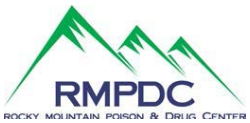
Review of work-related exposures reported to a poison center helpline, Colorado, 2000-2010

Reported by:
Colorado Department of Public Health and Environment
Occupational Health and Safety Surveillance Program

In collaboration with:
Rocky Mountain Poison and Drug Center
Denver Health and Hospitals



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CONTENTS

ABSTRACT

Background: In 2010, the US Bureau of Labor Statistics (BLS) reported 52,730 cases of workplace poisoning exposures nationwide, comprising 4.4% of all nonfatal occupational injuries and illnesses. As a similar estimate for Colorado is not readily available, this study examined the magnitude and distribution of poisoning exposures among Colorado's employed population reported to the Rocky Mountain Poison and Drug Center (RMPDC) at Denver Health and Hospitals. The objective was to better understand characteristics and risk factors associated with workplace exposures to inform public health surveillance efforts.

Methods: RMPDC Colorado data obtained from the National Poison Data System (NPDS) were analyzed to assess annual numbers, rates, and geo-spatial distribution of occupational exposures. NPDS contains self-reported case data on exposure calls to RMPDC, and includes demographic, exposure, substance, and medical outcome descriptions.

The case definition used in this study was derived from the Council of State and Territorial Epidemiologists (CSTE) and the National Institute for Occupational Safety and Health (NIOSH) guidelines for occupational health indicator surveillance of acute work-related pesticide poisoning. Both single and multiple substance exposures were included in the analyses.

Results: From 2000 through 2010, 8,367 occupational poisoning exposures were reported to RMPDC by Colorado residents, resulting in an average annual rate of 31.5 incidents per 100,000 workers. After 2001, rates steadily declined from a high of 43.8 reported exposures per 100,000 employed to a 2010 low of 21.8 exposures per 100,000. Although nearly a quarter of all poisoning exposures occurred among workers age 25-34 years, the youngest age group (16-19 years) experienced the highest mean rate of 54 per 100,000 ($p<.0001$). Most cases during the study period were male (59.3%) compared to female (38.3%) ($p<.0001$). Exposures to chemicals, gases, household cleaning substances, hydrocarbons, pharmaceuticals, and pesticides were most prevalent. Top exposure routes included inhalation (42.1%), ocular (19.3%) or dermal exposure (17.9%), and ingestion (9.0%), leading to the most common clinical effects of ocular or dermal injury, headache, nausea, and throat irritation. Seventy-six percent of reported medical outcomes were minor or not followed due to minimal clinical effects. Exposure to chemicals, gases, fumes, or vapors, and pesticides or fertilizers were more commonly reported from urban areas, but had higher reporting rates in rural areas.

Conclusions: RMPDC data indicate a significant burden of occupational injury that may not require medical treatment or hospitalization, and thus may not be captured in current occupational surveillance systems that rely on medical, workplace injury, or workers' compensation reports. In these data, males experienced higher overall exposure rates, as well as more severe medical outcomes. Exposure rates were inversely related to age group; however, the reverse trend is observed in some other occupational injury datasets. A better understanding of the industries and occupations associated with exposures would provide insight to developing targeted interventions based on gender and age, as well as aid in root cause investigations.

SIGNIFICANCE

Over 85,000 chemicals are on the US market today, with approximately 2,000 new substances introduced yearly[1]. These chemicals, along with a multitude of other potentially toxic products, are widely produced and used across many industries, putting workers from all sectors at risk for exposure to toxic substances.

Poisoning occurs when unintended exposure to extrinsic substances via oral, respiratory, ocular, or dermal routes leads to at least one adverse clinical effect[2, 3]. The US Bureau of Labor Statistics (BLS) Survey of Occupational Injuries and Illnesses (SOII) provides annual estimates on the numbers and rates of nonfatal work-related injuries and illnesses. 52,730 cases of occupational exposures to harmful substances or environments among those aged 16 and older were reported from the private sector, state government, and local government in 2010, comprising 4.4% of all occupational injuries and illnesses in the United States[4]. A median four days away from work resulted from these poisonings, accumulating almost 578 person-years lost in workplace productivity for 2010 alone. Currently, Colorado data are not reflected in this estimate as the state does not participate in the SOII.

Poison centers provide another resource for monitoring the occurrence of occupational exposures and poisonings at both state and national levels, aggregating data on exposure and information phone calls through the National Poison Data System (NPDS). In 2010, 37,707 workplace exposures were reported to poison centers across the US, accounting for 1.6% of all poison center exposure calls[5]. In comparison, approximately 1.9% of all Colorado exposure calls during 2010 were occupational.

These statistics are likely underestimations of the actual burden of work-related exposures and poisonings. It is estimated that the true incidence of total occupational morbidity in the US may be as much as three to five times higher than what is captured by current surveillance sources[6]. Workers with acute exposures that are not life threatening may not seek consultation due to concern about healthcare cost, lack of access to care, lack of awareness about workers' compensation benefits, or fear of negative consequences resulting from employers' knowledge of workplace injury. Long incubation periods from the time of exposure to a harmful substance to onset of clinical symptoms may result in misclassifying the source of exposure[7]. Furthermore, poisoning symptoms may be misdiagnosed as symptoms of other common illness and injury[7].

The extent of work-related poisonings across Colorado and the nation remains largely undocumented, but the associated morbidity and mortality, healthcare costs, and losses due to decreased productivity are thought to be significant. Previous studies have examined occupational injuries and illnesses due to pesticide exposures in Colorado; however, pesticides comprise only a fraction of all occupational poisoning exposures and few studies have focused on all toxic substance exposures across the state. Therefore, the objective of this study was to use poison center data to describe the magnitude, distribution, and trends of occupational exposures and poisonings from all substances among Colorado's employed population from 2000 to 2010. Findings will be used to inform occupational health surveillance and prevention efforts.

METHODS

Data Collection

The American Association of Poison Control Centers (AAPCC) National Poison Data System (NPDS) is utilized by all 57 US poison centers to capture and track near real-time data on exposure and information calls telephone calls to US poison centers[5]. This study analyzed only exposure calls, which are calls placed to the poison center by a person reporting a specific substance exposure.

When a call is placed to the Rocky Mountain Poison and Drug Center (RMPDC), specialists in poison information (SPIs) collect a core set of standardized variables in RMPDC's CasePRO® data management system. Approximately 60% of the collected information is uploaded to NPDS every 10 minutes. New case information is continually uploaded following this schedule so NPDS is always current. These data include clinical and demographic variables, exposure descriptions such as exposure site and exposure route, product information, health effect descriptors, case classification, and a number of other variables. NPDS is a web-based platform for poison center data with secure access from anywhere. Since it contains approximately 60% of the most used RMPDC data elements, NPDS was used as the source for RMPDC Colorado call data.

Case Definition

The National Institute for Occupational Safety and Health (NIOSH) and the Council of State and Territorial Epidemiologists (CSTE) developed a list of occupational health indicators (OHI), which can be collected and monitored at the state-level to provide information on the working population's health status in regards to workplace injuries, illnesses, and other factors that affect health[9]. The occupational exposure case definition used in this study was derived from the OHI guidance for identifying acute work-related pesticide-associated illness and injury. Closed-case exposure phone calls made to RMPDC from Colorado during 2000-2010 were selected from NPDS for inclusion in this study. The following criteria were additionally applied to each call report to identify occupational exposure cases:

- Call Type = (exposure)
- Exposure Site = (workplace) OR Exposure Reason=(occupational), with duplicate cases removed[i]
- Medical outcome = 201 (minor effect); 202 (moderate effect); 203 (major effect); 204 (death); 206 (not followed, minimal clinical effects possible); 207 (unable to follow, judged as a potentially toxic exposure)
- For Exposure Site = (workplace), EXCLUDE: Exposure reason = 9 (suspected suicide); 11 (intentional abuse); 12 (intentional action but specific intention unknown); 14 (malicious); 18 (unknown reason)
- Single substance exposure only = No (meaning, cases with exposure to multiple substances were also included in this study)
- Age ≥16 years
- EXCLUDED were exposures to the following product categories: Bites and Envenomations, Food Products/Food Poisonings, Information Calls, Radiation[ii]

[i] In this analysis, it was observed that all calls citing the exposure reason as "occupational" also cited the exposure site as "workplace". Thus, the primary criterion for identifying occupational poisoning exposures was Exposure Site = (workplace).

The CSTE OHI guidelines for occupational pesticide illness and injury surveillance suggest including only cases exposed to one substance, which is common practice when trying to identify or analyze health effects caused by a particular product. As the objective of this study was to capture all occupational poisonings, both single and multiple substance exposures were included for analysis. Multiple substance exposure cases were classified according to the first-listed substance[iii]. Figure 1 shows the flow of case selection for this study. Of the 8,367 calls meeting the case definition for occupational exposure, 788 (9.4%) were multiple substance cases.

Definition of Key Variables

The following information is important to consider throughout the report.

Clinical Effect: In NPDS, the clinical effect variable documents reported signs, symptoms and clinical findings associated with an exposure case. Each clinical effect is further sub-coded as "related", "not related", or "unknown if related". Because the NIOSH/CSTE OHI case definition for pesticide poisoning exposures does not set parameters for clinical effects, we included all exposure calls with and without reported clinical effects. We also were not able to account for relatedness of reported clinical effects.

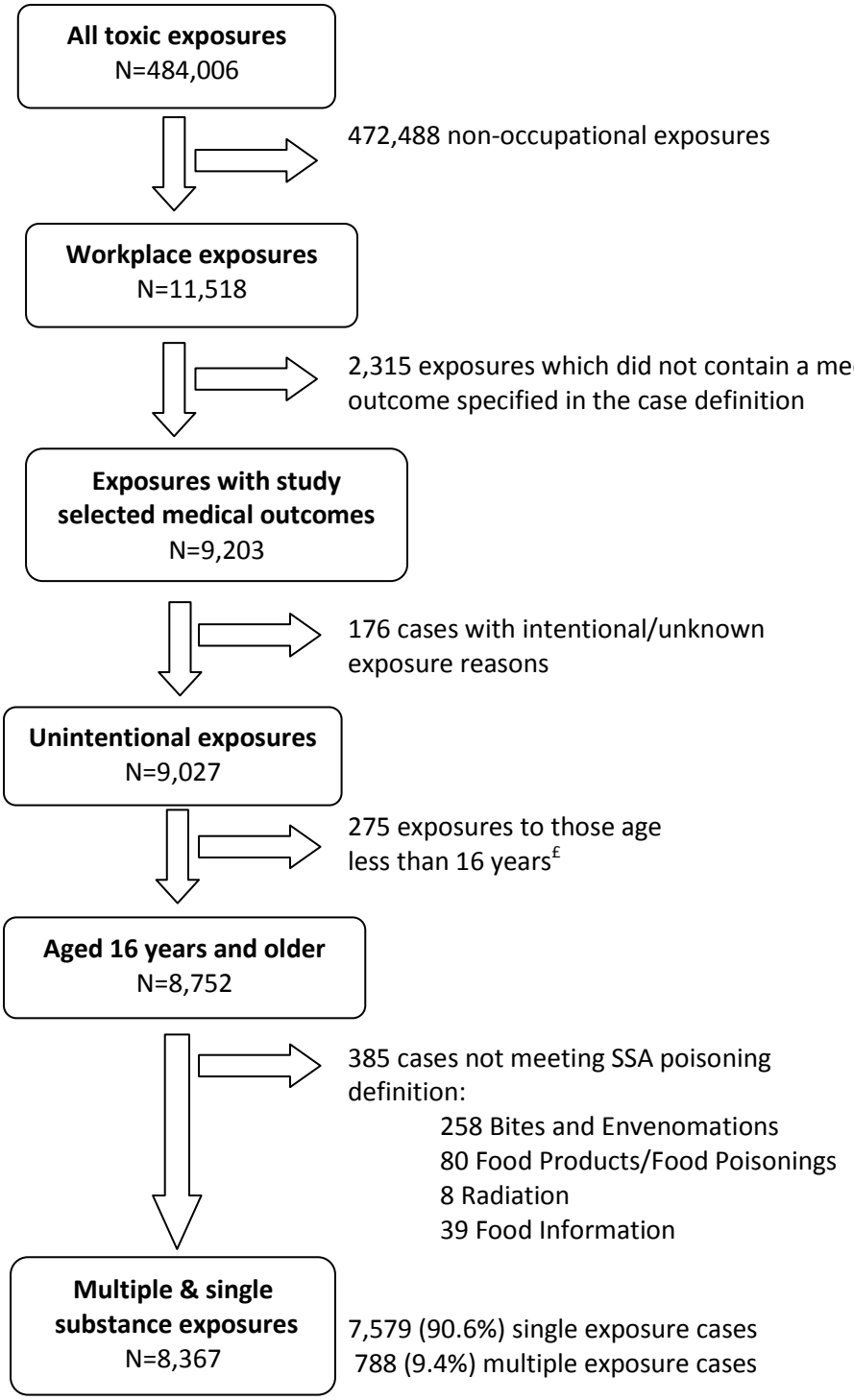
Medical Outcome: In NPDS, this variable is the final determination made by the SPI based on all case information available. The variable uses ten different values to document the severity of symptoms due to the reported exposure. SPIs make every attempt to follow a case until medical outcome can be documented. This variable can also be coded as "unrelated effect" and "confirmed non-exposure". As described above, only calls with select medical outcomes were included in this analysis.

Study-defined Product Groupings: When an exposure call is made to the RMDPC, the SPI attempts to identify the implicated substance's brand name and concentration. NPDS has a products data base of over 390,000 pharmaceutical and non-pharmaceutical products, each is assigned a unique 7-digit code. These specific products are further sorted into a controlled, hierarchical vocabulary of at least 965 generic codes (defined by the AAPCC) and grouped into 67 major generic categories. For this study, these 67 major groups were collapsed into 16 study-specific product groupings (Appendix B).

