Characteristics of Fatal Poisonings Among Infants and Young Children in the United States

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abstract

BACKGROUND AND OBJECTIVES: Fatal poisoning is a preventable cause of death among young children. Understanding factors surrounding these deaths will inform future prevention efforts. Our objective was to describe the characteristics of fatal pediatric poisonings using child death review data.

METHODS: We acquired data from 40 states participating in the National Fatality Review-Case Reporting System on deaths attributed to poisonings among children aged ≤5 years from 2005 to 2018. We analyzed select demographic, supervisor, death investigation, and substance-related variables using descriptive statistics.

RESULTS: During the study period, 731 poisoning-related fatalities were reported by child death reviews to the National Fatality Review-Case Reporting System. Over two-fifths (42.1%, 308 of 731) occurred among infants aged <1 year, and most fatalities (65.1%, 444 of 682) occurred in the child's home. One-sixth of children (97 of 581) had an open child protective services case at time of death. Nearly one-third (32.2%, 203 of 631) of children were supervised by an individual other than the biological parent. Opioids (47.3%, 346 of 731) were the most common substance contributing to death, followed by over-the-counter pain, cold, and allergy medications (14.8%, 108 of 731). Opioids accounted for 24.1% (7 of 29) of the substances contributing to deaths in 2005 compared with 52.2% (24 of 46) in 2018.

CONCLUSIONS: Opioids were the most common substances contributing to fatal poisonings among young children. Over-the-counter medications continue to account for pediatric fatalities even after regulatory changes. These data highlight the importance of tailored prevention measures to further reduce fatal child poisonings.

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WHAT'S KNOWN ON THIS SUBJECT: Fatal poisonings among young children have been associated with multiple substances and socioenvironmental factors. Traditional poisoning prevention efforts have reduced fatalities but may be less effective with respect to illicit substances or in cases of malicious intent.

WHAT THIS STUDY ADDS: Opioids and over-the-counter pain, cold, and allergy medications, were identified by death reviews as the most common contributors to death among children ≤5 years. Opioids accounted for a progressively greater proportion of substances contributing to death from 2005 to 2018.

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Pediatric poisoning fatalities are a tragic and preventable form of child mortality. Deaths in young children have been associated with many substances, including prescription and over-the-counter (OTC) medications, psychoactive substances, and environmental chemicals.[1–7] Children aged ≤5 years account for over half of all reported poisonings and have the highest rate of emergency department visits for unintentional drug-related poisonings.[5,8] Poisoning prevention is a critical yet challenging issue in this age group; exposure mechanisms vary and are related to the changing cognitive and motor development in early childhood, as well as the characteristics of care provided by a guardian.[9,10]

Since the passage of the Poison Prevention Packaging Act in 1970, which required child-resistant packaging for many medicines and hazardous products,[11] fatal unintentional poisonings among children aged ≤5 years have decreased substantially.[12] Despite these initial successes, mortality reduction has plateaued over the past decade.[12,13] Although child-resistant packaging has reduced poisonings because of medications, it is unlikely to prevent poisonings from recreational substances. More recently, the opioid epidemic in the United States has had increasing repercussions on children.[14–17] Fatalities because of malicious intent or neglect remain a difficult-to-characterize contributor to child poisoning deaths.[2,18,19] Improving our knowledge of the substance types and specific factors that contribute to fatal pediatric poisonings is crucial in developing targeted harm reduction interventions.[20]

Surveillance systems commonly used for toxicology research include the National Poison Data System (NPDS), which provides data on poisonings voluntarily reported to poison control centers (PCCs) and the Toxicology Investigators Consortium Registry, which collects data on poisonings reviewed by medical toxicologists at >50 participating sites. Although the NPDS and Toxicology Investigators Consortium Registry are rich data resources that provide important information on poisonings in the United States, they are not optimized to capture pediatric fatalities and often do not collect comprehensive data surrounding the circumstances of an exposure.[21,22] Descriptions surrounding fatal poisonings in the literature are generally confined to case reports or series or are limited to descriptions of a single substance type.[17,23–26]

Child death reviews (CDRs) present an opportunity to improve our understanding of fatal poisonings. Over 1300 state and local CDR committees operate in all 50 states and the District of Columbia.[27,28] Committees may vary in composition by jurisdiction but typically are composed of multidisciplinary team members, including, but not limited to, medical examiners, law enforcement, child protective services (CPS), clinicians, and social workers. CDR committees review pediatric fatalities within their jurisdiction to better understand the factors leading to a child's death, as well as to inform future fatality prevention efforts. The US National Center for Fatality Review and Prevention (NCFRP) provides resources and assistance to CDRs across the United States.[29] In addition, it maintains the National Fatality Review-Case Reporting System (NFR-CRS), a passive epidemiologic surveillance system that collects data from CDRs.[30]

The NFR-CRS provides a unique opportunity to comprehensively assess fatal poisonings in children on a national level. Our study objective was to use the NFR-CRS to:

1. describe the demographic characteristics of infants and young children who died of poisonings, as well as to identify the supervisor- and substance-related factors associated with these fatalities; and
2. characterize the proportion of poisoning deaths reviewed by CDRs that were attributed to opioids by year.

