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Title: Medication Overdoses Leading to Emergency Department Visits Among Children

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Abstract: Background: The high prevalence of medication use increases the potential for medication overdoses, especially among children. We sought to describe the burden of unintentional pediatric medication overdoses to target new prevention efforts.

Methods: In 2007 and 2008, we analyzed data from the National Electronic Injury Surveillance System (NEISS) collected January 1, 2004, through December 31, 2005, to estimate the number of emergency department (ED) visits from unintentional medication overdoses among children aged 18 years and younger in the United States. We analyzed these by patient demographics, overdose cause, and implicated products, and compared them to visits for non-pharmaceutical consumer product poisonings.

Results: Based on 3034 cases, an estimated 71,224 ED visits for medication overdoses were made annually by children aged 18 years and younger, representing 68.9% of ED visits for unintentional pediatric poisonings. The rate of unintentional poisonings from medications was twice the rate from non-pharmaceutical consumer products (9.2 visits per 10,000 individuals per year [95% CI, 7.3-11.0] vs. 4.2 per 10,000 individuals per year [95% CI, 3.3-5.0]). Four-fifths (82.2%) of visits for

medication overdoses were from unsupervised ingestions (children accessing medications on their own), while medication errors and misuse resulted in 14.3% of visits. Most visits (81.3%) involved children aged 5 years and younger, and medications commonly available over-the-counter were implicated in one-third (33.9%) of visits.

Conclusions: Medication overdoses among children, notably unsupervised ingestions, represent a substantial burden in terms of ED visits and hospitalizations. New efforts to prevent pediatric medication overdoses are needed.

Medication Overdoses Leading to Emergency Department Visits Among Children

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Background: The high prevalence of medication use increases the potential for medication overdoses, especially among children. **Purpose:** This paper is intended to describe the burden of unintentional pediatric medication overdoses in order to target new prevention efforts.

Methods: In 2007 and 2008, data were analyzed from the National Electronic Injury Surveillance System, collected January 1, 2004, through December 31, 2005, to estimate the number of emergency department visits resulting from unintentional medication overdoses among children aged ≤ 18 years in the U.S. These data were analyzed by patient demographics, overdose cause, and implicated products, and compared to visits for nonpharmaceutical consumer product poisonings.

Results: Based on 3034 cases, an estimated 71,224 emergency department visits for medication overdoses were made annually by children aged ≤ 18 years, representing 68.9% of emergency department visits for unintentional pediatric poisonings. The rate of unintentional poisonings from medications was twice the rate of those from nonpharmaceutical consumer products (9.2 visits per 10,000 individuals per year [95% CI=7.3, 11.0] vs 4.2 per 10,000 individuals per year [95% CI=3.3, 5.0]). Four fifths (82.2%) of visits for medication overdoses were from unsupervised ingestions (children accessing medications on their own); medication errors and misuse resulted in 14.3% of visits. Most visits (81.3%) involved children aged ≤ 5 years, and commonly available over-the-counter medications were implicated in one third (33.9%) of visits.

Conclusions: Medication overdoses among children, notably unsupervised ingestions, represent a substantial burden in terms of emergency department visits and hospitalizations. New efforts to prevent pediatric medication overdoses are needed.

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Introduction

Outpatient medication use is increasingly common in the U.S., with 82% of adults and 56% of children taking at least one medication every week. Use of multiple medications has also increased, with the prevalence of use of five or more medications among adults rising from 22% to 31% between 2000 and 2004.¹ The high frequency of medication usage and the rising number of medications stored in American homes increases the potential for medication overdoses in ambulatory settings, especially among children.