[ii] The Safe States Alliance (SSA) Injury Surveillance Workgroup 7 (ISW7) poisoning definition excludes exposures to bites and stings without envenomations, infections from food and waterborne sources, and exposure to external radiation2. Since envenomation or internal radiation exposure could not be determined with the provided data, 385 exposures to the "Bites and Envenomations" and "Radiation" product categories were omitted from the final selected cases, as well those exposed to food-related categories.

[iii] Call center staff at the RMPDC routinely list exposure substances in hierarchical order, relative to their contribution to the case. A review of cases with multiple substance exposures revealed that involved substances tended to be from the same product or generic category.

Figure 1: Occupational exposure case selection, National Poison Data System Colorado Cases, 2000-2010



Source: Rocky Mountain Poison and Drug Center (RMPDC) data from the National Poison Data System (NPDS)

£ See Appendix A

Note: In this analysis, it was observed that all calls citing the exposure reason as "occupational" also cited the exposure site as "workplace". Thus, the primary criterion for identifying occupational poisoning exposures was Exposure Site=Workplace.

Analysis

This retrospective study analyzed occupational exposure data for Colorado from 2000 – 2010 reported to RMPDC. Workplace exposures were evaluated to determine age and sex distribution, caller site, management site, exposure reason, route of exposure, clinical effect, medical outcome, poison exposure substance, and geographic trends. χ^2 and t-test analyses on contingency tables were used to test associations within demographic and exposure categories, using an α level of 0.05. The denominator data used to calculate crude gender- and age-stratified rates were obtained from the BLS Geographic Profile of Employment and Unemployment (GP).[8] The GP provides final statistical summary information from the Current Population Survey (CPS), including annual average data on the number of employed and unemployed by demographic and economic characteristics. SAS version 9.3 was used in data analyses. For exposure calls where zip-code was recorded, geospatial analysis was performed using ArcGIS; area boundaries were defined by 2010 Environmental Systems Research Institute (ESRI) estimates (www.esri.com).

RESULTS

During the 11-year period from 2000 through 2010, a total of 8,367 poison center workplace exposure calls from Colorado involved persons aged 16 and older with reported exposures to harmful substances or environments (Table 1). This resulted in an average annual rate of 31.5 exposure events per 100,000 employed (Table 2). After a high crude rate in 2001 of 43.80 poisonings per 100,000 employed, both the annual number and rate of poisonings have been steadily declining, with the lowest rate of 21.84 per 100,000 occurring during the most recently reported year, 2010 (Figure 2). This trend mirrors decreasing national trends in occupational poison exposure reporting to poison centers[5, 10].

Applying the same case-selection criteria to NPDS as was used for occupational exposures (See Figure 1), except specifying exposure site not equal to workplace, 70,665 non-occupational exposure calls were identified for comparison to the study group. Occupational poison exposures differed significantly from comparable non-occupational exposures in age, gender, caller site, medical outcome and exposure route (Table 1).

Table 1: Characteristics of occupational and non-occupational exposure cases reported to a poison center, Age 16 years and older, Colorado, 2000-2010

	Occupational exposures (N=8,367)	Non-occupational exposures[¥] (N=70,665)	p-value
	Number (%)	Number (%)	
Age group (years)			<.0001
16-19	574 (6.86)	6,100 (8.63)	
20-24	1,195 (14.28)	7,315 (10.35)	
25-34	2,007 (23.99)	12,930 (18.30)	
35-44	1,495 (17.87)	11,463 (16.22)	
45-54	961 (11.49)	9,749 (13.80)	
55-64	378 (4.52)	6,012 (8.51)	
65+	91 (1.09)	6,177 (8.74)	
Unspecified	1,666 (19.91)	10,919 (15.45)	
Gender			<.0001
Male	4,960 (59.28)	28,539 (40.39)	
Female	3,202 (38.27)	41,039 (58.08)	
Unspecified	205 (2.45)	1,087 (1.54)	
Caller site			<.0001
Health care facility	2,532 (30.26)	8,469 (11.98)	
Other	284 (3.39)	1,8412 (2.61)	
Other residence	151 (1.80)	2,814 (3.98)	
Own residence	3,007 (35.94)	54,125 (76.59)	
Public area	66 (0.79)	463 (0.66)	
Restaurant/food service	50 (0.60)	48 (0.07)	
School	75 (0.90)	595 (0.84)	
Unknown	82 (0.98)	807 (1.14)	
Workplace	2,120 (25.34)	1,502 (2.13)	
Medical outcome			<.0001
Minor effect	5,263 (62.90)	39,288 (55.60)	
Moderate effect	1,370 (16.37)	7,127 (10.09)	
Major effect	55 (0.66)	557 (0.79)	
Death	2 (0.02)	25 (0.04)	
Unable to follow [£]	542 (6.48)	5,997 (8.49)	
Not followed [€]	1,135 (13.57)	17,671 (25.01)	
Exposure route			<.0001
Dermal	1,496 (17.88)	7,162 (10.14)	
Ingestion	750 (8.96)	35,937 (50.86)	
Inhalation/nasal	3,526 (42.14)	13,953 (19.75)	
Multiple	696 (8.32)	3,116 (4.41)	
Ocular	1,616 (19.31)	8,602 (12.17)	
Parenteral	129 (1.54)	1,034 (1.46)	
Unknown	154 (1.84)	861 (1.22)	

Source: Rocky Mountain Poison and Drug Center (RMPDC) data from the National Poison Data System (NPDS)

[¥] Non-occupational exposure cases were identified using the same criteria for occupational exposures (See Case Definition), except with Exposure Site ≠ (workplace)

[£] Unable to follow, judged as a potentially toxic exposure

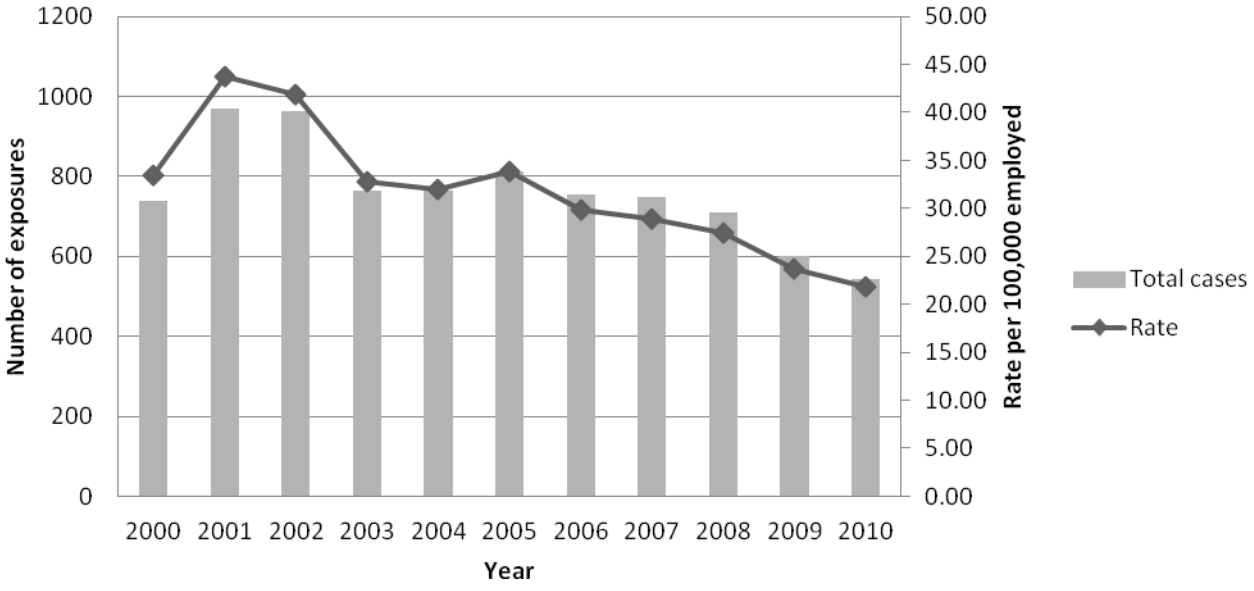
[€] Not followed, minimal clinical effects possible (no more than minor effect possible)

Table 2: Occupational exposures reported to a poison center, Age 16 years and older, Colorado, 2000-2010

Year	Annual number of occupational exposure cases	Number employed	Annual crude rate of occupational exposures per 100,000 employed
2000	740	2,213,000	33.44
2001	968	2,210,000	43.80
2002	962	2,298,000	41.86
2003	764	2,328,000	32.82
2004	764	2,389,000	31.98
2005	814	2,406,000	33.83
2006	754	2,527,000	29.84
2007	748	2,589,000	28.89
2008	711	2,594,000	27.41
2009	600	2,526,000	23.75
2010	542	2,482,000	21.84
Annual average	**760**	**2,414,727**	**31.50**

Source: Rocky Mountain Poison and Drug Center (RMPDC) data from the National Poison Data System (NPDS)
Numerator: Reported cases of work-related exposures from Colorado RMPDC case-level data in NPDS
Denominator: Employed persons age 16 years and older as reported by the Bureau of Labor Statistics (BLS) Geographic Profile of Employment and Unemployment

Figure 2: Annual number and crude rate of occupational exposures reported to a poison center, Age 16 years and older, Colorado, 2000-2010

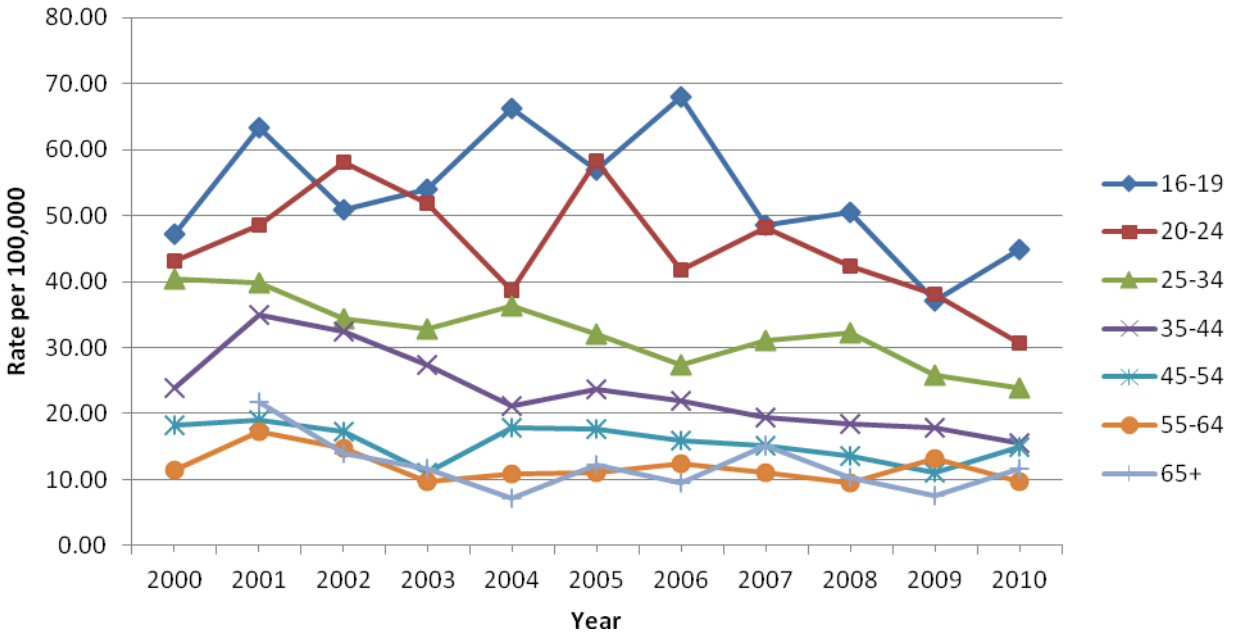


Source: Rocky Mountain Poison and Drug Center (RMPDC) data from the National Poison Data System (NPDS)
Numerator: Reported cases of work-related poison exposures from Colorado RMPDC case-level data in NPDS
Denominator: Employed persons age 16 years and older as reported by the Bureau of Labor Statistics (BLS) Geographic Profile of Employment and Unemployment

Age and Gender

Nearly a quarter of all reported workplace exposures (23.99%) occurred among the 25-34 year old age group (Table 1). Although the 16-19 age group reported one of the lowest frequencies of work-related poison exposures (Table 1), the average crude rate in this group is significantly higher compared to older age groups, at 53.95 exposures per 100,000 employed (p<.0001) (Figure 3). Poison exposure rates decreased in older age groups, with the exception of a slight increase in the 65+ group. About a fifth of callers to RMPDC chose not to disclose age information. Those aged 20-44 accounted for a greater proportion of workplace exposures (56.14%) than they did non-workplace exposures (44.87%) (Table 1). The reverse trend was observed in those aged 45 and older, with those age groups comprising 31.05% of all non-workplace exposures and only 17.10% of occupational exposures (Table 1).