METHODS

Data Source and Study Population

We obtained data from the NCFRP's NFR-CRS system. Since 2005, the NFR-CRS has served as a national, standardized case reporting tool for CDRs. The system collects information on >2600 variables related to demographics, circumstances of death, and death investigation outcomes and actions.[31,32] CDRs report to the NFR-CRS on a voluntary basis and on the basis of local protocols and resources. The technical aspects of this database, along with its strengths, limitations, and recent data quality initiatives, are described elsewhere.[33] We requested fatalities among children aged ≤5 years that occurred between January 1, 2005, and December 31, 2018, where cause of death was attributed to a "poisoning, overdose, or acute intoxication" from the NCFRP. Fatalities reported to the NFR-CRS included both single and polysubstance exposures. Age was limited to ≤5 years to focus on young children, who often account for a high proportion of reported poisoning exposures and present with epidemiologically distinct injury mechanisms compared with older individuals.[5,8] In total, 731 fatalities from 40 states met this inclusion criteria and comprised our study population.

Study Variables

We requested a subset of NFR-CRS variables for our study on the basis of their relevance to poisonings. Categories of variables selected for further examination included child and supervisor demographics, incident and death investigation information, and poisoning-related variables. Per the NFR-CRS, supervision is defined as "the action or process of watching and directing what someone does" and is influenced by factors including proximity and attention to the child.[32] Maltreatment history was defined in the NFR-CRS as:

1. a referral or substantiation from CPS; or
2. history of maltreatment documented in a law enforcement report, medical records, or autopsy.

Referrals to CPS that were made by an individual or institution but not substantiated are considered by the NFR-CRS as a history of maltreatment, unless completely falsified. A deliberate poisoning is defined by the NFR-CRS as "intentionally administering medication with the intent to harm the child." Race and ethnicity in the NFR-CRS are included as 2 distinct variables, which were provided by the NCFRP as a single, combined variable. These variables, which represent social constructs, are reported in this study because they are related to historic health inequities which have influenced child mortality.[34] Several NFR-CRS variables were recategorized for analysis (Supplemental Information 1).

Some NFR-CRS variables allow CDRs to provide free-text responses for a response of "other" or "specify." These free-text responses were reviewed by our study team and recoded into existing and new variables described in Supplemental Information 1. We provided the number of "unknown" or "unspecified" for the major variables presented in this study, because there are varying levels of information available to CDR teams for each case. In this study, OTC pain, cold, and allergy medications refer to single and combination drug products sold directly to consumers without a prescription from a health care provider; exemplar substances in this category include acetaminophen, ibuprofen, diphenhydramine, and dextromethorphan.

Statistical Analysis

Data from the NFR-CRS were analyzed using SPSS 28.0 for Windows (IBM Corporation, Armonk, NY). Basic descriptive statistics are reported. Unknown values were excluded from variable percentage calculations. Because the denominators used for calculating percentages differ on the basis of the variable, both the percentage and its fractional representation are reported throughout our analysis. Cell counts of ≤ 5 were suppressed per the NCFRP data use agreement to prevent inadvertent identification of individuals. This study was exempt from review by the authors' institutional review board. Though this study was approved by the NCFRP, the contents of this article do not necessarily represent the official views of the NCFRP, its funders (see Acknowledgments), or participating states.

RESULTS

General Characteristics

There were 731 cases of poisoning-related fatalities among children aged ≤ 5 years reported to the NFR-CRS during the study period (Table 1). The mean age of cases was 1.3 years old (median, 1.0; interquartile range, 0.0–2.0). Infants aged <1 year were the most common age group reported (42.1%, 308 of 731), followed by children aged 1 year (23.4%, 171 of 731). Among the 661 cases with documented race and ethnicity, non-Hispanic white was most common (43.7%, 289 of 661), followed by non-Hispanic Black (32.8%, 217 of 661).