Poison control center triage is currently performed to treat overexposure to many types of products—nonpharmaceutical consumer products such as cleaning substances, pesticides, and personal care products, as well as medication overdoses. Although there has been an overall decline in the number of calls to poison control centers for poisoning exposures among children aged ≤ 5 years, the proportion of calls for overexposures to medications has increased from 34% to 44% from 2002 to 2006.^{2,3} It has been previously estimated⁴ that more than 70,000 children aged ≤ 18 years are treated in U.S. emergency departments for unintentional medication overdoses annually, but the underlying causes and risk factors for unintentional medication overdoses have not been well described. Studies have focused on unintentional poisoning exposures in children⁵ or on pediatric medication errors,^{6,7} but nationally representative data on the scope, burden, and causes of medication overdoses are needed to help prioritize and target new efforts to prevent unintentional medication overdoses.⁸ In this report, a nationally representative public health surveillance system is used to describe outpatient pediatric medication overdoses that led to emergency department visits, and identify underlying causes.

The magnitude of the burden of medication overdoses is described by comparing medication overdoses to unintentional poisonings from nonpharmaceutical consumer products.

Methods

Data Sources

Cases of medication overdoses and nonpharmaceutical consumer product poisonings were identified using the U.S. Consumer Product Safety Commission's National Electronic Injury Surveillance System (NEISS). NEISS was created in 1971 for the purpose of estimating the national number of emergency department visits for product-related injuries by identifying cases from a national probability sample of hospitals that have a minimum of six beds and a 24-hour emergency department, in the U.S. and its territories.⁹

Trained coders at each hospital review clinical records of every emergency department visit. When physician-diagnosed adverse drug events (ADEs) are identified, coders report up to two drugs implicated, along with the ADE. They also record a narrative description of the incident. An ADE is defined as a condition that the treating physician attributed to the use of a drug or to a drug-specific effect.⁴ These data constitute the Cooperative Adverse Drug Event Surveillance component (NEISS-CADES) of the surveillance system. When consumer product-related poisonings are identified, coders report the intent of product use, cause of injury, consumer products associated with the injury, and a narrative description of the incident. Cases were identified from the All Injury Program component (NEISS-AIP) of the surveillance system. A total of 63 hospitals participate in the NEISS-CADES/AIP sample; five (7.9%) of these are pediatric hospitals.

Development, operation, and evaluation of both surveillance systems have been previously described.⁸⁻¹³ Data collection is managed by the U.S. Consumer Product Safety Commission in collaboration with the CDC (NEISS-CADES and NEISS-AIP) and the Food and Drug Administration (NEISS-CADES). Hospital participation in NEISS-CADES/AIP is voluntary and confidential (Consumer Product Safety Act, 15 U.S.C. 2051–2084). Data collection with NEISS was considered a public health surveillance activity and did not require IRB approval.

Case Definitions

A case was defined as presentation to an emergency department between January 1, 2004, and December 31, 2005 by a person aged ≤ 18 years for a condition that the treating physician attributed to a medication overdose (NEISS-CADES) or to poisoning from a nonpharmaceutical consumer product (NEISS-AIP). Medication overdoses were defined as exposure to more than the intended dose of a medication or inadvertent exposure to a medication. Cases included ingestions and dermal or ocular exposures. Emergency department visits resulting from intentional self-harm, recreational drug use, and drug addiction were excluded.

Medications included prescription and nonprescription pharmaceuticals, vitamins, herbals, and dietary supplements; they excluded illicit substances, alcohol, and tobacco. Nonpharmaceutical consumer products included potentially toxic substances such as cleaning substances, pesticides, and personal care products; they excluded illicit substances, alcohol, tobacco, botanicals, bee stings, and lead.

Measures

Patient age, gender, and race; the implicated product; clinical management; and disposition were identified by emergency department record abstraction by NEISS coders.^{8,11,12} Children were considered hospitalized if they were admitted to a hospital ward, assigned emergency department observation admission status, or transferred to another facility for medical care. The underlying causes of overdoses were identified by review of the abstracted clinical summary, chief complaint, and verbatim diagnoses; they were categorized as unsupervised ingestions, medication errors, or misuse. An unsupervised ingestion was defined as ingestion of a medication by a child aged <12 years without adult supervision. A medication error was defined as an unintended mistake in medication management, including using an incorrect dose, incorrect medication/formulation, incorrect dosing schedule, and error in prescribing or dispensing (provider/pharmacy error). Misuse was defined as intentional use of a medication in a manner inconsistent with how it should have been used, such as using a medication prescribed for another individual or using higher doses than recommended. Misuse and errors were not attributed to children aged <12 years. Overdoses not falling into any of these categories or otherwise not described were categorized as other/unspecified.