Figure 3: Crude rates of occupational exposures reported to a poison center, By age group, Age 16 and older, Colorado, 2000-2010

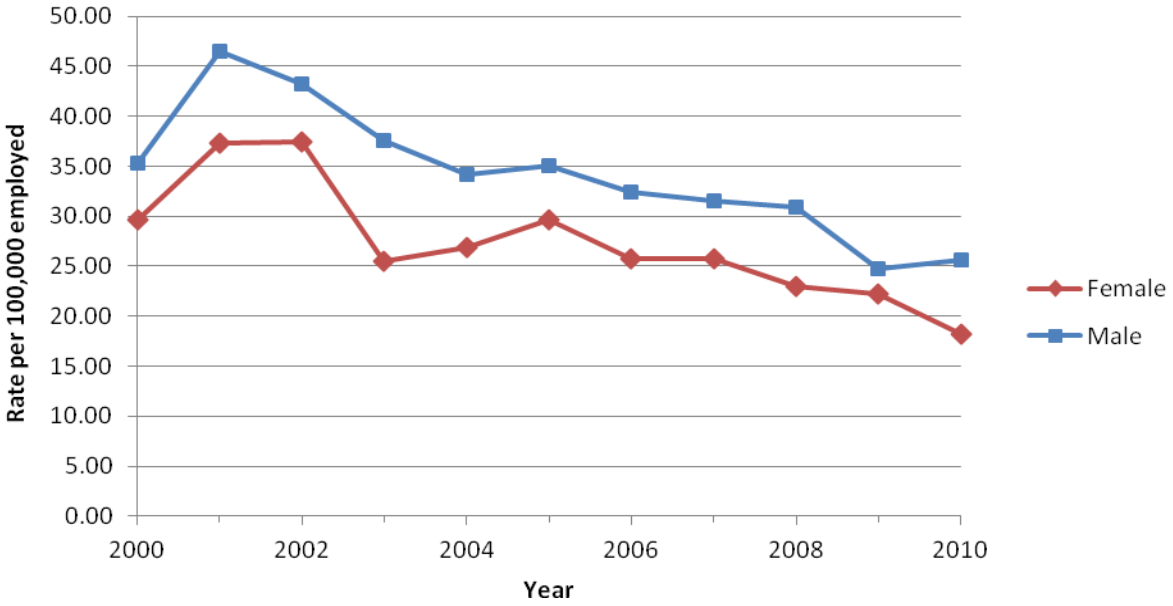


Source: Rocky Mountain Poison and Drug Center (RMPDC) data from the National Poison Data System (NPDS)
Numerator: Reported cases of work-related exposures from Colorado RMPDC case-level data in NPDS
Denominator: Employed persons in respective age categories as reported by the Bureau of Labor Statistics (BLS) Geographic Profile of Employment and Unemployment
Note: Unable to calculate rate for age 65+ for the year 2000 due to gap in BLS GP data

Annual crude poison exposure rates have been decreasing for both gender groups over the past 11 years (Figure 4), with an average annual rate of 34.04 exposures per 100,000 employed males and 26.71 per 100,000 employed females (p<.0001). While females accounted for a larger portion of non-workplace poison exposures (58.08%), males reported the majority of workplace poison exposures, out-weighing female occupational exposures at a ratio of approximately 3:2 (Table 1). Of the 3,202 female occupational cases, 48 (1.50%) occurred in pregnant individuals. Gender was more frequently

reported in RMPDC calls than was age, with only 205 callers (2.5%) with undisclosed gender information. However, as was observed with age, the proportion of callers with undisclosed gender information was greater in the workplace-associated exposure group than in the non-workplace exposure group (Table 1).

Figure 4: Crude rates of occupational exposures reported to a poison center, By gender, Age 16 and older, Colorado, 2000-2010

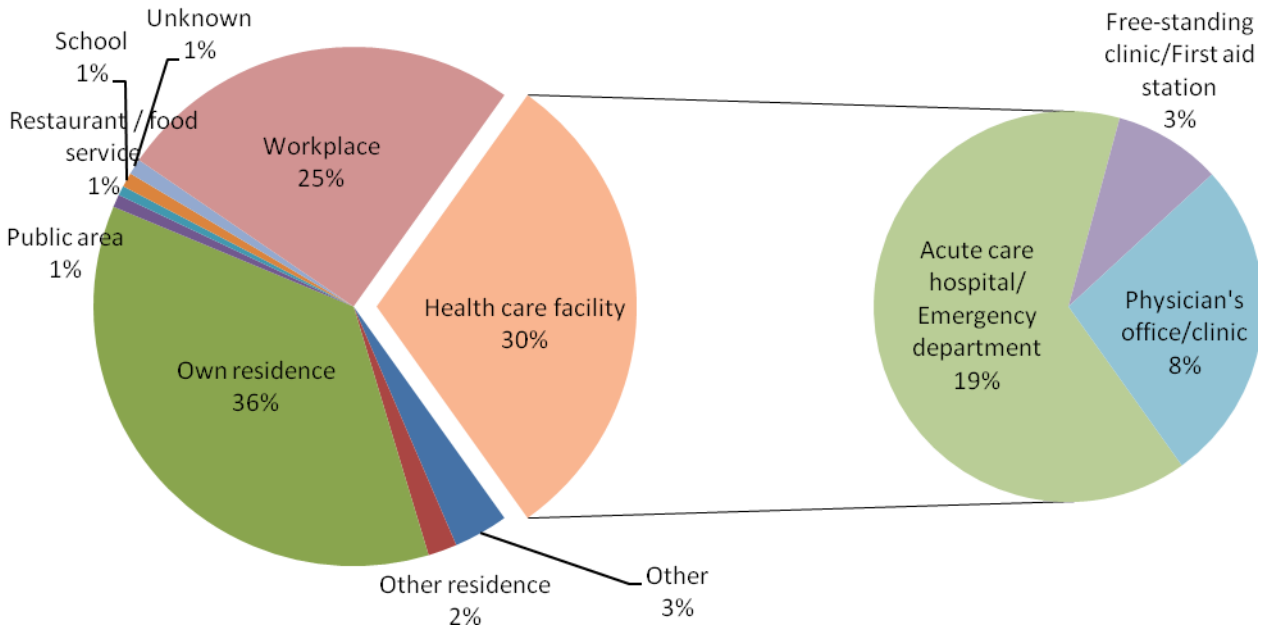


Source: Rocky Mountain Poison and Drug Center (RMPDC) data from the National Poison Data System (NPDS)
Numerator: Reported cases of work-related exposures from Colorado RMPDC case-level data in NPDS
Denominator: Employed persons age 16 years and older in respective gender categories as reported by the Bureau of Labor Statistics (BLS) Geographic Profile of Employment and Unemployment

Caller Site

Of the 8,367 occupational exposure calls to RMPDC, more than a third (3,007) were made from the caller's own residence (Figure 5). Most of the remaining calls were reported from either a healthcare facility – defined as a hospital-based patient care unit, emergency department or medical clinic, first aid station, physician's office, or clinic – or from the workplace. Occupational exposures were reported more frequently from a healthcare facility (30.26%) than were non-occupational exposures (11.98%) (Table 1).

Figure 5: Site of caller reporting occupational exposure to a poison center, Age 16 and older, Colorado, 2000-2010

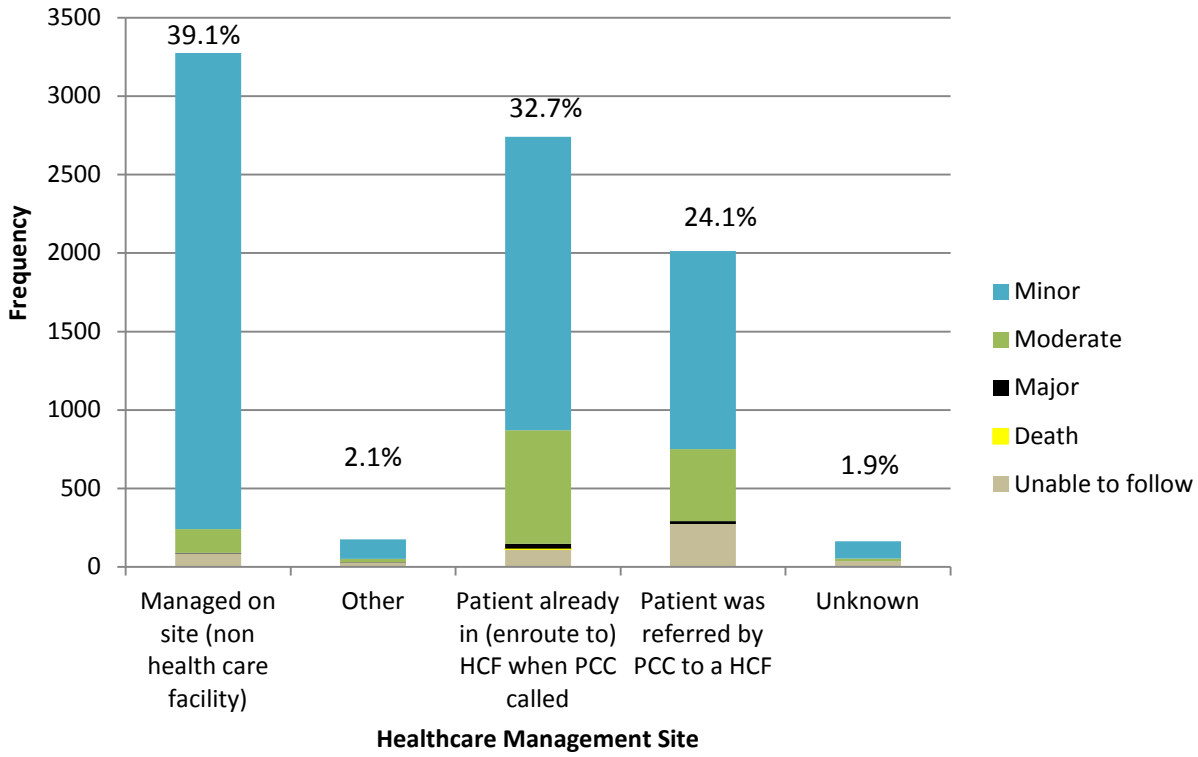


Source: Rocky Mountain Poison and Drug Center (RMPDC) data from the National Poison Data System (NPDS)

Exposure Management

Figure 6 shows that occupational exposure cases reported to RMPDC were commonly treated at non-health care sites, such as home or the workplace (3,274 or 39.13% of all cases). Another 2,740 (32.75%) were in or en route to a health care facility at the time of the poison center call, and 2,013 (24.06%) were advised by RMPDC to visit a healthcare facility. Compared to cases medically managed at the site of exposure, more cases that were in, en route to, or referred to a healthcare facility were associated with moderate and major medical outcomes.

Figure 6: Medical outcome of occupational exposures reported to a poison center, By healthcare management site, Age 16 and older, Colorado, 2000-2010



Source: Rocky Mountain Poison and Drug Center (RMPDC) data from the National Poison Data System (NPDS)
Note: It is difficult to see on this figure, but both deaths reported in these data occurred in the "Patient already in (en route to) HCF" category.

Reason for Exposure

Occupational exposure cases were selected on the fundamental criteria that the exposure was unintentional and occurred at the workplace (See Case Definition and Figure 1). However, only 78% of cases cited "occupational" as the exposure reason (Table 3). The remaining quarter of the calls were assigned various exposure reason categories, such as general, environmental, other, or misuse reasons.

Table 3: Reported reasons for occupational exposures reported to a poison center, Age 16 and older, Colorado, 2000-2010

Exposure Reason	Number	Percent
Occupational	6,566	78.47
General	744	8.89
Environmental	362	4.33
Other	273	3.26
Misuse	253	3.02
Drug	55	0.66
Therapeutic error	54	0.65
Unknown	38	0.45
Contamination / tampering	22	0.26
Total	**8,367**	**100**

Source: Rocky Mountain Poison and Drug Center (RMPDC) data from the National Poison Data System (NPDS)

Exposure Route and Clinical Effect

The top four reported exposure routes were: inhalation/nasal (42.1%), ocular (19.3%), dermal (17.9%), and oral ingestion (9.0%), amounting to 88% of all exposure routes (Table 4). More than one route of exposure (e.g. a chemical that was both inhaled and came into contact with the skin) was reported in 7.9% of cases, with unspecified, parenteral, other, and otic routes accounting for the remainder of the cases.

Table 4: Routes of occupational exposures reported to a poison center, Age 16 and older, Colorado, 2000-2010

Exposure route	Number	Percent
Inhalation/nasal	3,526	42.14
Ocular	1,616	19.31
Dermal	1,496	17.88
Ingestion	750	8.96
Multiple routes	664	7.94
Unknown	154	1.84
Parenteral	129	1.54
Other	18	0.22
Otic	14	0.17
Total	**8,367**	**100**

Source: Rocky Mountain Poison and Drug Center (RMPDC) data from the National Poison Data System (NPDS)

The most common clinical effect resulting from exposure was ocular irritation and pain, followed by other/unspecified effects, dermal irritation and pain, headache, and nausea (Table 5). Although 83 different clinical effects associated with poison exposure were reported to the RMPDC, these ten listed effects were experienced by 74%. Of the 8,367 occupational exposure reports, 447 (5.34%) did not report clinical effects.

Table 5: Top ten clinical effects resulting from occupational exposures reported to a poison center, Age 16 and older, Colorado, 2000-2010

Clinical effect	Number	% of all work-related poisonings[£]
Ocular - Irritation/pain	1,169	14.76
Other	915	11.55
Dermal - Irritation/pain	674	8.51
Headache	623	7.87
Nausea	619	7.82
Throat irritation	540	6.82
Cough/choke	430	5.43
Erythema/flushed	324	4.09
Vomiting	288	3.64
Burns	247	3.12
None reported	447	5.34

Source: Rocky Mountain Poison and Drug Center (RMPDC) data from the National Poison Data System (NPDS)
[£]This table displays only the top ten clinical effects reported, thus does not include data for all 8,367 cases.

Medical Outcome

In this study, males not only presented with a higher rate of occupational exposure (Figure 4), but they also presented with more severe medical outcomes as a result of exposure. Both mortality cases resulting from occupational exposure occurred in male workers (Table 6), one due to inhaled carbon monoxide and the other due to ingested gun bluing compounds. Males reported major effects – defined as symptoms that were life-threatening or resulted in significant residual disability or disfigurement – at a three-fold higher proportion than did females. Additionally, males reported moderate effects – defined as symptoms more pronounced or symptomatic than minor symptoms – at a two-fold increased proportion when compared to females. Occupational exposures most commonly resulted in minor effects across all gender categories.