The circumstances of poisoning were documented by CDRs in 72.6% of fatalities (531 of 731). Among these, 40.7% were determined to be accidental overdoses (216 of 531), 17.9% (95 of 531) were deliberate poisonings, and 41.4% (220 of 531) were because of other causes (eg, adverse effect, medical treatment mishap). Among deliberate poisonings, 36.8% (35 of 95) and 26.3% (25 of 95) involved infants aged <1 year and children aged 1 year, respectively.

Location of incident was available for 93.3% of cases (682 of 731), and among these, 65.1% (444 of 682) occurred within children's homes. Among cases where data on maltreatment history were available (65.8%, 481 of 731), 153 (31.8%, 153 of 481) had a previous history of child maltreatment. Nearly one-third (31.4%, 48 of 153) of fatalities with a history of maltreatment documented were in infants aged <1 year. Information on CPS involvement was available for 79.5% (581 of 731) of fatalities, and of these, one-sixth (16.7%, 97 of 581) had a documented open case at time of death. Among cases where data on both maltreatment history and open CPS case status were available, 37.6% (53 of 141) of fatalities with maltreatment history also had an open CPS case at time of death. Among fatalities with documentation on sibling placement status (65.7%, 480 of 731), over one-fifth (22.7%, 109 of 480) had a sibling placed outside of the home before death.

Child Supervision

Supervision status at time of incident was documented in 87.3% of cases (638 of 731); over one-tenth of children (11.9%, 76 of 638) were identified by CDRs as not being supervised but needing supervision (Table 2). The primary

TABLE 1 Selected Demographic Characteristics of Fatal Pediatric Poisonings by Age, NFR-CRS, 2005–2018

Characteristic	Age, Years					Study Total
	<1	1	2	3	4–5	
	n (%)[a]	*n* (%)[a]	*n* (%)[a]	*n* (%)[a]	*n* (%)[a]	*n* (%)[a]
Sex						
Male	166 (54.8)	93 (55.0)	50 (48.5)	38 (62.3)	43 (50.0)	390 (54.0)
Female	137 (45.2)	76 (45.0)	53 (51.5)	23 (37.7)	43 (50.0)	332 (46.0)
Unknown (n = 9)[b]	[b]	[b]	[b]	[b]	[b]	[b]
Race and/or ethnicity						
Non-Hispanic white	127 (46.0)	68 (42.8)	38 (40.9)	24 (44.4)	32 (40.5)	289 (43.7)
Non-Hispanic Black	83 (30.1)	51 (32.1)	37 (39.8)	18 (33.3)	28 (35.4)	217 (32.8)
Hispanic	48 (17.4)	27 (17.0)	13 (14.0)	8 (14.8)	17 (21.5)	113 (17.1)
Other race, multiracial	18 (6.5)	13 (8.2)	—	—	—	42 (6.4)
Unknown (n = 70)[b]	[b]	[b]	[b]	[b]	[b]	[b]
Previous illness or disability						
Yes	28 (11.9)	14 (10.1)	8 (9.8)	6 (14.3)	20 (30.3)	76 (13.5)
No	207 (88.1)	125 (89.9)	74 (90.2)	36 (85.7)	46 (69.7)	488 (86.5)
Unknown (n = 167)[b]	[b]	[b]	[b]	[b]	[b]	[b]
Location of incident						
Child's home	171 (61.5)	121 (73.3)	64 (64.0)	41 (69.5)	47 (58.8)	444 (65.1)
Friend or relative's home	28 (10.1)	25 (15.2)	24 (24.0)	7 (11.9)	13 (16.3)	97 (14.2)
Other	79 (28.4)	19 (11.5)	12 (12.0)	11 (18.6)	20 (25.0)	141 (20.7)
Unknown (n = 49)[b]	[b]	[b]	[b]	[b]	[b]	[b]
Sibling placed outside of home before child's death						
Yes	59 (29.8)	19 (17.0)	12 (16.0)	10 (23.8)	9 (17.0)	109 (22.7)
No	139 (70.2)	93 (83.0)	63 (84.0)	32 (76.2)	44 (83.0)	371 (77.3)
Unknown (n = 251)[b]	[b]	[b]	[b]	[b]	[b]	[b]
History of maltreatment						
Yes[c]	48 (24.6)	38 (32.2)	28 (38.4)	14 (37.8)	25 (43.1)	153 (31.8)
Physical	17 (8.7)	12 (10.2)	13 (17.8)	6 (16.2)	—	53 (11.0)
Neglect	34 (17.4)	26 (22.0)	21 (28.8)	9 (24.3)	16 (27.6)	106 (22.0)
Other or unspecified	7 (3.6)	—	—	—	6 (10.3)	21 (4.4)
No	147 (75.4)	80 (67.8)	45 (61.6)	23 (62.2)	33 (56.9)	328 (68.2)
Unknown (n = 250)[b]	[b]	[b]	[b]	[b]	[b]	[b]
Open CPS case at time of death						
Yes	42 (16.9)	16 (11.9)	15 (17.4)	7 (15.2)	17 (25.4)	97 (16.7)
No	206 (83.1)	118 (88.1)	71 (82.6)	39 (84.8)	50 (74.6)	484 (83.3)
Unknown (n = 150)[b]	[b]	[b]	[b]	[b]	[b]	[b]

—, per-state data-use agreements, counts of $n \leq 5$ were suppressed.

