Poisoned at work, 2015 – 2023

An Updated Evaluation of New Hampshire Occupational Poisoning Calls

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Introduction

This report expands on reports published by the New Hampshire Occupational Health Surveillance Program (NH OHSP) in 2013 and 2016, summarizing substance exposure events reported to the Northern New England Poison Center (NNEPC) from 2015 to 2023. These reports described occupational exposures reported to NNEPC from 2005 to 2011 and 2012 to 2014, respectively, and can be found at:

- Poison Center Data for Occupational Poisoning Exposures from 2005 to 2011, July 2013
- Poisoned at Work: An Updated Evaluation of New Hampshire Occupational Poisoning Calls to the Northern New England Poison Center from 2012 to 2014, March 2016

Overview

Data Source

The Northern New England Poison Center (NNEPC) serves Maine, New Hampshire, and Vermont. The center is nationally accredited by America's Poison Centers [1]. The NNEPC provides a free, 24-hour poison emergency and information help-line available at 1-800-222-1222, online chat at nnepc.org, and by texting POISON to 85511. The NNEPC serves the general public and health care professionals, with TTY and language interpretation service. Each year, the NNEPC manages approximately 30,000 potential exposures, including about 200 New Hampshire occupational exposures. The location of the call determines the state assigned to the case. New Hampshire cases include callers from New Hampshire (whether as determined by landline, or cell phone physical location), but may not necessarily be the state in which the workplace poisoning/exposure occurred nor the residence of the patient. For example, someone calling from New Hampshire with a Massachusetts cell phone number would be logged as a New Hampshire case. Regarding cases reported from hospitals, since calls are location-coded based on the caller location regardless of the patient's residence or the location of original exposure, there may be some added ambiguity in the hospital reported cases. Original exposure location and/or patient's residence are typically not known for hospital reported cases.

An occupational exposure case represents a single individual's contact with a potentially toxic substance. This contact can be self-reported or reported by someone else calling on the patient's behalf (e.g. health care professional, family member, coworker, etc.). Not all NNEPC cases represent an injury. Often the substance was ultimately determined to be non-toxic, or of minor impact to the patient's health (e.g. the exposure amount was not enough to cause

toxicity). This report includes all New Hampshire occupationally related substance exposure cases reported to NNEPC from 2015 to 2023, regardless of health outcome.

Methods

This analysis includes reported occupational (i.e. work) -related cases to the NNEPC from New Hampshire from 2015 to 2023. Only information necessary to do this study was transcribed from the records retained by NNEPC. All personally identifying information (names, phone numbers, company names, addresses, etc.) were excluded from the data set provided by NNEPC to NH OHSP. Industry and occupation were transcribed from case narrative notes and reviewed by NNEPC for data security, and auto-coded using NIOCCS (NIOSH Industry and Occupation Computerized Coding System). NH OHSP used a novel process (outlined here) to evaluate the free-text industry and occupation descriptions as NAICS and SOC codes [2][3][4][5].

All analysis was performed using R statistical programming version 4.2.1.

Results

Number of Events and Cases

During the 9 years from 2015 to 2023, a total of 1,506 work-related calls about distinct exposure events were made from New Hampshire, corresponding to 1,765 cases being reported. These calls include inquiries regarding both exposure to and concern about harmful substances

