No.	%	95% CI
Oral prescription solid medications			
Opioid analgesics	4661	13.8	11.8–15.8
Benzodiazepines	4293	12.7	10.8–14.7
Antidepressants	3594	10.7	8.9–12.4
β-blockers	2080	6.2	5.0–7.4
Amphetamine-related stimulants	1965	5.8	4.5–7.1
Centrally acting antiadrenergics	1847	5.5	4.0–6.9
Anticonvulsants	1715	5.1	4.0–6.2
Oral hypoglycemics	1454	4.3	2.6–6.0
Skeletal muscle relaxants	1437	4.3	3.2–5.3
Calcium channel blockers	1377	4.1	2.6–5.5
Atypical antipsychotics	1318	3.9	2.8–5.0
Angiotensin-converting enzyme inhibitors	1239	3.7	2.8–4.5
Oral OTC solid medications			
Acetaminophen	3017	19.2	15.6–22.7
Vitamins/minerals	2687	17.1	13.9–20.3
Ibuprofen	1663	10.6	8.1–13.0
Herbals/alternative therapies	1629	10.4	8.0–12.7
Acetaminophen and/or aspirin-containing analgesic combinations	1170	7.4	5.5–9.3
Aspirin	1021	6.5	3.8–9.2
Diphenhydramine	906	5.8	4.0–7.5
Second-generation antihistamines	706	4.5	3.1–5.9
Cough and cold remedies	678	4.3	2.4–6.2
Antiulcer agents	506	3.2	1.6–4.9
Oral OTC liquid medications			
Acetaminophen	2607	32.9	25.6–40.1
Cough and cold remedies	2182	27.5	20.2–34.9
Ibuprofen	1248	15.7	11.8–19.7
Diphenhydramine	1235	15.6	11.4–19.8

Estimates based on the NEISS-CADES project, 2010 through 2013. Medications implicated in at least 3% of estimated ED visits for the 3 most commonly implicated dosage form and prescription status combinations are listed.

DISCUSSION

An estimated 640 000 ED visits were made in the United States from 2004 through 2013 after a child aged <6 years accessed medication without caregiver permission or oversight; nearly 20% resulted in hospitalization. Previous studies reported rising numbers of ED visits and calls to poison centers for pediatric medication exposures throughout the 2000s.[6,16,17] However, timely, nationally representative data suggest that ED visits for unsupervised exposures are now decreasing, from a peak of ~76 000 estimated ED visits in 2010 to 59 000 visits in 2013.

Neither surveillance artifact nor secular trend in ED utilization likely explain the 22% decline in estimated number of ED visits for unsupervised medication exposures beginning in 2010. The estimated number of ED visits for ADEs after caregiver administration of medication to children aged <6 years increased throughout the study period, including the 2010–2013 period when unsupervised exposures were declining. Although unsupervised exposures are no longer the most common cause of ED visits for ADEs among young children (accounting for 46% of visits in 2013), national data on types of medications implicated in unsupervised exposures will continue to be helpful for targeting interventions and achieving further reductions in ED visits.

Addressing oral liquid medication exposures is a logical next step to continue to reduce pediatric medication exposures because these exposures commonly involve a relatively small number of pediatric OTC products, and efficacious interventions are available. Acetaminophen, cough and cold remedies, ibuprofen, or diphenhydramine were implicated in 91% of ED visits for OTC liquid medication exposures, accounting for 7200 visits annually from 2010 through 2013, and 87% involved pediatric formulations. Although nearly all of these medications require CR packaging,[1] like most medications in the United States, they are commonly sold in bottles that require caregivers to immediately and fully resecure the safety cap after every use. Newer safety packaging that incorporates passive safety features that do not rely solely on active engagement by caregivers (eg, flow restrictors, unit-dose packaging) has been shown to complement CR packaging by providing a secondary safety barrier or a barrier around each dose.[7,18–20] Efficacy standards for restricted delivery systems such as flow restrictors are being developed[21] and are currently implemented on infants' and some children's single-ingredient acetaminophen products.[22] A new final guidance from the US Food and Drug Administration recommends expanding use of such container features to prevent or limit pediatric exposures to all OTC pediatric liquid acetaminophen–containing products.[23]