[a] Column percentages may not sum to 100.0% because of rounding error.

[b] Per-state data-use agreements, age breakdown of unknowns were withheld to prevent calculation of suppressed cells.

[c] An individual case may have >1 type of maltreatment reported. Thus, the sum of *n* and percentage of individual types of maltreatment may exceed the corresponding maltreatment total.

supervisor was identified in 86.3% (631 of 731) of fatalities. Of these, the most common documented supervisor was a biological parent (67.8%, 428 of 631). Nearly one-third (32.2%, 203 of 631) of children were supervised by an individual other than the biological parent. Biological parents were documented as the primary supervisor among 73.4% (185 of 252) infants aged <1 year. Overall, in cases where the time since a child was seen by a supervisor was documented (55.7%, 407 of 731), approximately half (51.1%, 208 of 407) occurred with the child in sight of the supervisor at the time of incident.

Death Investigation, Incident, and Substance Storage

Substance storage location was documented in 31.9% of fatalities (233 of 731). Among these, 142 poisoning-related fatalities (60.9%, 142 of 233) were determined by CDRs to have substances stored in an open area (Table 3). In cases where container type was known (50.1%, 366 of 731), 28.4% (104 of 366) involved a substance not stored in its original container. Most fatalities had toxicology testing documentation (90.7%, 663 of 731), and of these, 97.9% (649 of 663) had toxicology testing performed.

Among cases with PCC correspondence information (69.8%, 510 of 731), 95.5% (487 of 510) of cases did not have explicitly documented communication with a PCC. Among cases where 911 or local emergency services communication was available (86.7%, 634 of 731), a call was made in 81.5% (517 of 634) of cases at the time of incident.

Substances Contributing to Death

The substances identified by CDR committees as contributing to death are summarized in Fig 1. Infants aged <1 year accounted for most

TABLE 2 Child Supervision Characteristics of Fatal Pediatric Poisonings by Age, NFR-CRS, 2005–2018

Characteristic	Age, Years					Study Total
	<1	1	2	3	4–5	
	n (%)[a]	*n* (%)[a]	*n* (%)[a]	*n* (%)[a]	*n* (%)[a]	*n* (%)[a]
Primary supervisor at time of incident						
Biological parent	185 (73.4)	106 (67.5)	61 (62.9)	31 (60.8)	45 (60.8)	428 (67.8)
Grandparent	16 (6.3)	25 (15.9)	19 (19.6)	10 (10.3)	10 (13.5)	80 (12.7)
Other relative	9 (3.6)	10 (6.4)	10 (10.3)	—	6 (8.1)	40 (6.3)
Babysitter or licensed child care worker	13 (5.2)	—	—	—	—	21 (3.3)
Nonbiological parent: foster, step, adoptive	—	6 (3.8)	—	—	—	15 (2.4)
Other	29 (11.5)	7 (4.5)	—	—	8 (10.8)	47 (7.4)
Unknown ($n = 100$)[b]	[b]	[b]	[b]	[b]	[b]	[b]
Supervision at time of incident						
Yes	222 (80.7)	120 (83.9)	74 (80.4)	41 (73.2)	60 (82.2)	516 (80.9)
No, but needed	22 (8.0)	18 (12.6)	16 (17.4)	11 (19.6)	9 (12.3)	76 (11.9)
No, not needed because of circumstance or age	31 (11.3)	—	—	—	—	46 (7.2)
Unknown ($n = 93$)[b]	[b]	[b]	[b]	[b]	[b]	[b]
Time since supervisor last saw child						
In sight of supervisor	106 (58.6)	40 (41.7)	19 (35.8)	20 (62.5)	23 (51.1)	208 (51.1)
Min	16 (8.8)	15 (15.6)	12 (22.6)	—	—	51 (12.5)
H	59 (32.6)	41 (42.7)	22 (41.5)	8 (25.0)	18 (40.0)	148 (36.4)
Unknown ($n = 324$)[b]	[b]	[b]	[b]	[b]	[b]	[b]

—, per-state data-use agreements, counts of $n \leq 5$ were suppressed.