Figure 1a. Number of Unintentional Occupational Exposure Events Per Year

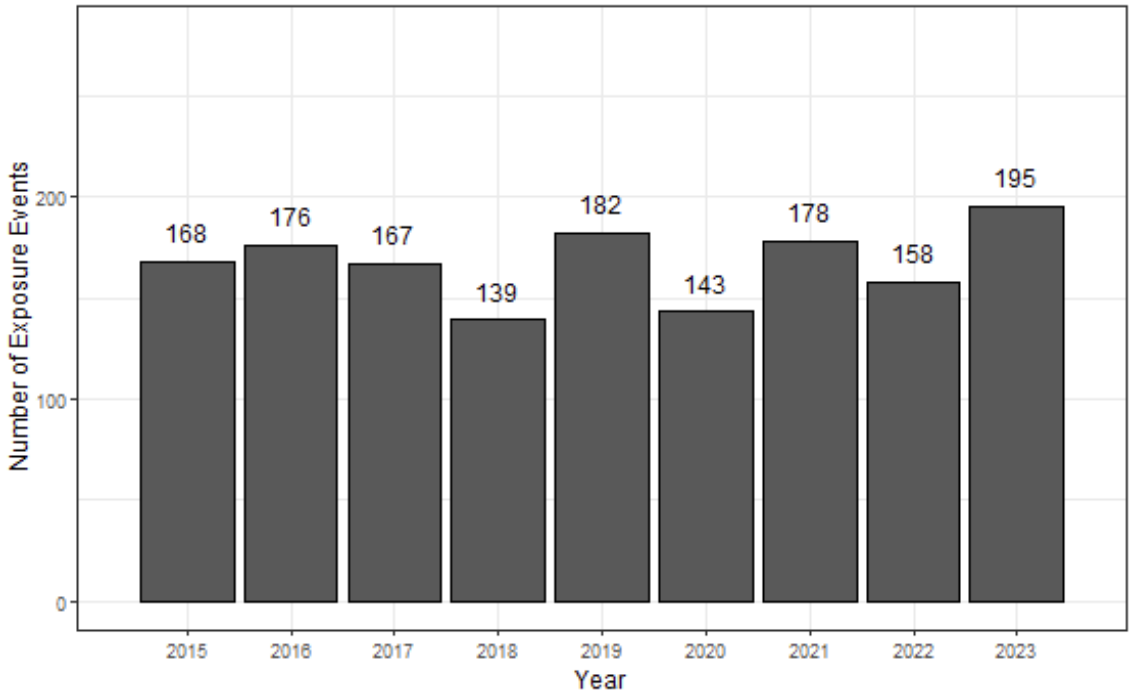
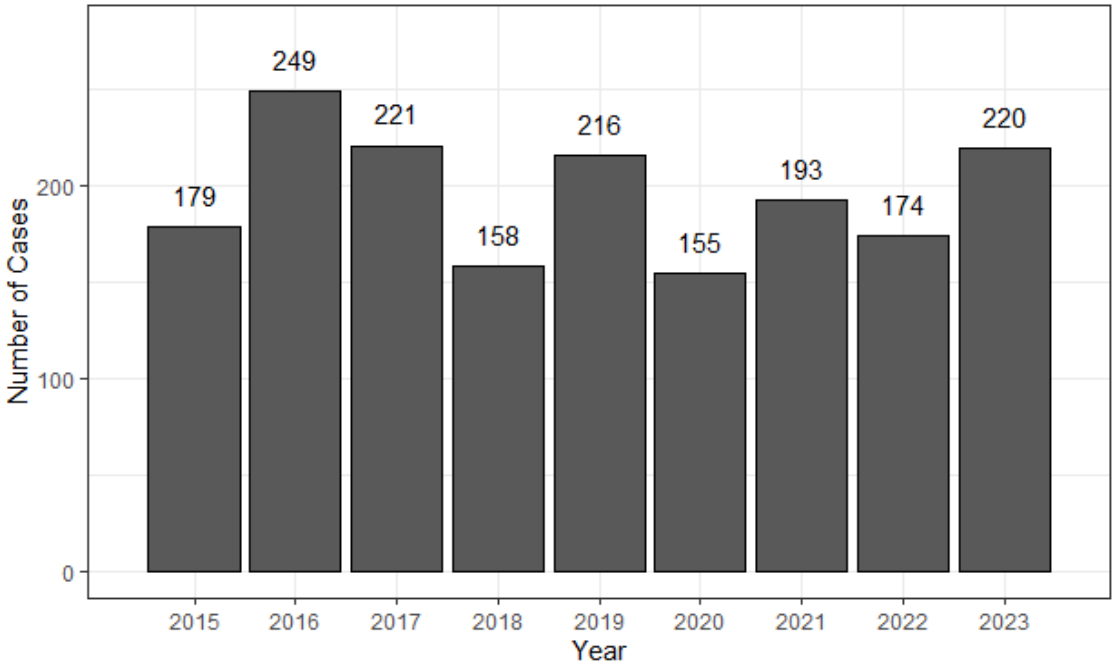


Figure 1b. Number of Unintentional Occupational Exposure Cases Per Year



Most exposure events involved one case being exposed, which means that most often only one person is exposed during an event. However, each year there did appear to be rare, but high number case exposure events. For example, in 2016, 2017, and 2018 there were 60, 30, and 30 case count single exposure event instances (see Table 1).

The years with the highest number of unintentional exposure cases are 2016, 2017, 2023, and 2019 respectively. The peak in exposure cases seen in 2016 appears to be partially due to multiple exposure events; a similar number of events resulted in more cases because there were more multiple exposure events.

There was a very sharp increase of cases from 2018 to 2019, followed by a significant drop in 2020. The decrease in 2020 of reported occupational cased may be related to pandemic increases in remote work and unemployment rates. There was a notable increase from 2022 to 2023 in both exposure events exposure cases.

Table 1: Number of exposure events and cases by year

Year	Exposure Events	Exposure Cases
2015	168	179
2016	176	249
2017	167	221
2018	139	158
2019	182	216
2020	143	155
2021	178	193
2022	158	174
2023	195	220
Sum	1506	1765

Top 5 Substances

The American Association of Poison Control Centers categorizes substances into generic categories (summarized in Figure 2 and Table 2). A call may include information about one or more substance exposures. The most common substance types involved in occupational exposures in New Hampshire were chemicals, cleaning substances, fumes/gases/vapors, heavy metals, and hydrocarbons.