Statistical Analysis

Because NEISS is a probability sample of U.S. hospitals, an estimated total number of emergency department visits nationally (referred to as national estimates or estimated visits) may be calculated by assigning each NEISS-CADES and NEISS-AIP case a sample weight based on the inverse probability of hospital selection. These weights are adjusted annually for hospital response rates and hospital closures and mergers.⁹

During 2007 and 2008, national estimates of emergency department visits during the period from 2004 to 2005 and the corresponding 95% CIs were calculated using Surveymeans and a direct variance estimation procedure in SAS version 9.1 to account for weighting and the complex sample design. Because data were collected over the 2-year period, these estimates were summed, and the sum was divided by 2 to determine annual national estimates. Population rates were calculated using projected 2004 and 2005 population estimates from the U.S. Census Bureau.¹⁴ National estimates based on <20 cases or with a coefficient of variation >30% were considered statistically unstable and are not reported.¹³

Results

Based on 3034 sample cases, an estimated 71,224 emergency department visits were made annually by children aged ≤ 18 years for unintentional medication overdoses. Based on 1405 sample cases, an estimated 32,217 emergency department visits were made annually for unintentional poisonings from nonpharmaceutical consumer products (Table 1). Medication overdoses accounted for 68.9% of emergency department visits for unintentional poisonings in this age group. Most emergency department visits for medication overdoses (81.3%) and nonpharmaceutical consumer product poisonings (92.3%) occurred among children aged ≤ 5 years.

The population rate of emergency department visits for medication overdoses was twice that for nonpharmaceutical consumer products (9.2 visits per 10,000 individuals per year [95% CI= 7.3, 11.0] vs 4.2 per 10,000 individuals per year [95% CI=3.3, 5.0]). Population rates of emergency department visits for medication overdoses were highest among children aged 2 years (54.7 per

10,000 individuals per year); the rate declined with increasing age, reaching a nadir for children aged 12–14 years (1.8 per 10,000 individuals per year; Figure 1). Medication overdose rates increased during adolescence, with children aged 15–18 years having nearly twice the rate of children aged 12–14 years (3.3 per 10,000 individuals per year [95% CI=2.5, 4.2] vs 1.8 per 10,000 individuals per year [95% CI=1.1, 2.4]).

African-American children had similar rates of emergency department visits for medication overdoses and nonpharmaceutical consumer product poisonings (6.8 per 10,000 individuals per year [95% CI=4.1, 9.6] vs 5.6 per 10,000 individuals per year [95% CI=2.9, 8.4]). For Caucasian children, the rate of emergency department visits for medication overdoses was three times higher than that for nonpharmaceutical consumer product poisonings (6.1 per 10,000 individuals per year [95% CI=4.2, 8.0] vs 2.1 per 10,000 individuals per year [95% CI=1.3, 2.8]).

The rate of hospitalizations for medication overdoses was four times higher than that for poisonings from nonpharmaceutical consumer products (1.4 per 10,000 individuals per year [95% CI=1.0, 1.9] vs 0.3 per 10,000 individuals per year [95% CI=0.2, 0.4]). Most hospitalizations (9249 estimated visits annually; 83.5% [95% CI=79.4%, 87.5%]) were among children aged ≤ 5 years. Nearly one third (29.2%) of children treated for unintentional medication overdoses received gastrointestinal decontamination, almost exclusively with activated charcoal.