[a] Column percentages may not sum to 100.0% because of rounding error.

[b] Per-state data-use agreements, age breakdown of unknowns were withheld to prevent calculation of suppressed cells.

cases where amphetamines (81.3%, 26 of 32), cocaine (84.0%, 21 of 25), and beverage alcohol (61.5%, 8 of 13) were documented as contributing to death (Supplemental Figure 3). The proportion of contributing substances to death by year is presented in Fig 2. Opioids accounted for 24.1% (7 of 29) of the proportion of substances contributing to death in 2005, compared with 52.2% (24 of 46) in 2018.

DISCUSSION

In this study, we report on fatal poisonings in young children using comprehensive, national-level data from the NFR-CRS. Opioids were the most common contributor to fatal poisonings in young children, accounting for over half of all poisoning fatalities in 2018. Among cases with available data, over three-fifths of poisoning fatalities occurred in a child's home, and approximately one-third were supervised by an individual other than the biological parent at the time of incident. Deliberate poisonings were commonly described among children aged <2 years.

Strikingly, opioids accounted for a progressively greater proportion of the substances contributing to poisoning-related deaths over the study period, from 24% in 2005 to 52% in 2018. These data highlight the increasing impact of the opioid epidemic on children and is in line with previous studies, which have described increasing rates of pediatric opioid exposures[16] and death.[2,35] Initiatives focused on reducing opioid prescribing and diversion were likely associated with a transient reduction in pediatric mortality in the early 2010s.[35,36] In the past decade, children have been exposed to new opioid sources, such as heroin, fentanyl, and opioids used in medication-assisted treatment (eg, methadone, buprenorphine), which have reversed previous public health gains.[35] Medication safety initiatives, such as the adoption of unit dose packaging, have shown promise in reducing exposures[37]; yet, this approach does not address illicit opioids or all prescription opioids. Further study is needed to improve our understanding of how infants and young children can be harmed by specific types of opioids and routes of opioid exposure. First responders and clinicians should maintain a high level of suspicion for opioid intoxication among children with altered mental status or respiratory depression; opportunities exist to improve both provider and community familiarity with the indications for and use of naloxone. As the landscape of the opioid crisis evolves, the development of pediatric-specific opioid response initiatives should be prioritized.

OTC pain, cold, and allergy medications were the second most common substance contributing to death in our study, and 74% of poisoning-related fatalities where this medication class contributed to death involved children aged <2 years. In 2008, the US Food and Drug Administration responded to safety concerns related to cough and cold medications, recommending changes to medication labels to include age restrictions and language advising against use for sedation.[38] A fatality review conducted by Halmo et al after

TABLE 3 Death Investigation, Incident, and Substance Storage Characteristics of Fatal Pediatric Poisonings by Age, NFR-CRS, 2005–2018

Characteristic	Age, Years					Study Total
	<1	1	2	3	4–5	
	n (%)[a]	*n* (%)[a]	*n* (%)[a]	*n* (%)[a]	*n* (%)[a]	*n* (%)[a]
Substance storage location						
Open area	30 (50.8)	44 (64.7)	30 (69.8)	18 (66.7)	20 (55.6)	142 (60.9)
Cabinet	11 (18.6)	13 (19.1)	7 (16.3)	—	7 (19.4)	41 (17.6)
Other	18 (30.5)	11 (16.2)	6 (14.0)	6 (22.2)	9 (25.0)	50 (21.5)
Unknown ($n = 498$)[b]	[b]	[b]	[b]	[b]	[b]	[b]
Substance in original container						
Yes	30 (19.6)	42 (46.7)	27 (50.0)	19 (57.6)	20 (55.6)	138 (37.7)
No	24 (15.7)	38 (42.2)	20 (37.0)	11 (33.3)	11 (30.6)	104 (28.4)
Not applicable	99 (64.7)	10 (11.1)	7 (13.0)	—	—	124 (33.9)
Unknown ($n = 365$)[b]	[b]	[b]	[b]	[b]	[b]	[b]
Container had a child safety cap						
Yes	7 (4.9)	19 (28.8)	15 (31.3)	7 (28.0)	15 (46.9)	63 (20.1)
No	25 (17.6)	19 (28.8)	18 (37.5)	14 (56.0)	9 (28.1)	85 (27.2)
Not applicable	110 (77.5)	28 (42.4)	15 (31.3)	—	8 (25.0)	165 (52.7)
Unknown ($n = 418$)[b]	[b]	[b]	[b]	[b]	[b]	[b]
Toxicology testing performed						
Yes	268 (96.8)	155 (99.4)	94 (97.9)	56 (98.2)	76 (98.7)	649 (97.9)
No	9 (3.2)	—	—	—	—	14 (2.1)
Unknown ($n = 68$)[b]	[b]	[b]	[b]	[b]	[b]	[b]
911 or local emergency services called						
Yes	189 (72.4)	133 (88.1)	84 (87.5)	46 (88.5)	65 (87.8)	517 (81.5)
No	46 (17.6)	16 (10.6)	11 (11.5)	6 (11.5)	7 (9.5)	86 (13.6)
Not applicable	26 (10.0)	—	—	—	—	31 (4.9)
Unknown ($n = 97$)[b]	[b]	[b]	[b]	[b]	[b]	[b]
PCC called						
Yes	—	7 (6.1)	7 (9.9)	—	—	23 (4.5)
No	220 (98.7)	107 (93.9)	64 (90.1)	37 (92.5)	59 (95.2)	487 (95.5)
Unknown ($n = 221$)[b]	[b]	[b]	[b]	[b]	[b]	[b]