Table 6: Medical outcomes of occupational exposures reported to a poison center, By gender, Age 16 and older, Colorado, 2000-2010

Medical outcome	Number (%)			
	Female	Male	Gender unknown	All cases
Death	0 (0.00)	2 (0.04)	0 (0.00)	2 (0.02)
Major effect	13 (0.41)	42 (0.85)	0 (0.00)	55 (0.66)
Moderate effect	401 (12.52)	959 (19.33)	10 (4.88)	1370 (16.37)
Minor effect	2172 (67.83)	2959 (59.66)	132 (64.39)	5263 (62.90)
Not followed, minimal clinical effects possible (no more than minor effect possible)[¥]	466 (14.55)	635 (12.8)	34 (16.59)	1135 (13.57)
Unable to follow, judged as a potentially toxic exposure[¥]	150 (4.68)	363 (7.32)	29 (14.15)	542 (6.48)
Total	**3202 (38.27)**	**4960 (59.28)**	**205 (2.45)**	**8367 (100)**

Source: Rocky Mountain Poison and Drug Center (RMPDC) data from the National Poison Data System (NPDS)

[¥] *These categories indicate circumstances in which it was not appropriate or possible to follow a patient to a reasonably certain medical outcome, e.g. the exposure was believed to result in only minimal toxicity or a patient disconnected from the call to the poison center before a known outcome could be ascertained*

Major effect medical outcomes were most frequently reported by workers ages 20-24 and 35-44 (Table 7). Callers that chose not to disclose their age were also more likely to not be followed or were unable to be followed by RMPDC (Table 7).

Table 7: Medical outcomes of occupational exposures reported to a poison center, By age group, Age 16 and older, Colorado, 2000-2010

Medical outcome	Age group (years)								
	16-19 N (%)	20-24 N (%)	25-34 N (%)	35-44 N (%)	45-54 N (%)	55-64 N (%)	65+ N (%)	Age Unknown N (%)	All Cases N (%)
Death	0 (0.00)	0 (0.00)	0 (0.00)	0 (0.00)	1 (50.00)	1 (50.00)	0 (0.00)	0 (0.00)	2 (0.02)
Major effect	0 (0.00)	15 (27.27)	11 (20.00)	18 (32.73)	6 (10.91)	0 (0.00)	1 (1.82)	4 (7.27)	55 (0.66)
Moderate effect	90 (6.57)	175 (12.77)	336 (24.53)	285 (20.80)	205 (14.96)	79 (5.77)	15 (1.09)	185 (13.50)	1370 (16.37)
Minor effect	386 (7.33)	803 (15.26)	1302 (24.74)	899 (17.08)	602 (11.44)	240 (4.56)	49 (0.93)	982 (18.66)	5263 (62.90)
Not followed, minimal clinical effects possible (no more than minor effect possible) [¥]	73 (6.43)	145 (12.78)	248 (21.85)	192 (16.92)	98 (8.63)	47 (4.14)	20 (1.76)	312 (27.49)	1135 (13.57)
Unable to follow, judged as a potentially toxic exposure [¥]	25 (4.61)	57 (10.52)	110 (20.30)	101 (18.63)	49 (9.04)	11 (2.03)	6 (1.11)	183 (33.76)	542 (6.48)
Total	**574 (6.86)**	**1195 (14.28)**	**2007 (23.99)**	**1495 (17.87)**	**961 (11.49)**	**378 (4.52)**	**91 (1.09)**	**1666 (19.91)**	**8367 (100)**

Source: Rocky Mountain Poison and Drug Center (RMPDC) data from the National Poison Data System (NPDS)

[¥] *These categories indicate circumstances in which it was not appropriate or possible to follow a patient to a reasonably certain medical outcome, e.g. the exposure was believed to result in only minimal toxicity or a patient disconnected from the call to the poison center before a known outcome could be ascertained*

Exposure Substances

Table 8 shows that 66.16% of all reported Colorado occupational poison exposures from 2000-2010 resulted from exposure to the following study-defined product groupings[iv]: Chemicals; Fumes/Gases/Vapors; Cleaning Substances (Household); Hydrocarbons; Pharmaceuticals; and, Pesticides/Fertilizers (with fertilizers comprising less than 3% of this category). Chemicals were responsible for the greatest number of occupational exposure cases (Tables 8 and 9), as well as for the highest rate of all cases (Table 10). Although the types of substances implicated in non-occupational exposures were similar to those of the occupational exposures, distribution was different with pharmaceuticals accounting for almost half of all non-occupational exposures.

[iv] See Methods and Appendix B

Table 8: Top ten product groupings contributing to occupational and non-occupational exposures reported to a poison center, Age 16 and older, Colorado, 2000-2010

Occupational[£]			Non-Occupational[£]		
Product grouping[¥]	**N**	**% of total cases**	**Product grouping[¥]**	**N**	**% of total cases**
Chemicals	1,459	17.44	Pharmaceuticals	29,316	41.49
Fumes/Gases/Vapors	956	11.43	Cleaning Substances, Household	7,221	10.22
Cleaning Substances (Household)	916	10.95	Pesticides/Fertilizers	4,843	6.85
Hydrocarbons	755	9.02	Fumes/Gases/Vapors	4,720	6.68
Pharmaceuticals	736	8.80	Other/Unknown Non-drug/Missing Substances	3,978	5.63
Pesticides/Fertilizers	713	8.52	Cosmetics/Personal Care Products	3,841	5.44
Other/Unknown Non-drug/Missing Substances	613	7.33	Hydrocarbons	3,737	5.29
Other Industrial-use Substance	489	5.84	Chemicals	2,745	3.88
Industrial Cleaners	443	5.29	Other Industrial-use Substance	2,682	3.80
Other Miscellaneous Substance	304	3.63	Plant-based Substances	1,690	2.39

Source: Rocky Mountain Poison and Drug Center (RMPDC) data from the National Poison Data System (NPDS)
[£] This table displays only the top ten product groupings, thus does not include data for all 8,367 occupational and 70,665 non-occupational cases in this study.
[¥] See Methods and Appendix B

Across most age groups, products in the Chemicals group were found to be the most common source of occupational exposure (Table 9). The 16-19 and 65+ age groups, however, had different product groups implicated as the most common exposure types. Approximately 20% of exposures reported by 16-19 year olds were to Household Cleaning Substances and 23% of exposures in the 65+ group were to Pesticides/Fertilizers.

Exposure substance was also found to vary by gender, with Household Cleaning Substances being the greatest cause of reported exposure among females (4.20 cases per 100,000 employed females). Chemical exposures produced the highest rates in males (6.92 cases per 100,000 employed males) and overall (5.49 cases per 100,000 employed) (Table 10). Cases for which gender was unknown reported substances in the Fumes/Gases/Vapors group as the leading cause of exposure (20.98%) (Table 10).

Table 9: Products implicated in occupational exposures reported to a poison center, By age group, Age 16 and older, Colorado, 2000-2010

Study product grouping[¥]	Age group (years)																	
	16-19		20-24		25-34		35-44		45-54		55-64		65+		Unknown		All Cases	
	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%	N	%
Adhesives/Art, Office Supplies	9	1.57	27	2.26	42	2.09	32	2.14	18	1.87	9	2.38	3	3.30	38	2.28	178	2.13
Alcohols/Deodorizers/Dyes/ Essential Oils	10	1.74	26	2.18	37	1.84	27	1.81	14	1.46	3	0.79	0	0.00	27	1.62	144	1.72
Building and Construction Products	14	2.44	32	2.68	68	3.39	63	4.21	45	4.68	11	2.91	1	1.10	48	2.88	282	3.37
Chemicals	77	13.41	197	16.49	365	18.19	268	17.93	172	17.90	65	17.20	12	13.19	303	18.19	1459	17.44
Cleaning Substances (Household)	116	20.21	150	12.55	193	9.62	144	9.63	115	11.97	36	9.52	8	8.79	154	9.24	916	10.95
Cosmetics/Personal Care Products	4	0.70	17	1.42	20	1.00	15	1.00	4	0.42	3	0.79	3	3.30	21	1.26	87	1.04
Fumes/Gases/Vapors	59	10.28	121	10.13	212	10.56	194	12.98	118	12.28	52	13.76	4	4.40	196	11.76	956	11.43
Heavy Metals	7	1.22	34	2.85	63	3.14	49	3.28	35	3.64	16	4.23	7	7.69	38	2.28	249	2.98
Hydrocarbons	49	8.54	115	9.62	187	9.32	141	9.43	95	9.89	18	4.76	1	1.10	149	8.94	755	9.02
Industrial Cleaners	45	7.84	67	5.61	113	5.63	66	4.41	32	3.33	22	5.82	3	3.30	95	5.70	443	5.29
Other Industrial-use Substances	18	3.14	83	6.95	135	6.73	78	5.22	48	4.99	21	5.56	6	6.59	100	6.00	489	5.84
Other Miscellaneous Substances	34	5.92	45	3.77	71	3.54	44	2.94	30	3.12	14	3.70	1	1.10	65	3.90	304	3.63
Other/Unknown Non-drug/ Missing Substances	42	7.32	86	7.20	126	6.28	121	8.09	72	7.49	22	5.82	8	8.79	136	8.16	613	7.33
Pesticides/Fertilizers	60	10.45	95	7.95	157	7.82	111	7.42	97	10.09	40	10.58	21	23.08	132	7.92	713	8.52
Pharmaceuticals	25	4.36	95	7.95	210	10.46	137	9.16	62	6.45	45	11.90	13	14.29	149	8.94	736	8.80
Plant-based Substances	5	0.87	5	0.42	8	0.40	5	0.33	4	0.42	1	0.26	0	0.00	15	0.90	43	0.51
Total	**574 (6.86)**		**1195 (14.28)**		**2007 (23.99)**		**1495 (17.87)**		**961 (11.49)**		**378 (4.52)**		**91 (1.09)**		**1666 (19.91)**		**8367**	**100**

Source: Rocky Mountain Poison and Drug Center (RMPDC) data from the National Poison Data System (NPDS)

[¥] *See Methods and Appendix B*

Table 10: Products implicated in occupational exposures reported to a poison center, By gender, Gender-stratified percentages and rates, Age 16 and older, Colorado, 2000-2010

Study product grouping[¥]	Gender										
	Female (N=3,202)			Male (N=4,960)			Unknown (N=205)		All Cases (N=8,367)		
	N	%	Rate per 100,000 Employed	N	%	Rate per 100,000 Employed	N	%	N	%	Rate per 100,000 Employed
Adhesives/Art, Office Supplies	75	2.34	0.63	96	1.94	0.66	7	3.41	178	2.13	0.67
Alcohols/Deodorizers/Dyes/Essential Oils	56	1.75	0.47	82	1.65	0.56	6	2.93	144	1.72	0.54
Building and Construction Products	43	1.34	0.36	239	4.82	1.64	0	0.00	282	3.37	1.06
Chemicals	430	13.43	3.59	1009	20.34	6.92	20	9.76	1459	17.44	5.49
Cleaning Substances (Household)	504	15.74	4.20	406	8.19	2.79	6	2.93	916	10.95	3.45
Cosmetics/Personal Care Products	65	2.03	0.54	22	0.44	0.15	0	0.00	87	1.04	0.33
Fumes/Gases/Vapors	396	12.37	3.30	517	10.42	3.55	43	20.98	956	11.43	3.60
Heavy Metals	41	1.28	0.34	202	4.07	1.39	6	2.93	249	2.98	0.94
Hydrocarbons	220	6.87	1.84	519	10.46	3.56	16	7.80	755	9.02	2.84
Industrial Cleaners	208	6.50	1.74	227	4.58	1.56	8	3.90	443	5.29	1.67
Other Industrial-use Substances	106	3.31	0.88	357	7.20	2.45	26	12.68	489	5.84	1.84
Other Miscellaneous Substances	125	3.90	1.04	162	3.27	1.11	17	8.29	304	3.63	1.14
Other/Unknown Non-drug/Missing Substances	234	7.31	1.95	363	7.32	2.49	16	7.80	613	7.33	2.31
Pesticides/Fertilizers	316	9.87	2.64	384	7.74	2.64	13	6.34	713	8.52	2.68
Pharmaceuticals	364	11.37	3.04	351	7.08	2.41	21	10.24	736	8.80	2.77
Plant-based Substances	19	0.59	0.16	24	0.48	0.16	0	0.00	43	0.51	0.16
Total	**3202**	**100.00**	**26.71**	**4960**	**100.00**	**34.04**	**205**	**100.00**	**8367**	**100.00**	**31.50**

Source: Rocky Mountain Poison and Drug Center (RMPDC) data from the National Poison Data System (NPDS)
Numerator: Reported cases of work-related exposures from Colorado RMPDC case-level data in NPDS
Denominator: 2000-2011 sum of employed persons age 16 years and older in respective gender categories as reported by the Bureau of Labor Statistics (BLS) Geographic Profile of Employment and Unemployment
[¥] *See Methods and Appendix B*

Table 11 shows that the distribution of certain substances implicated in occupational exposures differed between males and females. Males comprised the majority of exposures to the Building and Construction Products, Chemicals, Heavy Metals, Hydrocarbons, and Other Industrial-use Substances study product groupings. In comparison, females reported poison exposures to Cosmetics/Personal Care Products at a higher proportion than males.