Although approximately one-half of ED visits for medication exposures involved prescription solid medications, the targeting of interventions is more complex because these exposures involve a broader range of products, typically intended for adults, which are often repackaged at retail pharmacies and are more easily transferred out of CR containers in the home. Although only 1 pediatric medication (ie, single-ingredient acetaminophen) was implicated in one-third of ED visits for OTC liquid exposures from 2010 through 2013, ten medications combined accounted for one-third of visits for prescription solid exposures. With so many different implicated

medications, packaging interventions could be targeted to medications that lead to high rates of pediatric exposure (disproportionate relative to use) and high severity.[24] However, because prescription medications in solid dosage form are not likely to be prescribed to children aged <6 years, interventions to improve child safety should be balanced with usability and adherence by older users.[25]

In addition, unlike with liquid medications, solid dose medications may be left by adults outside of containers or they may be transferred to non-child-resistant containers to improve access, portability, or adherence. It is notable that 80% of prescription solid exposure visits were made by children aged ≤2 years, and 42% were made by those aged ≤1 year, well below the youngest participants (aged 3.5 years) included in the Poison Prevention Packaging Act protocol testing.[26] It is unlikely that many 2-year-olds, much less 1-year-olds, can open fully secured CR containers, suggesting that they accessed medications from containers which were not fully secured, medications from containers without CR features (eg, daily or weekly pill minders), loose pills intentionally left out (eg, for the next dose), or dropped pills. As with liquid medications, CR unit-dose packaging can prevent or limit pediatric solid medication exposures because the CR protection for each unit remains in place until opened. A recent study of poison center calls found significantly higher rates of pediatric exposure for buprenorphine/naloxone tablets packaged in multidose bottles compared with buprenorphine/naloxone film packaged in unit-dose pouches, suggesting that differences in packaging may have affected the rates of exposure calls.[27] Although incorporation of passive protection features in medication packaging may limit solid dosage exposures, additional innovations, as well as complementary educational messages, may be needed to reduce exposures when medications are removed from their original packaging.

The present findings should be interpreted in the context of the limitations of public health surveillance data. First, because data were collected in an emergency setting, detailed information about medication dosage strength or brand name was not always documented; thus, there is potential for misclassification of medication type. Similarly, the specific circumstances surrounding the exposures (eg, type of container from which medication was accessed) were not always documented, but this information could help further target interventions.[28] Second, trained abstractors reported the first 2 implicated medications for each ED visit; if additional medications were involved, they were neither systematically collected nor analyzed. However, only 9% of cases involved >1 medication, and fewer would involve >2 medications. Third, although the data suggest a decreasing trend in ED visits for unsupervised exposure, analyses were limited to the 10 years for which data were available. Nonetheless, active surveillance is generally preferred to voluntary reporting for monitoring trends and should continue to monitor effects of expanded interventions.[29,30] Fourth, although medication utilization was not assessed, future studies could identify specific medications with disproportionate rates of unsupervised exposure relative to use, and assess medication-specific trends.

CONCLUSIONS

The observed decline in estimated ED visits for unsupervised exposure cannot be attributed to specific interventions; however, the decline coincides with renewed prevention efforts, including those of the PRevention of Overdoses and Treatment Errors in Children Taskforce (PROTECT) Initiative and its partners.[8,22,31–34] Initiated in 2008, PROTECT is a public–private partnership led by the Centers for Disease Control and Prevention that aims to prevent unsupervised medication exposures by encouraging development and implementation of innovative exposure-limiting packaging (eg, flow restrictors) and by updating and disseminating evidence-based educational messages on safe use and storage of medications that resonate with new generations of caregivers. To maintain or even accelerate reductions in preventable harm from pediatric medication exposures will require continuing efforts to address the medications that lead to frequent and disproportionate harm, including interventions that balance efficacy and feasibility.

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ABBREVIATIONS

ADE: adverse drug event
APC: annual percentage change
CI: confidence interval
CR: child-resistant
ED: emergency department
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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