Unsupervised medication ingestions caused 82.2% (95% CI=80.1%, 84.3%) of emergency department visits from medication overdoses (58,550 estimated visits annually, 7.6 visits per

10,000 individuals per year [95% CI=6.0, 9.1]; Table 2). Medication errors caused 8.0% (95% CI=6.8%, 9.2%) of emergency department visits (5691 estimated visits annually, 0.7 visits per 10,000 individuals per year [95% CI=0.6, 0.9]); medication misuse caused 6.3% (95% CI=5.0%, 7.6%) of emergency department visits (4469 estimated visits annually, 0.6 visits per 10,000 individuals per year [95% CI=0.4, 0.7]). The causes of the remaining medication overdoses were unspecified (3.5% [95% CI=1.9%, 5.1%], 2515 estimated visits annually). Hospitalization rates for unsupervised ingestions, misuse, and medication errors were similar (15.8%, 14.9%, and 10.0%, respectively [95% CI=11.4, 20.2; 4.0, 25.9; and 5.4, 14.6, respectively]).

Unsupervised ingestions caused nearly all (97%) of the emergency department visits among children aged 1–5 years (Table 2). Although unsupervised ingestions accounted for a smaller proportion of overdoses among children aged <1 year or 6–11 years, they remained the most common cause of overdose, causing 69.7% and 65.2% of overdoses, respectively, in these groups. Medication errors caused approximately one fourth of medication overdoses among infants aged <1 year, but only 2.2% of overdoses among children aged 1–5 years (Table 2). Errors accounted for 28.4% of overdoses among children aged 12–18 years. Misuse caused 56.6% of medication overdoses among children aged 12–18 years.

The most common type of medication error was administration of the incorrect dose (113 cases, 43.7% of visits from errors). Of the cases involving dosing errors, 14 cases (12.4%) resulted from misplacing decimal points, as in administration of 5 mL instead of 0.5 mL; and 7 cases (6.2%) resulted from using incorrect units of volume, as in using a tablespoon rather than a

teaspoon. The second most common type of error was administration of the incorrect medication or formulation (79 cases, 33.2% of visits from errors), followed by use of an incorrect schedule of administration (32 cases, 11.4% of visits from errors).

The four medications most frequently implicated in overdoses were acetaminophen (7226 estimated visits annually, 9.3% [95% CI=7.9%, 10.8%]); cough and cold medications (5650 estimated visits annually; 7.3% [95% CI=5.7%, 8.9%]); antidepressants (4737 estimated visits annually, 6.1% [95% CI=4.8%, 7.5%]); and nonsteroidal anti-inflammatory drugs (NSAIDs) (4083 estimated visits annually, 5.3% [95% CI=4.1%, 6.4%]). Unsupervised ingestions were the underlying cause of the overdose in over 80% of these emergency department visits (Figure 2). Oral medications commonly available over-the-counter (which included acetaminophen, non-opioid and noncarbinoxamine cough and cold medications, NSAIDs, antihistamines, vitamins/minerals, aspirin, and other non-opioid analgesics) were implicated in an estimated 26,162 visits annually, accounting for 33.9% of all visits (95% CI=31.1%, 36.6%); and in 35.9% of visits for unsupervised ingestions (95% CI=32.8%, 39.0%; Table 3). Nearly half (2606 estimated visits annually, 42.2% [95% CI=32.0%, 52.3%]) of visits for medication errors involved central nervous system agents (which included anticonvulsants, antidepressants, antipsychotics, stimulants, opioids/benzodiazepines, alpha adrenergic agents, and miscellaneous central nervous system agents), whereas analgesics (acetaminophen, NSAIDs, opioids, aspirin, and non-opioid analgesics) were the most commonly implicated type of medication among misuse cases (2138 estimated visits annually, 43.0% [95% CI=33.3%, 52.6%]).