Table 11: Products implicated in occupational exposures reported to a poison center, By gender, Product-stratified percentages, Age 16 and older, Colorado, 2000-2010

Study product grouping[¥]	Gender							
	Female		Male		Unknown		Total	
	N	% of product exposures	N	% of product exposures	N	% of product exposures	N	% of product exposures
Adhesives/Art, Office Supplies	75	42.13	96	53.93	7	3.93	178	100.0
Alcohols/Deodorizers/Dyes/Essential Oils	56	38.89	82	56.94	6	4.17	144	100.0
Building and Construction Products	43	15.25	239	84.75	0	0.00	282	100.0
Chemicals	430	29.47	1009	69.16	20	1.37	1459	100.0
Cleaning Substances (Household)	504	55.02	406	44.32	6	0.66	916	100.0
Cosmetics/Personal Care Products	65	74.71	22	25.29	0	0.00	87	100.0
Fumes/Gases/Vapors	396	41.42	517	54.08	43	4.50	956	100.0
Heavy Metals	41	16.47	202	81.12	6	2.41	249	100.0
Hydrocarbons	220	29.14	519	68.74	16	2.12	755	100.0
Industrial Cleaners	208	46.95	227	51.24	8	1.81	443	100.0
Other Industrial-use Substances	106	21.68	357	73.01	26	5.32	489	100.0
Other Miscellaneous Substances	125	41.12	162	53.29	17	5.59	304	100.0
Other/Unknown Non-drug/Missing Substances	234	38.17	363	59.22	16	2.61	613	100.0
Pesticides/Fertilizers	316	44.32	384	53.86	13	1.82	713	100.0
Pharmaceuticals	364	49.46	351	47.69	21	2.85	736	100.0
Plant-based Substances	19	44.19	24	55.81	0	0.00	43	100.0
Total	3202		4960		205		8367	

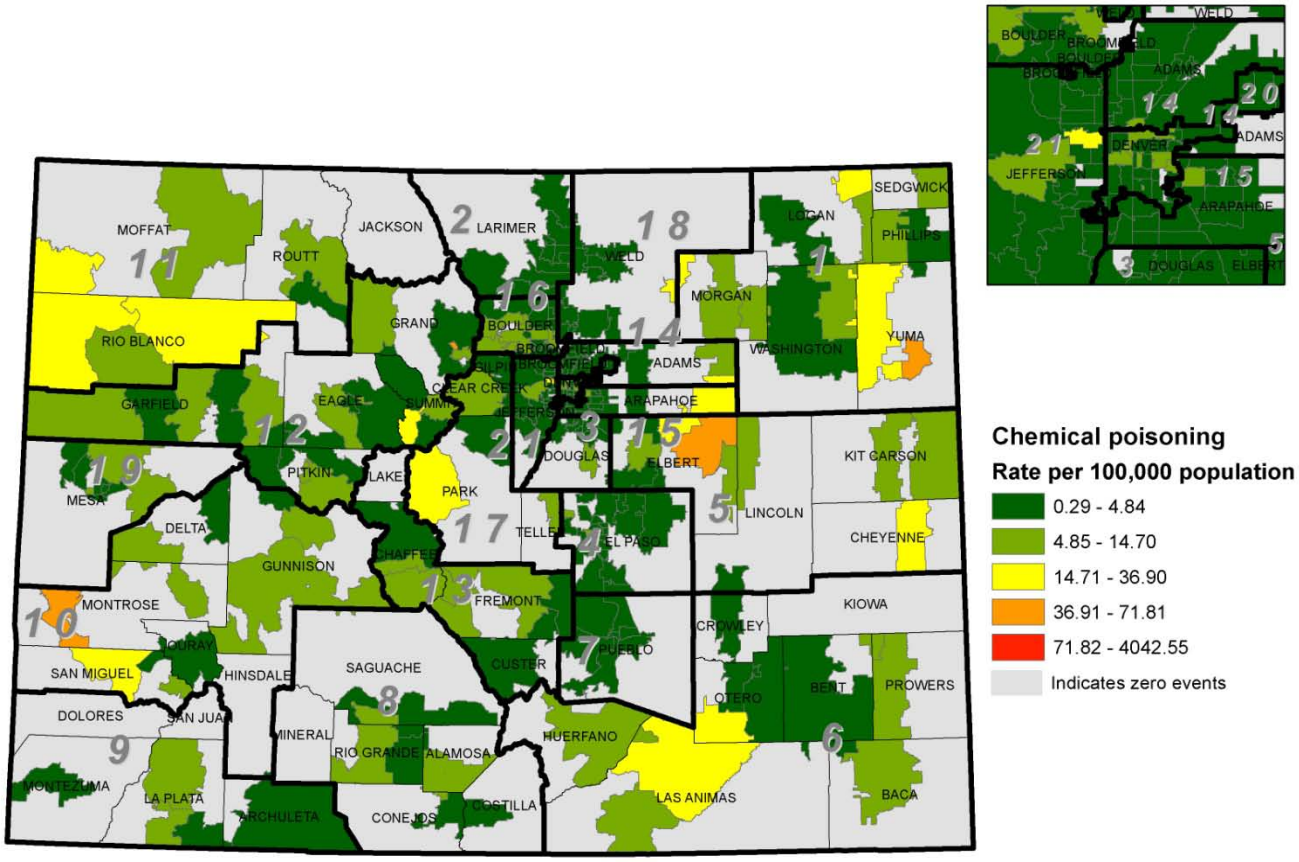
Source: Rocky Mountain Poison and Drug Center (RMPDC) data from the National Poison Data System (NPDS)

[¥] *See Methods and Appendix B*

Geographic Distribution

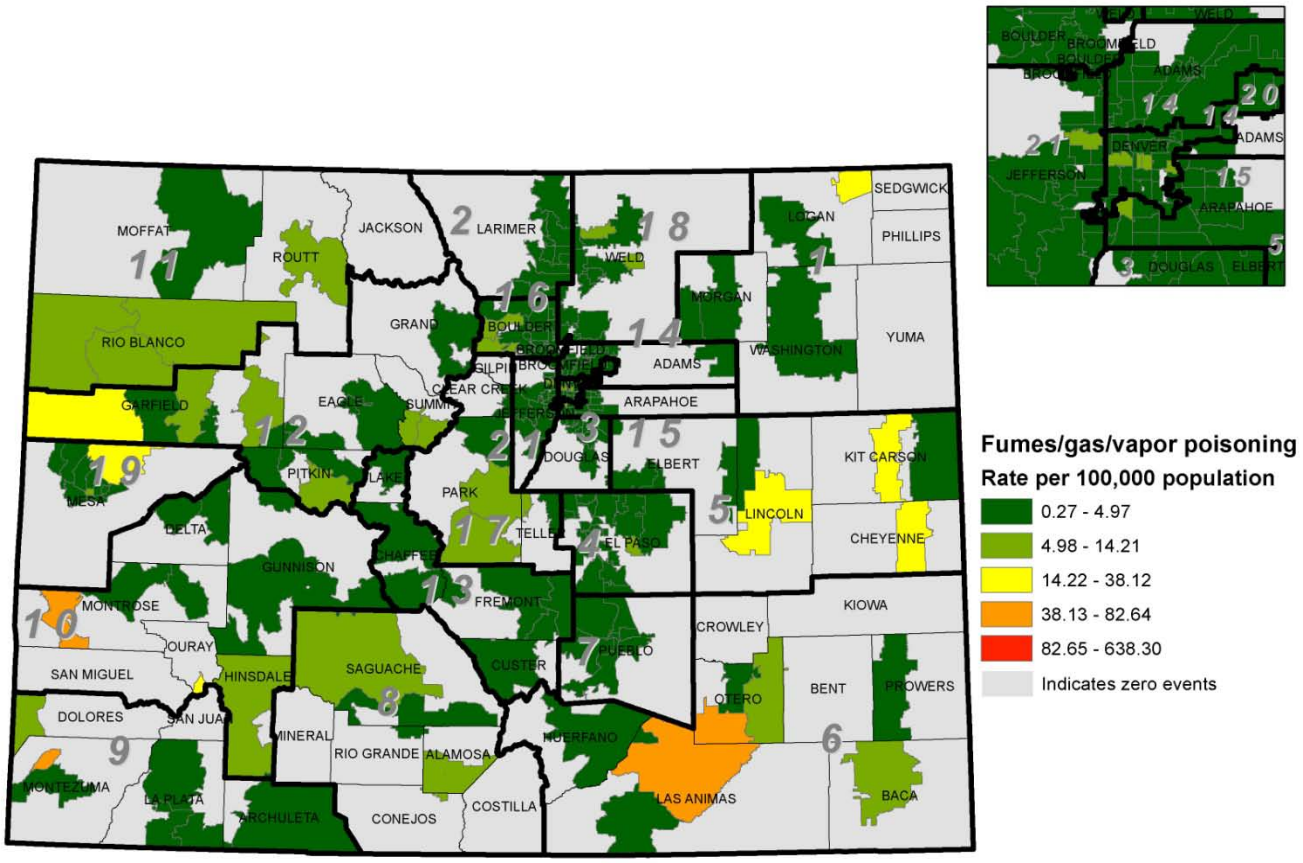
Caller zip code is routinely collected and transmitted to NPDS. The maps below (Figures 7-9) show that geographic distribution of exposure phone calls placed to RMPDC varied by the exposure substance. Cases with occupational exposure to the top two substance categories, Chemicals and Fumes/Gases/Vapors, and to substances of interest in occupational health and safety surveillance, Pesticides/Fertilizers, were chosen for this analysis. Exposures to all three of these product groupings were most commonly reported from metro-area zip codes; however, exposure rates were higher in rural-area zip codes. Reported exposure rates for Chemicals and Fumes/Gases/Vapors (Figures 7 and 8) were similarly distributed, with elevated rates in western, southwest, southern-central, and eastern Colorado zip codes. Rates of Pesticide/Fertilizer exposure (Figure 9) were highest along Colorado's eastern border. (See the Discussion section for more information on interpreting geographic results.)

Figure 7: Crude rates of occupational exposures to Chemicals[¥] reported to a poison center, By caller zip code, Age 16 and older, Colorado, 2000-2010



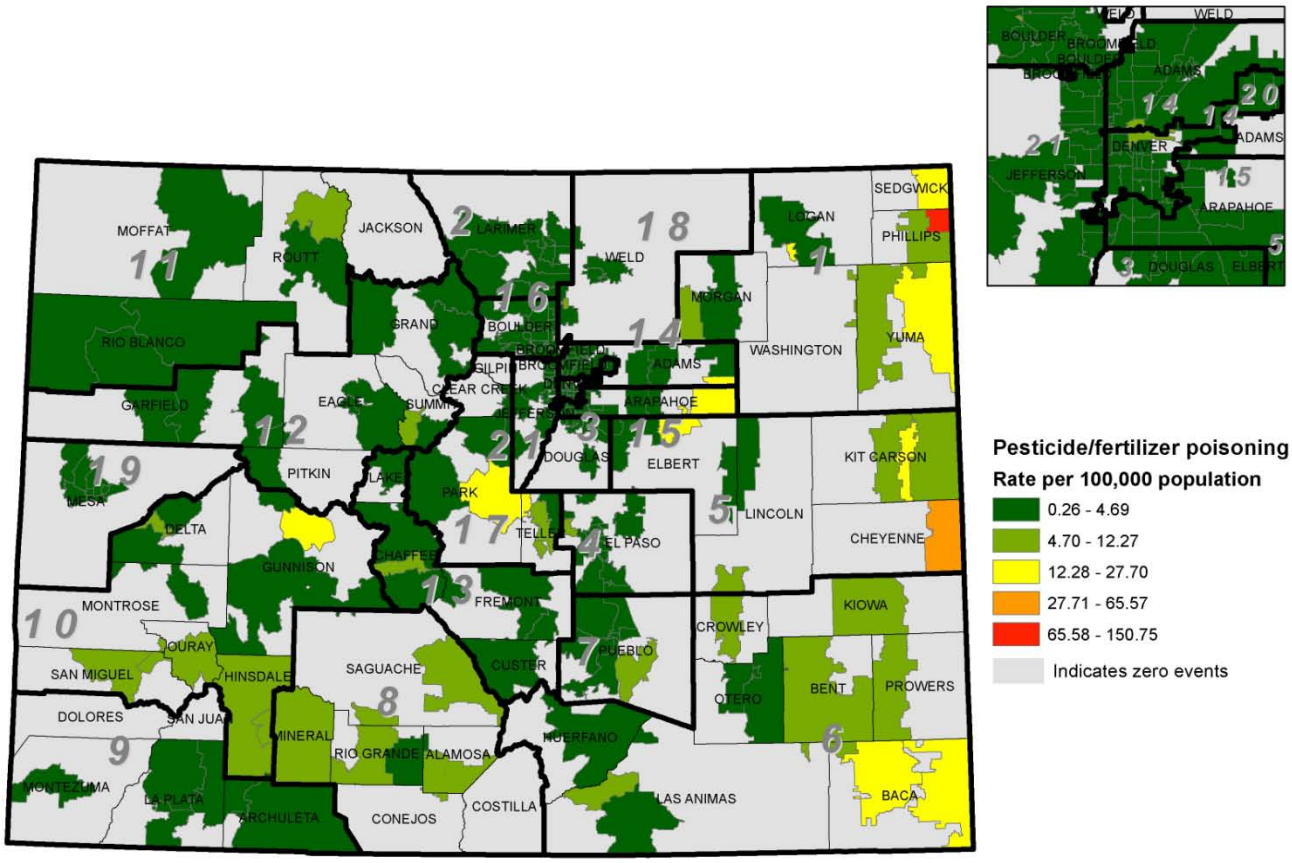
Source: Rocky Mountain Poison and Drug Center (RMPDC) data from the National Poison Data System (NPDS)
Numerator: Reported cases of work-related exposure from Colorado RMPDC case-level data in NPDS, Age 16 and older
Denominator: ZIP code populations based on 2010 ESRI, multiplied by 11 to reflect number of poisoning data years. Includes all ages.
Prepared by: Colorado Occupational Health and Safety Surveillance Program and Health Statistics Section, Colorado Department of Public Health and Environment (CDPHE)
Rates are per 100,000 population in ZIP code
County and CDPHE Health Statistics Regions boundaries are included for reference
[¥] *"Chemicals" refers to those products included in the study product grouping called "Chemicals". See Appendix B*

Figure 8: Crude rates of occupational exposures to Fumes/Gases/Vapors[¥] reported to a poison center, By caller zip code, Age 16 and older, Colorado, 2000-2010



Data source: Rocky Mountain Poison and Drug Center (RMPDC) data from the National Poison Data System (NPDS)
Numerator: Reported cases of work-related exposure from Colorado RMPDC case-level data in NPDS, Age 16 and older
Denominator: ZIP code populations based on 2010 ESRI, multiplied by 11 to reflect number of poisoning data years. Includes all ages.
Prepared by: Colorado Occupational Health and Safety Surveillance Program and Health Statistics Section, Colorado Department of Public Health and Environment
Rates are per 100,000 population in ZIP code
County and CDPHE Health Statistics Regions boundaries are included for reference
[¥] *"Fumes/Gases/Vapors" refers to those products included in the study product grouping called "Fumes/Gases/Vapors". See Appendix B*

Figure 9: Crude rates of occupational exposures to Pesticides/Fertilizers[¥] reported to a poison center, By caller zip code, Age 16 and older, Colorado, 2000-2010



Data source: Rocky Mountain Poison and Drug Center (RMPDC) data from the National Poison Data System (NPDS)
Numerator: Reported cases of work-related exposure from Colorado RMPDC case-level data in NPDS, Age 16 and older
Denominator: ZIP code populations based on 2010 ESRI, multiplied by 11 to reflect number of poisoning data years. Includes all ages.
Prepared by: Colorado Occupational Health and Safety Surveillance Program and Health Statistics Section, Colorado Department of Public Health and Environment
Rates are per 100,000 population in ZIP code
County and CDPHE Health Statistics Regions boundaries are included for reference
[¥] *"Pesticides/Fertilizers" refers to those products included in the study product grouping called "Pesticides/Fertilizers". See Appendix B. Products identified by NPDS as fertilizers comprise less than 3% of this grouping.*

DISCUSSION

The results of this study support the utility of poison center data in occupational and public health surveillance efforts. NPDS is the only US surveillance system that provides near-real time information on toxic exposures and their associated morbidities and mortalities. Additionally, exposure cases captured through poison centers reflect a significant burden of occupational injury that may not require extensive medical care (with 39.13% of cases not receiving care in a health care facility). This indicates that NPDS may contain novel cases that are not reported through other hospital-or clinic-based surveillance programs, workplace injury reports, or workers' compensation reports.