—, per-state data-use agreements, counts of $n \leq 5$ were suppressed.

[a] Column percentages may not sum to 100.0% because of rounding error.

[b] Per-state data-use agreements, age breakdown of unknowns were withheld to prevent calculation of suppressed cells.

these changes were adopted by manufacturers noted that the majority of pediatric deaths occurred in children aged <2 years, involved nontherapeutic or malicious intent, and were associated with diphenhydramine.[1] Because labeling and packaging changes are ineffective against intentional administration, prevention efforts should include provider and public education. Increased physician awareness of adverse outcomes has led to fewer providers recommending cough and cold medications for the pediatric population.[39] Clinicians should continue to counsel families against off-label use of OTC medications and address appropriate age and weight-based dosing to prevent misadministration, especially in populations with limited health literacy.[40]

Where a location was available, 65% of fatal poisonings occurred in a child's home and many fatal poisonings occurred while a child was supervised. Clinicians often counsel families on home safety, including keeping potential poisons in their original containers, out of reach and sight, and behind locked storage containers or cabinets. Our data highlight the importance of ensuring a safe environment beyond a child's primary residence. Additional opportunities exist to enhance home safety through other modalities, including increasing PCC awareness among caregivers, and identifying and addressing parental substance use disorder. Because 32% of fatal poisonings for which supervision information was available occurred under the supervision of someone other than the biological parent, initiatives that include other caregivers are essential.

For fatalities with circumstance data available, 18% were determined by CDRs to be deliberate in nature, and 63% of these occurred in children aged <2 years. Malicious poisonings are challenging to characterize and are likely underdetected and underreported.[41] Previous studies have implicated opioids, antihistamines, and sympathomimetics as common agents in cases of child abuse.[1,2,18,19] Children aged <2 years are more likely to be victims of intentional poisonings because of their reliance on caregivers and their relative susceptibility to toxicity given their size and weight.[18,19,42] Though early identification of at-risk children can prevent future harm, CPS referrals for poisonings are uncommon and often only occur after