Discussion

Between 2004 and 2005, medications caused an estimated 68.9% of all emergency department visits for unintentional poisonings (9.2 visits per 10,000 individuals per year). Most emergency department visits for medication overdoses occurred among children aged ≤ 5 years (estimated 57,928 emergency department visits annually, 81.3%). Four fifths (82.2%) of emergency department visits for medication overdoses were from unsupervised ingestions, and nonprescription medications were implicated in 35.9%. The fact that, annually, one of every 180 children aged 2 years (54.7/10,000 individuals) is treated in an emergency department for a medication overdose, despite current prevention efforts, underscores the size of this public health issue. Further, these data reflect visits to only emergency departments. Poison control centers receive 1.5 million calls for pediatric overexposures of all types annually, and approximately three fourths of calls are managed over the telephone and do not result in direct treatment by a healthcare professional.³

Because unsupervised ingestions by children aged ≤ 5 years account for over three fourths of pediatric outpatient medication overdoses, efforts should focus on preventing unsupervised ingestions in this age group. Strategies to prevent injuries such as pediatric medication overdoses may be categorized as engineering (modifying the product or how it is stored or accessed); education (convincing individuals to change their behavior); or enforcement (enacting regulations that modify individual behavior). Because young children's curiosity and hand-to-mouth behavior place them at increased risk for unsupervised ingestions,¹⁵⁻¹⁷ engineering strategies to prevent children's access to medications can be particularly attractive as these are commonly passive approaches that do not require human behavior change.¹⁸⁻²¹ Child-resistant

packaging is an engineering strategy that has been made a regulatory requirement for many medications and other products implicated in children's poisonings²²⁻²⁴; it is estimated to have reduced the child mortality rate from accidental overdose of prescription drugs by 45% between 1974 and 1992.²⁵ However, limitations of current child-resistant packaging have been described, and they include children's ability to gain access to items stored in such packaging even when it is properly closed.^{5,26} Educational efforts have tried to address limitations of current child-resistant packaging by reminding parents and caregivers to keep medications in their original containers and to always securely replace child-resistant caps.²⁷ These data demonstrate that despite current child-resistant packaging technology and parental education, unsupervised ingestions of products remain a public health problem.

Passive engineering innovations that could be evaluated to determine their effectiveness in preventing pediatric medication overdoses have been described previously.²⁸ One innovation is the use of adaptors on bottles of liquid medication so that the medication can be accessed only with a needleless syringe, thereby discouraging unsupervised young children from drinking directly from the bottle and reducing the amount they ingest if they do drink from the bottle. Use of unit-dose packaging may also reduce the amount an unsupervised child could ingest. The national data presented here suggest that the testing of these packaging innovations should initially focus on the medications most commonly implicated in pediatric overdoses, such as over-the-counter products.

Although medication errors caused far fewer emergency department visits than unsupervised ingestions, these data point to error-reduction interventions that could be evaluated. Most

medication errors were caused by incorrect dosing (43.7%) or inadvertent administration of an incorrect product (33.2%). Both types of errors are potentially preventable with engineering strategies. Unit-dose packaging could reduce dosing errors but may be impractical for products with wide dosing ranges.^{29,30} Dispensing a dosing device that shows only units that correspond to those used in the accompanying prescription³¹ and that accommodates a volume nearly equivalent to a dose is another potential intervention that could be evaluated. Potential prevention strategies to address administration of an incorrect product include unambiguous product labeling and clearly differentiating product packaging for different members of a household.³²

Although rates of outpatient medication overdoses are highest among children aged ≤ 5 years, rates rise again as children proceed through adolescence. Parents and caregivers may perceive adolescents to have the maturity necessary for medication administration; however, these data suggest that at least some adolescents may lack the judgment to take medication without adult supervision. Because misuse caused most medication overdoses among children aged 12–18 years (56.6%), counseling on proper medication administration, incorporated into routine anticipatory guidance during health supervision visits, might help prevent medication overdoses among adolescents. Educational approaches to address medication misuse in adolescents could be provided through school health curricula, public service announcements, or current poison control center outreach activities.³³