Reported occupational exposure rates have been declining in more recent years. The reasons for the decline are unknown, though may simply reflect the overall decline in poison center call volume in Colorado and nationwide. Never the less, RMPDC Colorado data show that about 22 incidents per 100,000 employed persons aged 16 and older occurred in 2010 despite current intervention and education efforts. In this study, nearly half of all comparable non-occupational exposures occurred from ingestion, and were most commonly ascribed to pharmaceuticals. This contrasts with occupational exposures, which were more frequently due to inhalation, ocular exposure, or dermal exposures, and ascribed to most commonly ascribed to chemicals, fumes, gases, or vapors, household cleaning substances, and hydrocarbons. Some of these substances are widely used both inside and outside workplace environments, and should be a focus of public health injury prevention efforts.

In this study, the majority of occupational exposures (approximately 76%) were reported as having minor medical outcomes or assumed to have minor medical outcomes (i.e. not followed, minimal clinical effects possible). This proportion of minor injuries was similar to that of the non-occupational study group. In this analysis, however, occupational exposures were more often reported from a healthcare facility than were non-occupational exposures (30.3% vs. 12.0%, respectively). This finding suggests that persons exposed to toxic substances in the workplace are more likely to seek or require medical care. Further research is needed to confirm and draw conclusions on this finding.

While the 25-34 year old age group experienced the highest incidence of work-related exposures, younger age groups had higher rates, with 16-19 year olds having an average annual rate of 54 reported exposures per 100,000 employed. This observed inverse relationship between exposure rate and age group is consistent with occupational poisoning data found in other studies [12], but is reverse to trends found in other Colorado occupational, non-poisoning injury datasets[13]. However, as nearly 20% of occupational exposure calls did not report age, these findings should be interpreted with caution.

In these data, males not only reported occupational events at a higher frequency and rate compared to females, but they also reported more major medical outcomes. Though males and young workers appear to be at higher risk in these data, NPDS does not contain information on the industries and occupations associated with toxic substance exposures. In order to target prevention efforts based on age and gender, more information is needed to understand where and how exposures occur.

Occupational exposures to the study product groupings Chemicals, Fumes/Gases/Vapors, and Pesticides/Fertilizers were more commonly called in from Colorado's urban areas, but rates were higher in rural areas. Zip codes located in western, southwestern, southern-central, and eastern Colorado had the highest rates of callers reporting to the RMPDC for Chemical and Gas/Fume/Vapor exposures. Geographic distribution differed for reporting of Pesticide/Fertilizer exposure, which had higher rates along Colorado's eastern state lines. Reasons for these higher observed reporting rates in rural areas might be complex or artifacts of the analyses methods, and need to be further investigated.

Strengths and Limitations

NPDS is a passive surveillance system relying on self-reports, and this results in at least six sources of information and reporting biases which may affect the quality of the data used for this analysis. First, poison centers may not capture all toxic substance exposure cases, as more acute and severe cases may bypass a poison center hotline and seek immediate medical care at a health facility. Second, proclivity to seek care or call the poison center for less severe events may vary by age or gender, which would affect conclusions drawn by differences in proportions and rates across these variables. Third, the caller reporting the exposure may not be the exposed worker or the clinician treating the worker; accordingly, information reported to the poison center may be incomplete or inaccurate. Fourth, the NPDS database is a call-based data system, designed to capture case information from multiple calls, such as separate reporting by the exposed person and his/her health care provider and case follow-up for medical outcome. RMPDC makes every effort to identify and resolve duplicate cases that may result from such multiple calls, however a portion of NPDS exposure reports may not reflect unique cases. Fifth, because nearly a quarter of all exposures occurring at the workplace did not cite occupational as the exposure reason, there may be some fallacy in methods used for identifying work-related exposure calls. Finally, by categorizing multiple substance exposure calls according to the first substance cited, a small portion of these calls may have been assigned to a product grouping that did not accurately reflect the substance responsible for reported clinical effects or medical outcomes.

Though the NPDS dataset is rich in clinical information about exposure circumstances, inclusion of more detailed demographic and employment data would greatly enhance its public health utility. Incomplete and non-reporting of key variables such as age, race, ethnicity, industry, and occupation reduce the ability of the data to accurately describe the true distribution and burden of poisonings in various employment groups.

Regarding geo-spatial analysis, though these data reflect the best possible geographic representation of reported occupational poison exposure in Colorado, geo-coding with only zip code information presents some challenges to interpretation. Zip codes are assigned according to the caller's address and may not necessarily reflect site of the workplace exposure. Zip code boundaries are a construct of the United States Postal Service used to facilitate mail delivery and frequently change[11]. Although occupational poison exposure events occurred over a period of 11 years, the maps included in this report were generated using recent 2010 zip code boundary estimates. Furthermore, the only available population denominator data for the 2010 zip code boundaries included all ages, while cases in the numerator represented only those aged 16 and older. This discordance in numerator-denominator populations would likely result in calculated crude rates that are lower than true rates, but may also skew rates if age distribution significantly differs across certain zip codes.

Conclusions

Although poison center occupational injury reporting numbers may be smaller than other established occupational health surveillance systems, NPDS data could be useful in identifying cases with certain exposures and medical outcomes that would otherwise be left undetected. Despite the limitations associated with a voluntary, self-reported dataset, the sentinel nature and real-time aspect of NPDS may allow for earlier detection of occupational exposures, which, in conjunction with already-established health surveillance programs, may be useful in reducing the morbidity and mortality from resulting injuries.

Between the years 2000-2010, 8,367 workplace exposures to toxic substances in Colorado were reported to RMPDC. Young age groups and males were identified as the highest-risk groups for occupational exposure and often presented with the most severe medical outcomes (or poisoning events), indicating that they are deserving of further study. Additionally, many of the substances and exposure routes involved in occupational events are already targeted in education and prevention efforts, such as the use of precautionary workplace measures in handling these substances and PPE. The finding that exposures still occur via these routes and agents in spite of current prevention efforts suggests that additional or more focused steps need to be pursued to prevent occupational exposure. Poison center data may provide a metric to measure these prevention efforts.

Future Studies

NPDS contains a set of standardized, aggregate data from regional poison centers. Only about 60% of the information that a poison center collects at the time of an exposure phone call is uploaded to NPDS. A more enhanced investigation of Colorado center-level reports in the CasePRO® data system may yield additional information on underlying causes of occupational exposure that can be used to better guide public health efforts. It is also unknown whether RMPDC captures cases that are not reported in other poison surveillance systems based on hospitalization or laboratory reports. As such, it is planned that this study will be followed with a capture-recapture analysis, linking and comparing cases identified in RMPDC CasePRO® data to those identified through Colorado's established surveillance systems for lead and mercury toxicity.

DISCLAIMERS

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This project was approved by the CDPHE Institutional Review Board (Protocol # 2010 010).

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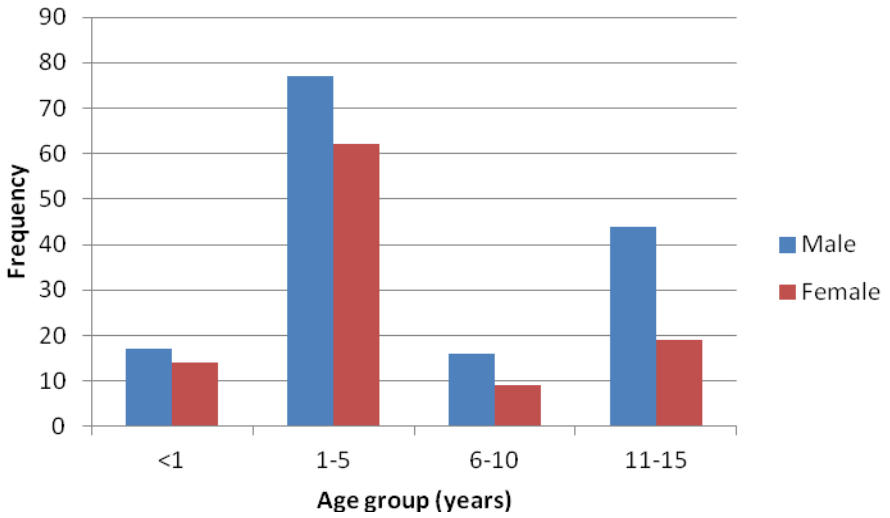
APPENDIX A: Work-place exposures in individuals aged less than 16 years, Colorado, 2000-2010

As noted in Figure 1 of this report, 275 unintentional workplace exposures with study selected medical outcomes were reported in individuals age 15 years and younger over the study period. Further exclusion of case reports that did not meet recommended SSA poisoning criteria (See Figure 1 of this report) yielded a total of 258 cases of work-place poison exposures among juveniles. A limited analysis of this population revealed the following key observations:

- Gender distribution of workplace poison exposures among those less than 16 years of age was similar to that in the ≥16 occupationally exposed population, with 59.70% of reported exposures occurring among males and 40.31% occurring among females (Table A1)
- The majority of exposures occurred in those aged 1-5 years (Figure A1).
- Almost three-quarters (69%) of all exposures were reported from the caller's own residence (Figure A2)
- Similar to adult occupational exposures, most juvenile occupational exposures resulted in minor or minimal possible health outcomes (89.53%), with treatment administered at the worksite (Figure A3)
- More than half (57.36%) of identified workplace exposures in minors occurred via ingestion (Table A3)
- Ocular irrigation and pain and vomiting were the most common reported clinical effects from exposure (14.81% for both effects) (Table A4)
- Minor medical outcomes were the most common reported (Table A5). Moderate medical outcomes were most common in those ages 11-15, with 1-5 year old having the highest proportion not followed due to minimal possible health effects (Table A6)
- The most common exposure substance was to pharmaceuticals, 28.68% (Table A7)
    - Plant-based substances was the most common exposure to those age <1 (Table A8)
    - Pharmaceuticals was the most common exposure to the 1-5 and 6-10 age groups (Table A8)
    - Household cleaning substances was the most common exposure amongst 11-15 year olds (Table A8)

Figure A1: Occupational exposures reported to a poison center, Frequencies by gender and age group, Age 15 and younger, Colorado, 2000-2010



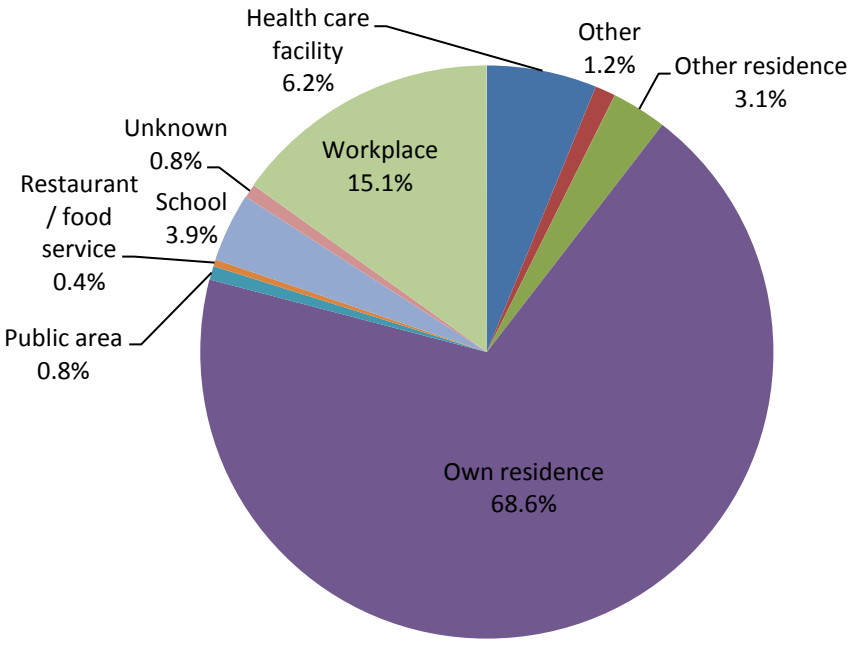
Source: Rocky Mountain Poison and Drug Center (RMPDC) data from the National Poison Data System (NPDS)

Table A1: Occupational exposures reported to a poison center, By gender, Age 15 years and younger, Colorado, 2000-2010

Year	Gender					
	Female		Male		Total	
	N	%	N	%	N	%
2000	5	1.94	9	3.49	14	5.43
2001	6	2.33	4	1.55	10	3.88
2002	32	12.40	32	12.40	64	24.81
2003	4	1.55	27	10.47	31	12.02
2004	8	3.10	14	5.43	22	8.53
2005	7	2.71	14	5.43	21	8.14
2006	7	2.71	6	2.33	13	5.04
2007	4	1.55	9	3.49	13	5.04
2008	9	3.49	19	7.36	28	10.85
2009	12	4.65	5	1.94	17	6.59
2010	10	3.88	15	5.81	25	9.69
Total	**104**	**40.31**	**154**	**59.70**	**258**	**100.00**