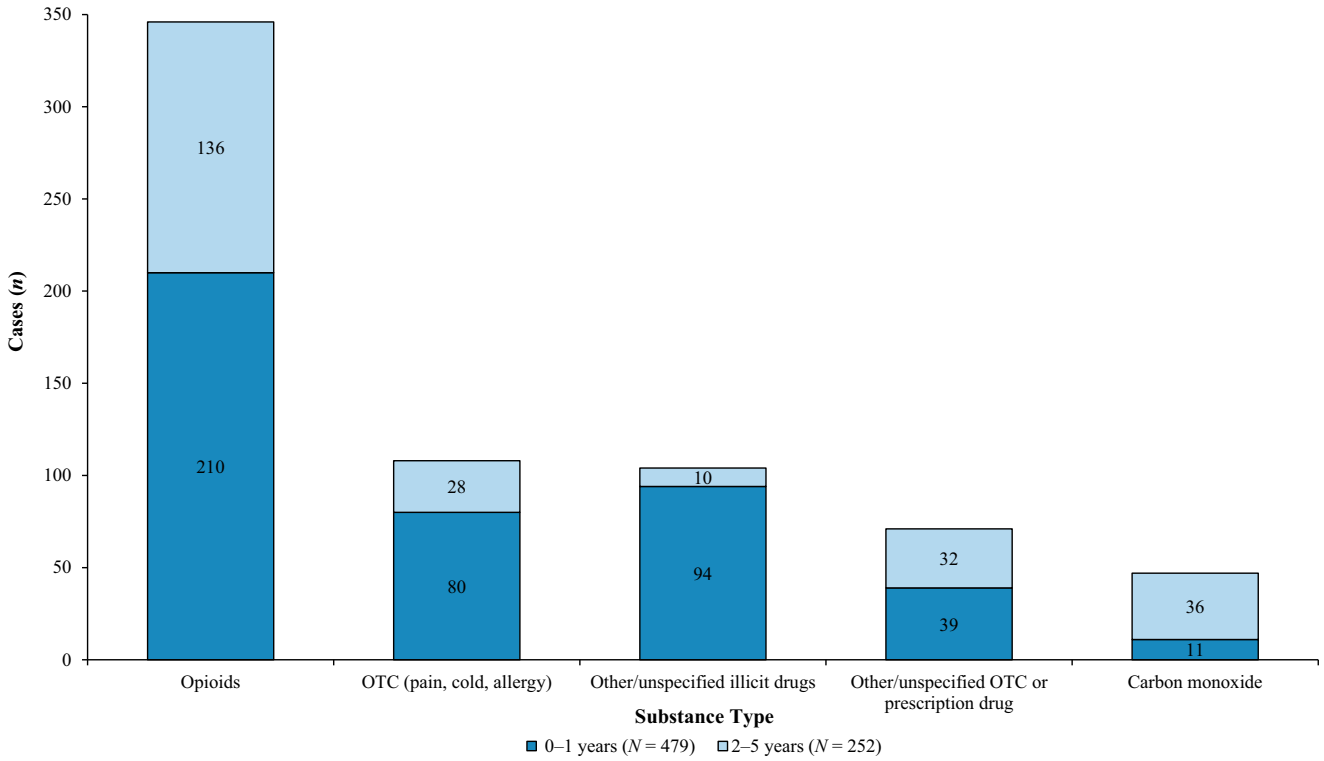

FIGURE 1

Fatal pediatric poisonings by age and selected contributing substances, NFR-CRS, 2005–2018. *CDR committees may identify >1 substance as contributing to death in a single case.

severe poisonings.[43] A subset of our study population (Table 1) demonstrated factors associated with child abuse, including history of previous maltreatment,[44] illness or disability,[45,46] or sibling placement.[47] Other familial and community factors, including substance use disorder, poverty, and social inequities, have also been identified as associated factors.[48] Further research is needed to elucidate the role of these social factors in fatal poisonings to inform individual- and community-level safety interventions.

There are several limitations to our study. The CDR process is subject to jurisdictional protocols and resources available CDR committees. Therefore, these programs vary in the proportion of child fatalities that undergo review, the fatality selection for and approach to review, and the data-recording process.[28,33] The NFR-CRS does not capture all fatal poisonings; its capture of poisoning fatalities compared with other databases is an opportunity for future research. Our study noted that PCCs were not called in most poisoning fatalities, suggesting that the NFR-CRS database may contain fatalities not captured by the NPDS.

Furthermore, CDR committees may also differentially interpret variables with potential subjectivity, such as what constitutes a deliberate poisoning, which can affect coding patterns. These factors may contribute to bias in reporting. Some variables examined in our study overlap with the field of child abuse pediatrics, which continues to address systemic racial and ethnic disparities in maltreatment screening, identification, and reporting.[49–51] Our study population demographics correlate with previous studies on fatal pediatric poisonings,[2,42] though further study is needed to ensure the accurate and equitable representation of these data. The NCFRP has ongoing efforts with CDRs to promote and improve racial equity in fatality review.[52]

State participation in the NFR-CRS is voluntary. Thus, the NFR-CRS is not representative of the population of the participating states or the United States. Data reporting and quality assurance procedures vary between both reporters and states, and thus may be subject to bias. Some NFR-CRS variables may have a high frequency of unknown data, which limits analysis and interpretation. Additionally, we were unable to perform subanalyses on route of exposure, single versus polysubstance fatalities, or fatalities related to specific types of opioids because of limitations in how the data were collected. Despite these limitations, the NFR-CRS is one of the most comprehensive, consolidated death databases available. Its variables