Medication overdose surveillance with NEISS-CADES has several limitations that likely underestimate the burden of outpatient pediatric medication overdoses. NEISS-CADES captures

medication overdoses resulting in emergency department visits but misses cases in which the patient does not receive medical attention (including those who die before receiving medical attention) or is evaluated only in an outpatient setting. However, the emergency department is likely the most appropriate single setting to ascertain severe, acute outpatient medication overdoses. Although NEISS-CADES has relatively low sensitivity for identifying certain ADEs (e.g., attributing gastrointestinal bleeding to warfarin or NSAIDs),¹¹ cases of medication overdoses among children are probably more easily identified in the emergency department. Nonetheless, correctly identifying overdoses requires parents, children, and adolescents to be forthcoming about their exposure to medication; emergency department clinicians to correctly diagnose and document medication overdoses; and NEISS-CADES coders to correctly interpret and report the diagnoses and supporting clinical information. A final limitation is the potential for misclassification. It is possible that some cases of misuse among adolescents actually represent intentional overdoses but because the adolescent was not forthcoming about their intentions, these cases were inappropriately coded as unintentional.

Medication overdoses among children, notably unsupervised ingestions, represent a substantial public health burden in terms of emergency department visits and hospitalizations. However, much of the morbidity from medication overdoses is potentially preventable through renewed injury-prevention efforts. New engineering approaches targeting unsupervised ingestions by children aged ≤ 5 years and the medications most commonly implicated may have the greatest impact in reducing the burden of outpatient pediatric medication overdoses.

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Sarah Schillie discloses that she owns stock in Pfizer, Eli Lilly, Monsanto, General Electric, and Walgreen's, and that she previously owned stock in Abbott. Karen Thomas reports she owns stock in Baxter. The other authors report no financial disclosures.

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Figure Titles

Figure 1. Differences in rates of emergency department visits for medication overdoses and nonpharmaceutical product overexposures in children, by age category; population rate estimates based on the average of 2004 and 2005 mid-year U.S. Census estimates from the National Center for Health Statistics, CDC; bars represent 95% CIs

Figure 2. Overdose cause for the four medication classes most commonly implicated in pediatric medication overdoses; cough and cold agents include over-the-counter and prescription combination drugs; NSAIDs, nonsteroidal anti-inflammatory drugs

Table 1. Emergency department visits by children for medication overdoses and nonpharmaceutical product overexposures, U.S., 2004–2005

Patient characteristics	Emergency department visits for medication overdoses ^a			Emergency department visits for unintentional nonpharmaceutical product overexposures ^b		
	Cases	Annual national	Population rate per 10,000	Cases	Annual national	Population rate per 10,000 individuals ^c
	<i>n</i>	<i>n</i> (%)	<i>n</i> (95% CI)	<i>n</i>	<i>n</i> (%)	<i>n</i> (95% CI)
Age (years)						
<1	177	4,313 (6.1)	10.5 (7.9, 13.1)	109	2,779 (8.6)	6.8 (4.0, 9.5)
1	743	17,557 (24.7)	43.2 (32.9, 53.5)	638	14,733 (45.7)	36.2 (27.5, 44.9)
2	924	21,980 (30.9)	54.7 (42.7, 66.6)	329	7,571 (23.5)	18.8 (13.9, 23.8)
3	408	9,721 (13.6)	24.1 (18.9, 29.4)	119	2,786 (8.6)	6.9 (4.9, 8.9)
4	152	2,845 (4.0)	7.1 (5.1, 9.2)	63	920 (2.9)	2.3 (1.2, 3.4)
5	79	1,512 (2.1)	3.9 (2.7, 5.1)	37	939 (2.9)	2.4 (1.4, 3.4)
6–11	237	5,418 (7.6)	2.3 (1.6, 2.9)	43	699 (2.2)	0.3 (0.2, 0.4)
12–14	106	2,282 (3.2)	1.8 (1.1, 2.4)	23	606 (1.9)	0.5 (0.2, 0.7)
15–18	208	5,596 (7.9)	3.3 (2.5, 4.2)	44	1,183 (3.7)	0.7 (0.5, 0.9)
Gender^d						
Female	1,430	32,978 (46.3)	8.7 (7.0, 10.4)	561	13,202 (41.0)	3.5 (2.7, 4.3)
Male	1,603	38,206 (53.6)	9.6 (7.5, 11.8)	844	19,015 (59.0)	4.8 (3.9, 5.7)
Race						
White	1,377	36,718 (51.5)	6.1 (4.2, 8.0)	436	12,434 (38.6)	2.1 (1.3, 2.8)
Black/African-American	626	8,653 (12.1)	6.8 (4.1, 9.6)	481	7,122 (22.1)	5.6 (2.9, 8.4)
Unspecified	966	23,694 (33.3)	—	275	8,844 (27.5)	—
Other	65	2,159 ^e (3.0) ^e	—	213	3,817 ^e (11.8) ^e	—
Disposition^d						
Admitted, observed, or transferred	545	11,081 (15.6)	1.4 (1.0, 1.9)	119	2,514 (7.8)	0.3 (0.2, 0.4)
Treated and released, or left against medical advice	2,489	60,144 (84.4)	7.8 (6.1, 9.4)	1,285	29,697 (92.2)	3.8 (3.1, 4.6)
Total	3,034	71,224 (100)	9.2 (7.3, 11.0)	1,405	32,217 (100.0)	4.2 (3.3, 5.0)