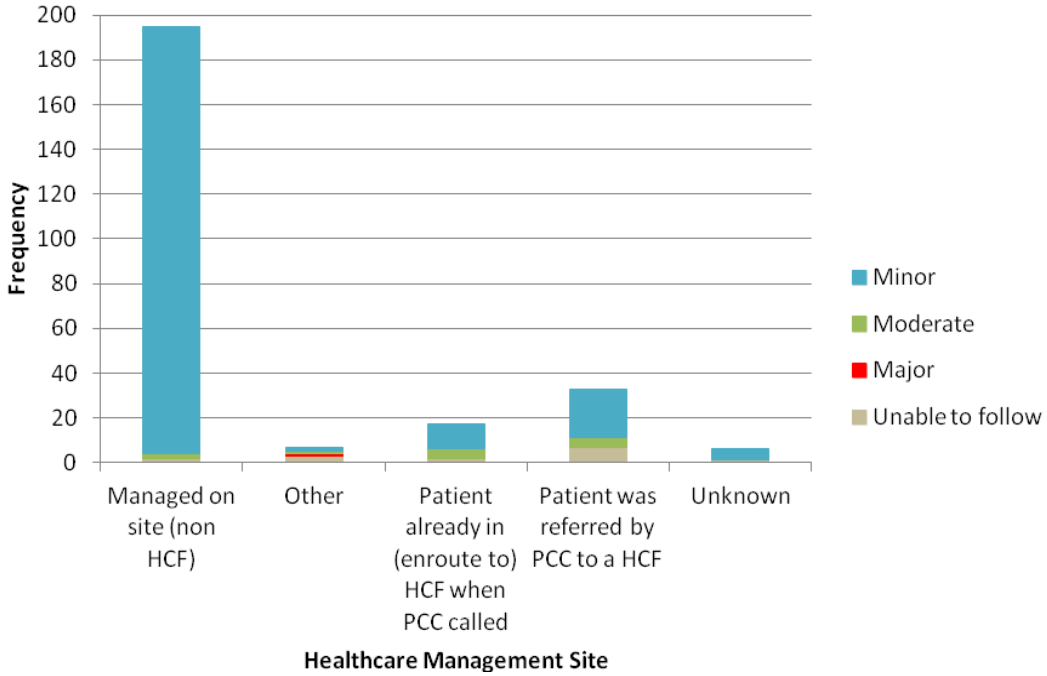
Source: Rocky Mountain Poison and Drug Center (RMPDC) data from the National Poison Data System (NPDS)

Figure A2: Site of caller reporting occupational exposures to a poison center, Age 15 and younger, Colorado, 2000-2010



Source: Rocky Mountain Poison and Drug Center (RMPDC) data from the National Poison Data System (NPDS)

Figure A3: Medical outcome of occupational exposures reported to a poison center, By healthcare management site, Age 15 and younger, Colorado, 2000-2010



Source: Rocky Mountain Poison and Drug Center (RMPDC) data from the National Poison Data System (NPDS)

Table A2: Reasons for occupational exposures reported to a poison center, Age 15 and younger, Colorado, 2000-2010

Exposure reason	Number	Percent
General	140	54.26
Occupational	70	27.13
Misuse	12	4.65
Environmental	11	4.26
Other	8	3.10
Therapeutic error	8	3.10
Drug	5	1.94
Contamination / tampering	2	0.78
Unknown	2	0.78
Total	**258**	**100**

Source: Rocky Mountain Poison and Drug Center (RMPDC) data from the National Poison Data System (NPDS)

Table A3: Routes of occupational exposures reported to a poison center, Age 15 and younger, Colorado, 2000-2010

Exposure route	Number	Percent
Ingestion	148	57.36
Ocular	32	12.40
Inhalation/nasal	29	11.24
Multiple routes	25	9.70
Dermal	22	8.53
Unknown	2	0.78
Total	**258**	**100**

Source: Rocky Mountain Poison and Drug Center (RMPDC) data from the National Poison Data System (NPDS)

Table A4: Top ten clinical effects resulting from occupational exposures reported to a poison center, Age 15 and younger, Colorado, 2000-2010

Clinical effect	Number	% of all work-related poisonings[£] (Total N=258)
Ocular - Irritation/pain	24	14.81
Vomiting	24	14.81
Other	18	11.11
Dermal - Irritation/pain	12	7.41
Drowsiness/lethargy	9	5.56
Erythema/flushed	9	5.56
Throat irritation	9	5.56
Cough/choke	7	4.32
Abdominal Pain	5	3.09
Rash	5	3.09
None reported	96	37.21

Source: Rocky Mountain Poison and Drug Center (RMPDC) data from the National Poison Data System (NPDS)
[£]These data reflect only the top ten, thus do not account for all 258 exposure calls.

Table A5: Medical outcomes of occupational exposures reported to a poison center, By gender, Age 15 and younger, Colorado, 2000-2010

Medical outcome	N (%)		
	Female	Male	All Cases
Major effect	0 (0.00)	1 (0.39)	1 (0.39)
Moderate effect	3 (1.16)	8 (3.10)	11 (4.26)
Minor effect	42 (16.28)	74 (28.68)	116 (44.96)
Not followed, minimal clinical effects possible	56 (21.71)	59 (22.87)	115 (44.57)
Unable to follow, judged as a potentially toxic exposure	3 (1.16)	12 (4.65)	15 (5.81)
Total	**103 (40.31)**	**154 (59.69)**	**258 (100)**

Source: Rocky Mountain Poison and Drug Center (RMPDC) data from the National Poison Data System (NPDS)

Table A6: Medical outcomes of occupational exposures reported to a poison center, By age group, Age 15 and younger, Colorado, 2000-2010

Medical outcome	Age group (years)				
	< 1 N (%)	1-5 N (%)	6-10 N (%)	11-15 N (%)	All Cases N (%)
Major effect	0 (0.00)	1 (100.00)	0 (0.00)	0 (0.00)	1 (0.39)
Moderate effect	2 (18.18)	2 (18.18)	0 (0.00)	7 (63.64)	11 (4.26)
Minor effect	9 (7.76)	61 (52.59)	12 (10.34)	34 (29.31)	116 (44.96)
Not followed[£]	15 (13.04)	69 (60.00)	13 (11.30)	18 (15.65)	115 (44.57)
Unable to follow[€]	5 (33.33)	6 (40.00)	0 (0.00)	4 (26.67)	15 (5.81)
Total	**31 (12.02)**	**139 (53.88)**	**25 (9.69)**	**63 (24.42)**	**258 (100)**

Source: Rocky Mountain Poison and Drug Center (RMPDC) data from the National Poison Data System (NPDS)
[£] *Not followed, minimal clinical effects possible (no more than minor effect possible)*
[€] *Unable to follow, judged as a potentially toxic exposure*

Table A7: Top products implicated in occupational exposures reported to a poison center, Age 15 and younger, Colorado, 2000-2010

Study product groupings[¥]	Number[£] (Total N=258)	% of total cases
Pharmaceuticals	74	28.68
Cleaning Substances (Household)	37	14.34
Cosmetics/Personal Care Products	27	10.47
Pesticides/Fertilizers	23	8.91
Plant-based Substances	17	6.59
Chemicals	12	4.65
Hydrocarbons	12	4.65
Alcohols/Deodorizers/Dyes/Essential oils	9	3.49
Adhesives/Art, Office Supplies	8	3.1
Fumes/Gases/Vapors	8	3.1

Source: Rocky Mountain Poison and Drug Center (RMPDC) data from the National Poison Data System (NPDS)
[£] *This table represents only the top ten product groups, so number does not total to study group sum of 258.*
[¥] *See Methods and Appendix B*

Table A8: Products implicated in occupational exposures reported to a poison center, By age group, Age 15 and younger, Colorado, 2000-2010

Study product grouping[¥]	Age group (years)									
	< 1		1-5		6-10		11-15		All Cases	
	N	%	N	%	N	%	N	%	N	%
Adhesives/Art, Office Supplies	1	3.23	2	1.44	1	4.00	4	6.35	8	3.10
Alcohols/Deodorizers/Dyes/Essential Oils	1	3.23	5	3.60	1	4.00	2	3.17	9	3.49
Building and Construction Products	1	3.23	2	1.44	1	4.00	2	3.17	6	2.33
Chemicals	3	9.68	5	3.60	1	4.00	3	4.76	12	4.65
Cleaning Substances (Household)	5	16.13	16	11.51	4	16.00	12	19.05	37	14.34
Cosmetics/Personal Care Products	5	16.13	15	10.79	1	4.00	6	9.52	27	10.47
Fumes/Gases/Vapors	1	3.23	1	0.72	3	12.00	3	4.76	8	3.10
Heavy Metals	2	6.45	1	0.72	1	4.00	1	1.59	5	1.94
Hydrocarbons	1	3.23	5	3.60	1	4.00	5	7.94	12	4.65
Industrial Cleaners	0	0.00	2	1.44	0	0.00	2	3.17	4	1.55
Other Industrial-use Substances	1	3.23	0	0.00	0	0.00	2	3.17	3	1.16
Other Miscellaneous Substances	0	0.00	4	2.88	0	0.00	3	4.76	7	2.71
Other/Unknown Non-drug/Missing Substances	0	0.00	5	3.60	1	4.00	0	0.00	6	2.33
Pesticides/Fertilizers	2	6.45	15	10.79	1	4.00	5	7.94	23	8.91
Pharmaceuticals	2	6.45	53	38.13	8	32.00	11	17.46	74	28.68
Plant-based Substances	6	19.35	8	5.76	1	4.00	2	3.17	17	6.59
Total	**31 (12.02)**		**139 (53.88)**		**25 (9.69)**		**63 (24.42)**		**258 (100)**	

Source: Rocky Mountain Poison and Drug Center (RMPDC) data from the National Poison Data System (NPDS)

[¥] *See Methods and Appendix B*

Table A9: Products implicated in occupational exposures reported to a poison center, By gender group, Gender-stratified percentages, Age 15 and younger, Colorado, 2000-2010

Study product grouping[¥]	Gender					
	Female		Male		All Cases	
	N	%	N	%	N	%
Adhesives/Art, Office Supplies	5	4.81	3	1.95	8	3.10
Alcohols/Deodorizers/Dyes/Essential Oils	2	1.92	7	4.55	9	3.49
Building and Construction Products	2	1.92	4	2.60	6	2.33
Chemicals	4	3.85	8	5.19	12	4.65
Cleaning Substances (Household)	16	15.38	21	13.64	37	14.34
Cosmetics/Personal Care Products	7	6.73	20	12.99	27	10.47
Fumes/Gases/Vapors	2	1.92	6	3.90	8	3.10
Heavy Metals	3	2.88	2	1.30	5	1.94
Hydrocarbons	5	4.81	7	4.55	12	4.65
Industrial Cleaners	1	0.96	3	1.95	4	1.55
Other Industrial-use Substances	0	0.00	3	1.95	3	1.16
Other Miscellaneous Substances	2	1.92	5	3.25	7	2.71
Other/Unknown Non-drug/Missing Substances	4	3.85	2	1.30	6	2.33
Pesticides/Fertilizers	10	9.62	13	8.44	23	8.91
Pharmaceuticals	33	31.73	41	26.62	74	28.68
Plant-based Substances	8	7.69	9	5.84	17	6.59
Total	**104**	**100.00**	**154**	**100.00**	**258**	**100.00**

Source: Rocky Mountain Poison and Drug Center (RMPDC) data from the National Poison Data System (NPDS)

[¥] *See Methods and Appendix B*

Table A10: Products implicated in occupational exposures reported to a poison center, By gender group, Product-stratified percentages, Age 15 and younger, Colorado, 2000-2010

Study product grouping¥	Gender					
	Female		Male		All Cases	
	N	% of product exposures	N	% of product exposures	N	% of product exposures
Adhesives/Art, Office Supplies	5	62.50	3	37.50	8	100.00
Alcohols/Deodorizers/Dyes/Essential Oils	2	22.22	7	77.78	9	100.00
Building and Construction Products	2	33.33	4	66.67	6	100.00
Chemicals	4	33.33	8	66.67	12	100.00
Cleaning Substances (Household)	16	43.24	21	56.76	37	100.00
Cosmetics/Personal Care Products	7	25.93	20	74.07	27	100.00
Fumes/Gases/Vapors	2	25.00	6	75.00	8	100.00
Heavy Metals	3	60.00	2	40.00	5	100.00
Hydrocarbons	5	41.67	7	58.33	12	100.00
Industrial Cleaners	1	25.00	3	75.00	4	100.00
Other Industrial-use Substances	0	0.00	3	100.00	3	100.00
Other Miscellaneous Substances	2	28.57	5	71.43	7	100.00
Other/Unknown Non-drug/Missing Substances	4	66.67	2	33.33	6	100.00
Pesticides/Fertilizers	10	43.48	13	56.52	23	100.00
Pharmaceuticals	33	43.24	41	55.41	74	100.00
Plant-based Substances	8	47.06	9	52.94	17	100.00
Total	**104**		**154**		**258**	

Source: Rocky Mountain Poison and Drug Center (RMPDC) data from the National Poison Data System (NPDS)

¥ *See Methods and Appendix B*

Preliminary Conclusions

These juvenile exposure calls were identified using the same case definition criteria as was used for the adult exposure calls in this report, except limiting to ages 15 and younger. As explained in Figure 1 in the body of this report, it was observed that all calls citing the exposure reason as "occupational" also cited the exposure site as "workplace". Thus, the primary criterion for identifying occupational poisoning exposures was Exposure Site=Workplace.

The findings in this appendix support the potential for fallacy when using "Exposure Site=Workplace" as a primary identifier of occupational exposure in these data. This conclusion is supported by the following points:

- A large proportion of juveniles in this sub-study group are not of legal working age.
- Pharmaceuticals were the most frequently implicated exposure substances.
- Only 27% of calls cited "occupational" as the exposure reason (Table A2).

However, it should also be noted that some findings suggest opportunities for public health prevention. One being that Household Cleaning Substances was the second leading product group implicated in these exposures and disproportionately affects 11-15 year old children, who may feasibly employ these substances in a paid job.