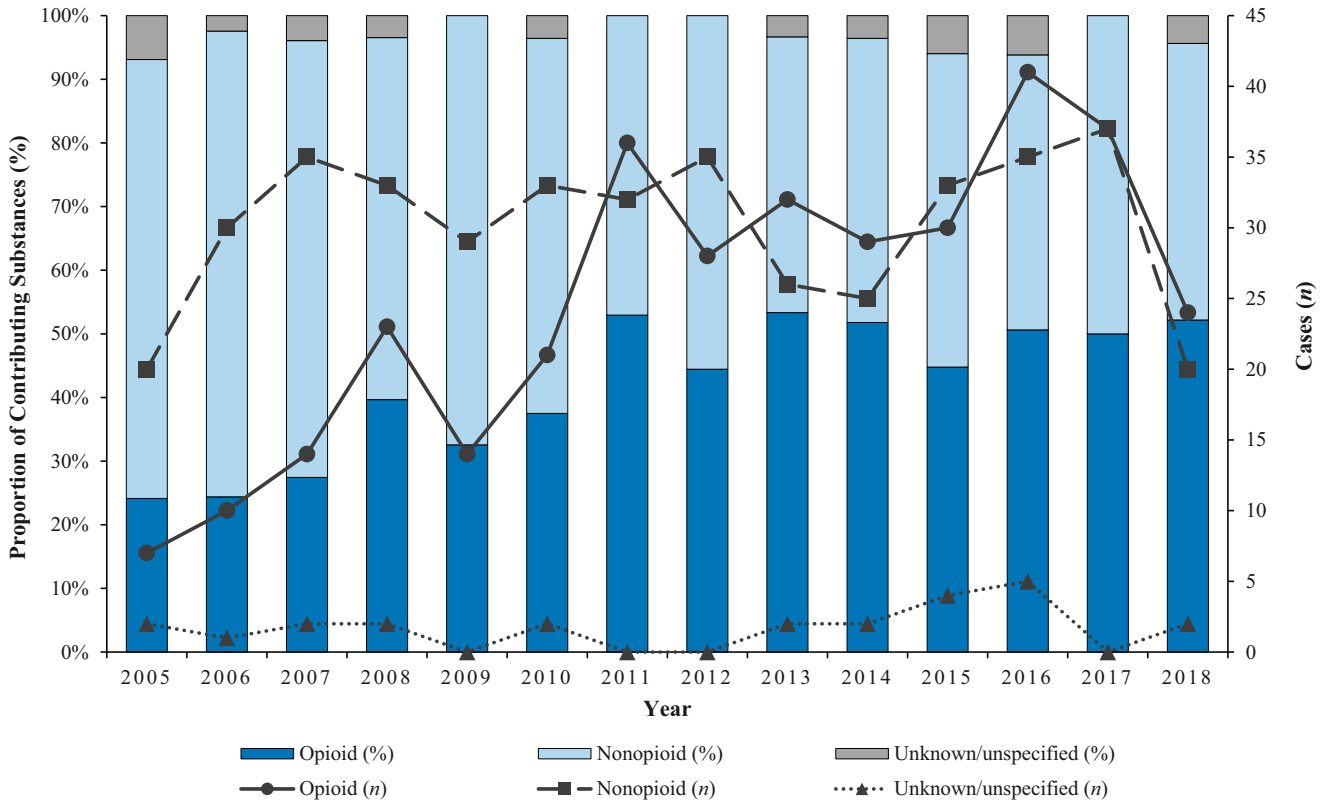

FIGURE 2

Number and proportion of opioid and nonopioid substances contributing to death by year, NFR-CRS, 2005–2018. *CDR committees may identify both an opioid and nonopioid substance as contributing to death in a single case.

describe factors, such as supervision and substance storage, that have important implications for pediatric poisonings and are not available in death-certificate data or other poisoning-focused databases.[21,22] Participation in the NFR-CRS by jurisdictions is increasing over time.[28,33,53] The NCFRP has also performed iterative refinement of its intake form and promoted state-level data quality initiatives that are enhancing the database's ability to capture the circumstances surrounding a pediatric fatality more accurately.[54]

CONCLUSIONS

Opioids are the most common substance contributing to fatal poisonings among young children, and CDRs report an increasing proportion of opioid-related poisoning deaths. As the types of opioids circulating during the current epidemic continue to evolve, policy and programmatic initiatives should focus on children in addition to adults. Regulatory changes have improved the safety of OTC medications, but a substantial proportion of pediatric fatalities are still associated with this medication class. Prevention of fatal pediatric poisonings requires a multifaceted approach involving caregiver education, as well as community-level interventions, particularly among communities facing socioeconomic disparities. Further work is warranted in improving the capture of fatal child poisonings and characterizing the ecological factors associated with these cases.

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ABBREVIATIONS

CDR: child death review
CPS: child protective services
NCFRP: National Center for Fatality Review and Prevention
NFR-CRS: National Fatality Review-Case Reporting System
NPDS: National Poison Data System
OTC: over the counter
PCC: poison control center

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