^aCase counts and estimates for medications from the 2004–2005 National Electronic Injury Surveillance System–Cooperative Adverse Drug Event Surveillance project, CDC. Medications refer to prescription or nonprescription pharmaceuticals, vitamins, herbals, and dietary supplements.

^bCase counts and estimates from the 2004–2005 National Electronic Injury Surveillance System–All Injury Program, CDC. Nonpharmaceutical products refer to cleaning substances, pesticides, personal care products, and other potentially toxic substances, excluding illicit substances, alcohol, tobacco, botanicals, bee stings, and lead.

^cPopulation estimates based on the average of 2004 and 2005 mid-year U.S. Census estimates from the National Center for Health Statistics, CDC.

^dUnknown for one case.

^eRates are not calculated for estimates with coefficient of variation > 30% or based on <20 cases (—), and estimates for which a denominator was not available.

Table 2. Emergency department visits by children for medication overdoses, U.S., 2004–2005^a

Patient age (years)	Unsupervised ingestion		Medication errors		Misuse		Unspecified		
	Cases	Annual national estimate (58,550 visits)	Cases	Annual national estimate (5691 visits)	Cases	Annual national estimate (4469 visits)	Cases	Annual national estimate (2515 visits)	
		<i>n</i> (%)		95% CI		<i>n</i> (%)		95% CI	<i>n</i> (%)
<1	119 (69.7)	(60.9, 78.4)	54 (26.4)	(18.1, 34.7)	0	—	—	4 (—)	—
1–5	2225 (97.0)	(96.1, 97.9)	60 (2.2)	(1.5, 3.0)	1 ^b	—	—	20 (0.8)	(0.3, 1.2)
6–11	139 (65.2)	(52.7, 77.7)	64 (20.7)	(13.2, 28.2)	1 ^b	—	—	33 (14.0)	—
12–18	0 (—)	—	82 (28.4)	(21.0, 35.8)	178	56.6	(47.6, 65.6)	54 (15.0)	(7.0, 23.0)

^aCase counts and estimates for medications from the 2004–2005 National Electronic Injury Surveillance System–Cooperative Adverse Drug Event Surveillance project, CDC. Estimates with coefficient of variation >30% or based on <20 cases are not calculated (—).

^bCaregiver responsible for misuse.