APPENDIX B: Consolidation of the 67 NPDS-defined product categories into 16 product groupings used for analysis in the study

Study-defined product groupings	NPDS-defined major product categories*	NPDS-defined minor product categories	NPDS-defined product examples¥
Adhesives/Art, Office Supplies	Adhesives/Glues	Miscellaneous Adhesives/Glues	Cyanoacrylates (Superglues, etc), Epoxy, Toluene/Xylene Adhesives
	Arts/Crafts/Office Supplies	Miscellaneous Arts/Crafts/Office Supplies	Artist Paints, Chalks, Clays, Pens or inks, Glazes
Alcohols/Deodorizers/ Dyes/ Essential Oils	Alcohols	Miscellaneous Alcohols	Ethanol (non-rubbing), Isopropanol (Excluding Rubbing Alcohols and Cleaning Agents), Methanol (Excluding Automotive Products and Cleaning Agents)
		Rubbing Alcohols	Ethanol, Isopropanol
	Deodorizers	Air Freshener	(Any form)
		Miscellaneous Deodorizers	Diaper Pail Deodorizers (Excluding Moth Repellants), Toilet Bowl Deodorizers
	Dyes	Miscellaneous Dyes	Chlorate Containing, Fabrics, Foods (Including Easter Egg)
	Essential Oils	Miscellaneous Essential Oils	Cinnamon Oil, Eucalyptus Oil, Tea Tree Oil
Building and Construction Products	Building and Construction Products	Insulation	Asbestos, Fiberglass
		Miscellaneous Building and Construction Products	Caulking Compounds and Construction Putties, Cement or Concrete (Excluding Glues), Soldering Flux
Chemicals	Chemicals	Acids	Hydrochloric Acid
		Miscellaneous Chemicals	Cyanides (Excluding Rodenticides), Dioxins, Formaldehyde, Ketones, Methylene Chloride (Excluding Paint Strippers), Phenol or Creosotes (Excluding Disinfectants), Strychnine (Excluding Rodenticides), Toluene Diisocyanate
Cleaning Substances (Household)	Cleaning Substances (Household)	Automatic Dishwasher Detergents	
		Bleaches	
		Cleansers	
		Disinfectants	
		Drain Cleaners	
		Fabric Softeners/Antistatic Agents	
		Glass Cleaners	
		Hand Dishwashing	
		Laundry Additives	
		Laundry Detergents	
		Laundry Prewash/Stain Removers	

		Miscellaneous Cleaners	
		Miscellaneous Cleaning Substances (Household)	
		Oven Cleaners	
		Rust Removers	
		Spot Removers/Dry Cleaning Agents	
		Toilet Bowl Cleaners	
		Wall/Floor/Tile Cleaners	
Cosmetics/Personal Care Products	Cosmetics/Personal Care Products	Dental Care Products	False Teeth Cleaning Agents, Toothpastes
		Hair Care Products	Curl Activators, Hair Coloring Agents, Hair Relaxers, Hair Sprays
		Hand Sanitizers	
		Miscellaneous Cosmetics/Personal Care Products	Bath Oils and/or Bubble Baths, Creams, Lotions, and Make-Up, Deodorants, Perfumes, Colognes, and Aftershaves, Powders, Soaps, Suntan and/or Sunscreen Products
		Mouthwashes	
		Nail Products	Nail Adhesives, Primers, Polishes, and Removers
Fumes/Gases/Vapors	Fumes/Gases/Vapors	Miscellaneous Fumes/Gases/Vapors	Carbon Dioxide, Carbon Monoxide Chlorine Gas, Hydrogen Sulfide (Sewer Gas), Methane and Natural Gas
	Lacrimators	Miscellaneous Lacrimators	Capsicum Defense Sprays
Heavy Metals	Heavy Metals	Miscellaneous Heavy Metals	Aluminum, Arsenic (Excluding Pesticides), Cadmium, Copper, Lead, Mercury, Selenium, Thallium
Hydrocarbons	Hydrocarbons	Miscellaneous Hydrocarbons	Benzene, Diesel Fuels, Freon and Other Propellants, Gasolines, Toluene and/or Xylene (Excluding Adhesives), Turpentine
Industrial Cleaners	Industrial Cleaners	Miscellaneous Industrial Cleaners	Disinfectants, Acids
Other Industrial-Use Substances	Automotive/Aircraft/Boat Products	Automotive Products	Brake Fluids, Glycol and Methanol Mixtures, Hydrocarbons (Transmission Fluids, Power Steering Fluids, etc)
		Miscellaneous Automotive/Aircraft/Boat Products	
	Batteries	Disc Batteries	Alkaline (MNO2), Lithium, Mercuric Oxide, Nickel Cadmium
		Miscellaneous Batteries	Automotive/Aircraft/Boat Batteries, Penlight/Flashlight/Dry Cell Batteries
	Paints and Stripping Agents	Miscellaneous Paints and Stripping Agents	Varnishes and Lacquers
		Paints	Anti-Algae Paints, Anti-Corrosion Paints, Oil-Base

			Paints, Water Base Paints (Acrylic, Latex, etc), Wood stains
		Stripping Agents	Methylene Chloride Stripping Agents
	Polishes and Waxes	Miscellaneous Polishes and Waxes	Floor Waxes, Polishes, or Sealers, Furniture Polishes
	Waterproofers/Sealants	Miscellaneous Waterproofers/Sealants	
Other Miscellaneous Substances	Fire Extinguishers	Miscellaneous Fire Extinguishers	
	Foreign Bodies/Toys/Miscellaneous	Miscellaneous Foreign Bodies/Toys/Miscellaneous	Ashes, Bubble Blowing Solutions, Charcoals, Feces/Urine, Soil, Toys
		Thermometers	Mercury, Other
	Matches/Fireworks/Explosives	Miscellaneous Matches/Fireworks/Explosives	Explosives, Fireworks, Matches
	Photographic Products	Miscellaneous Photographic Products	Developers, Fixing Baths, Stop Baths, Photographic Coating Fluids
	Sporting Equipment	Miscellaneous Sporting Equipment	Fishing Baits, Golf Balls (Including Liquid Center of Golf Balls), Gun Bluing Compounds
	Swimming Pool/Aquarium	Miscellaneous Swimming Pool/Aquarium	Algicides, Bromine/Chlorine Shock Treatments, Swimming Pool and Aquarium Test Kits
	Weapons of Mass Destruction	Miscellaneous Weapons of Mass Destruction	Anthrax, Nerve Gases, Suspicious Powders in Envelope or Package
Other/Unknown Non-drug/Missing Substances	Other/Unknown Non-drug Substances	Miscellaneous Other/Unknown Nondrug Substances	
Pesticides/Fertilizers[£]	Fertilizers	Miscellaneous Fertilizers	Household Plant Foods (Generally for Indoor Plants), Outdoor Fertilizers
	Pesticides	Fumigants	Aluminum Phosphide, Methyl Bromide, Sulfuryl Fluoride
		Fungicides (Non-medicinal)	Carbamate Fungicides, Copper Compound Fungicides, Mercurial Fungicides, Phthalimide Fungicides, Wood Preservatives
		Herbicides (Including Algaecides, Defoliants, Dessicants, Plant Growth Regulators)	Carbamate Herbicides (Excluding Metam Sodium), Chlorophenoxy Herbicides, Diquat, Glyphosate, Triazine Herbicides, Urea Herbicides
		Insecticides (Including Insect Growth Regulators, Molluscicides, Nematicides)	Carbamate Insecticides, Chlorinated Hydrocarbon Insecticides, Insect Growth Regulators, Metaldehyde, Nicotine (Excluding Tobacco Products), Organophosphate Insecticides, Pyrethrins, Pyrethroids, Rotenone
		Miscellaneous Pesticides	Arsenic Pesticides, Borates and/or Boric Acid Pesticides (Excluding Other Uses), Metam Sodium

		Repellants	Animal Repellents, Insect Repellents, Moth Repellants (Excluding Deodorizing Products)
		Rodenticides	ANTU (1-naphthalenylthiourea), Cholecalciferol Rodenticides, Cyanide Rodenticides, Strychnine Rodenticides
Pharmaceuticals	Analgesics	Acetaminophen Alone	
		Acetaminophen Combinations	
		Acetylsalicylic Acid Alone	
		Acetylsalicylic Acid Combinations	
		Miscellaneous Analgesics	
		Nonsteroidal Antiinflammatory Drugs	
		Opioids	
		Other Acetaminophen and Acetylsalicylic Acid Combinations	
	Anesthetics	Inhalation Anesthetics	
		Local and/or Topical Anesthetics	
		Miscellaneous Anesthetics	
	Anticholinergic Drugs	Miscellaneous Anticholinergic Drugs	
	Anticoagulants	Miscellaneous Anticoagulants	
	Anticonvulsants	Miscellaneous Anticonvulsants	
	Antidepressants	Cyclic Antidepressants	
		Miscellaneous Antidepressants	
	Antihistamines	Miscellaneous Antihistamines	
	Antimicrobials	Anthelmintics	
		Antibiotics	
		Antifungals	
		Antiparasitics	
		Antituberculars	
		Antivirals	
		Miscellaneous Antimicrobials	
	Antineoplastics	Miscellaneous Antineoplastics	
	Asthmas Therapies	Miscellaneous Asthma Therapies	
	Cardiovascular Drugs	Miscellaneous Cardiovascular Drugs	
	Cold and Cough Preparations	Acetaminophen Combinations with Decongestant and/or Antihistamine without Phenylpropanolamine	
		Acetaminophen and Acetylsalicylic Acid Combinations with Decongestant and/or Antihistamine without	

		Phenylpropanolamine	
		Acetaminophen and Phenylpropanolamine Combinations with Decongestant and/or Antihistamine	
		Acetaminophen, Acetylsalicylic Acid, and Phenylpropanolamine Combinations with Decongestant and/or Antihistamine	
		Acetylsalicylic Acid Combinations with Decongestant and/or Antihistamine without Phenylpropanolamine	
		Acetylsalicylic Acid and Phenylpropanolamine Combinations with Decongestant and/or Antihistamine	
		Antihistamine and/or Decongestant with Phenylpropanolamine	
		Antihistamine and/or Decongestant without Phenylpropanolamine	
		Miscellaneous Cold and Cough Preparations	
		Non-Acetylsalicylic Acid Salicylates and Phenylpropanolamine Combinations with Decongestant and/or Antihistamine	
		Non-Acetylsalicylic Acid Salicylates with Decongestant and/or Antihistamine without Phenylpropanolamine	
	Diagnostic Agents	Miscellaneous Diagnostic Agents	
	Dietary Supplements/Herbals/Homeopathic	Amino Acids	
		Botanical Products	
		Cultural Medicines	
		Energy Products	
		Hormonal Products	
		Miscellaneous Dietary Supplements/Herbals/Homeopathic	
		Other Dietary Supplements	
	Diuretics	Miscellaneous Diuretics	
	Electrolytes and Minerals	Miscellaneous Electrolytes and Minerals	
	Eye/Ear/Nose/Throat Preparations	Miscellaneous Eye/Ear/Nose/Throat Preparations	
		Nasal Preparations	

		Ophthalmic Preparations	
		Otic Preparations	
		Throat Preparations	
	Gastrointestinal Preparations	Antacids	
		Antidiarrheals	
		Antispasmodics	
		Miscellaneous Gastrointestinal Preparations	
	Hormones and Hormone Antagonists	Miscellaneous Hormones and Hormone Antagonists	
		Oral Hypoglycemic	
	Miscellaneous Drugs	Other Miscellaneous Drugs	
	Muscle Relaxants	Miscellaneous Muscle Relaxants	
	Narcotic Antagonists	Miscellaneous Narcotic Antagonists	
	Radiopharmaceuticals	Miscellaneous Radiopharmaceutical	
	Sedative/Hypnotics/Antipsychotics	Barbiturates	
		Miscellaneous Sedative/Hypnotics/Antipsychotics	
	Serums/Toxoids/Vaccines	Miscellaneous Serums, Toxoids, Vaccines	
	Stimulants and Street Drugs	Cannabinoids and Analogs	
		Diet Aids	
		Miscellaneous Stimulants and Street Drugs	
	Topical Preparations	Miscellaneous Topical Preparations	
	Veterinary Drugs	Miscellaneous Veterinary Drugs	
	Vitamins	Miscellaneous Vitamins	
		Multiple Vitamin Liquids: Adult Formulations	
		Multiple Vitamin Liquids: Pediatric Formulations	
		Multiple Vitamin Tablets: Adult Formulations	
		Multiple Vitamin Tablets: Pediatric Formulations	
		Multiple Vitamins, Unspecified Adult Formulations	
		Multiple Vitamins, Unspecified Pediatric Formulations	
		Other Vitamins	
	Unknown Drug	Miscellaneous Unknown Drug	

Plant-based Substances	Mushrooms	Miscellaneous Mushrooms	
	Plants	Miscellaneous Plants	
	Tobacco/Nicotine Products	Miscellaneous Tobacco Products	Chewing Tobacco, Cigarettes, Cigars
		Nicotine Containing (Excluding Tobacco Products)	Electronic Cigarettes

***** NPDS regularly updates its product generic code list. The 63 major categories listed in this table are from the October 2, 2011 *AAPCC Pharmaceutical and Non-Pharmaceutical Generic Code List*. An additional four NPDS major categories were excluded from this study and are not listed on this table: Bites and Envenomations, Food products/Food Poisoning, Information Calls, Radiation.Each minor product category contains mutually exclusive products.

¥ Some example products are listed to provide context to readers. This is not the complete list of the products/substances in NPDS.

£ Important Note: This study utilized the CSTE case definition for pesticide products, which includes additional generic codes for 7 disinfectants, 3 herbicides, and 1 rodenticide that are not included in the NPDS-defined major product category for pesticides. These 11 codes were removed from their original NPDS major product categories, and reclassified into the study product grouping for pesticides. For the complete list of generic codes included in the CSTE definition of pesticide products, see the CSTE guidance for Occupational Health Indicators (Reference # 9 in this report).