Table 3. Medications most commonly implicated in emergency department visits for overdoses in children, U.S., 2004–2005^a

Unsupervised ingestion		Medication error		Misuse	
Drug class	Cases <i>n</i> (%)	Drug class	Cases <i>n</i> (%)	Drug class	Cases <i>n</i> (%)
Acetaminophen	289 (10.5)	Anticonvulsants	29 (10.0)	NSAIDs	33 (15.8)
Opioids/benzodiazepines	211 (7.7)	Cough and cold agents ^b	29 (10.0)	Acetaminophen	28 (13.5)
Cough and cold agents ^b	202 (7.4)	Antipsychotics	19 (6.6)	Opioids/benzodiazepines	18 (8.7)
NSAIDs	167 (6.1)	Opioids/benzodiazepines	18 (6.2)	Cough and cold agents ^b	13 (6.3)
Antidepressants	161 (5.9)	Antidepressants	16 (5.6)	Miscellaneous central nervous system agents	11 (5.3)
Antihistamines	160 (5.8)	Stimulants	16 (5.6)	Antidepressants	10 (4.8)
Antihypertensives ^c	149 (5.4)	Insulin	14 (4.8)	Antihistamines	10 (4.8)
Unknown agents	133 (4.8)	Alpha-2 adrenergic agonists ^d	14 (4.8)	Aspirin	10 (4.8)
Vitamins/nutrients	125 (4.6)	Antihypertensives ^c	13 (4.5)	Miscellaneous non-opioid or unnamed analgesics	10 (4.8)
Topical agents	98 (3.6)	Metoclopramide	12 (4.2)	Anticonvulsants	9 (4.3)

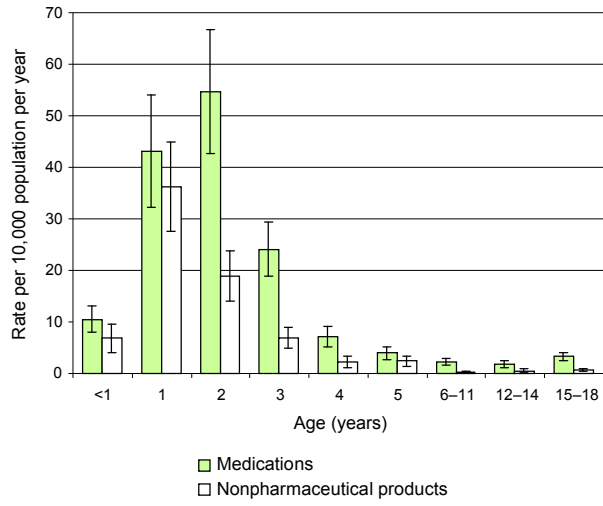
^aCase counts from the 2004–2005 National Electronic Injury Surveillance System–Cooperative Adverse Drug Event Surveillance project, CDC. For 336 cases (annual estimate, 6028 visits), two drugs were implicated in the adverse event. Percentages calculated with a denominator of all implicated drugs (3370 drugs).

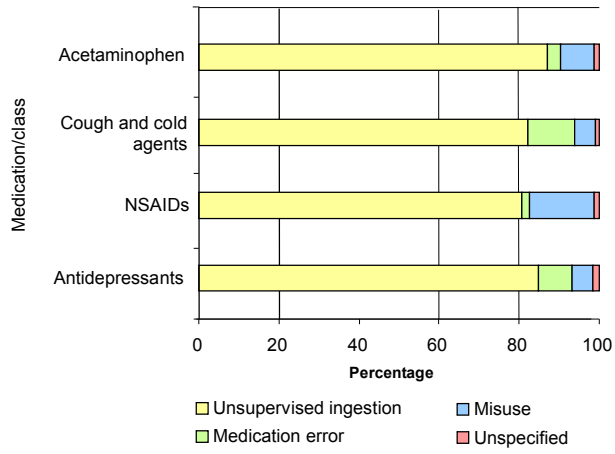
^bIncludes over-the-counter and prescription combination drugs.

^cIncludes beta-blockers, calcium channel blockers, hydralazine, and unnamed antihypertensives.

^dIncludes clonidine and guanfacine.

NSAIDs=nonsteroidal anti-inflammatory drugs





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