Figure 2. Top 5 Substances by Year

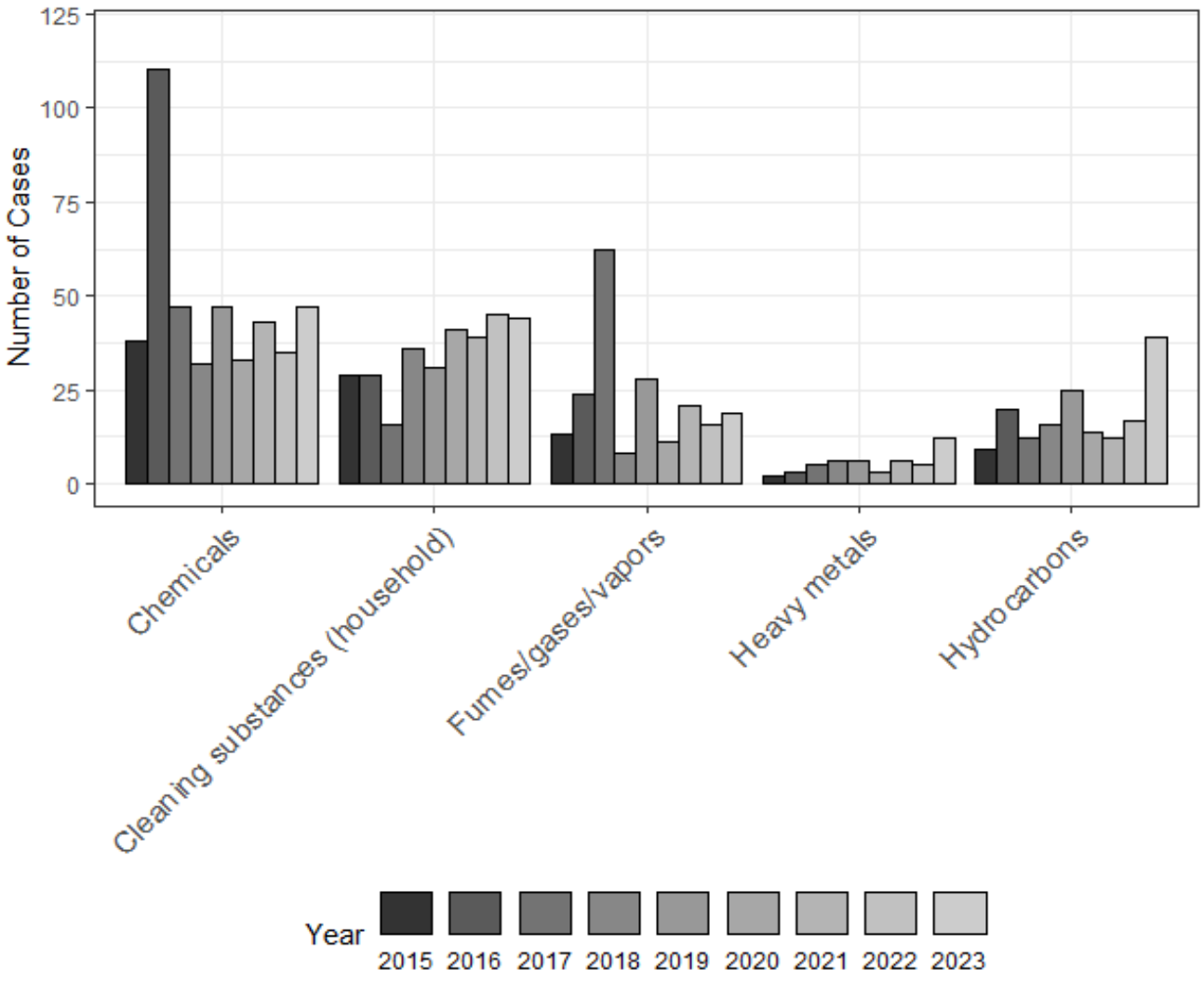


Table 2. Top 5 Substances by Year

Year	Chemicals	Cleaning substances (household)	Fumes / gases/vapors	Heavy metals	Hydrocarbons	Other Substances
2015	38	29	13	2	9	98
2016	110	29	24	3	20	79
2017	47	16	62	5	12	88
2018	32	36	8	6	16	99
2019	47	31	28	6	25	110
2020	33	41	11	3	14	73
2021	43	39	21	6	12	96
2022	35	45	16	5	17	74
2023	47	44	19	12	39	86
Total	432	310	202	48	164	803

In 2016, there was an anomalous event which involved 60 employees. Other than 2016, the numbers of chemicals were fairly consistent through the years. There was a sharp increase in exposures from cleaning substances from 2017 to 2018. 2017 saw a dramatic increase in exposures involving fumes, vapors, and gases. This is followed by a very sharp decrease from 62 to 8 from 2017 to 2018. 2019 saw large increases in exposures due to heavy metals, hydrocarbons, and other substances.

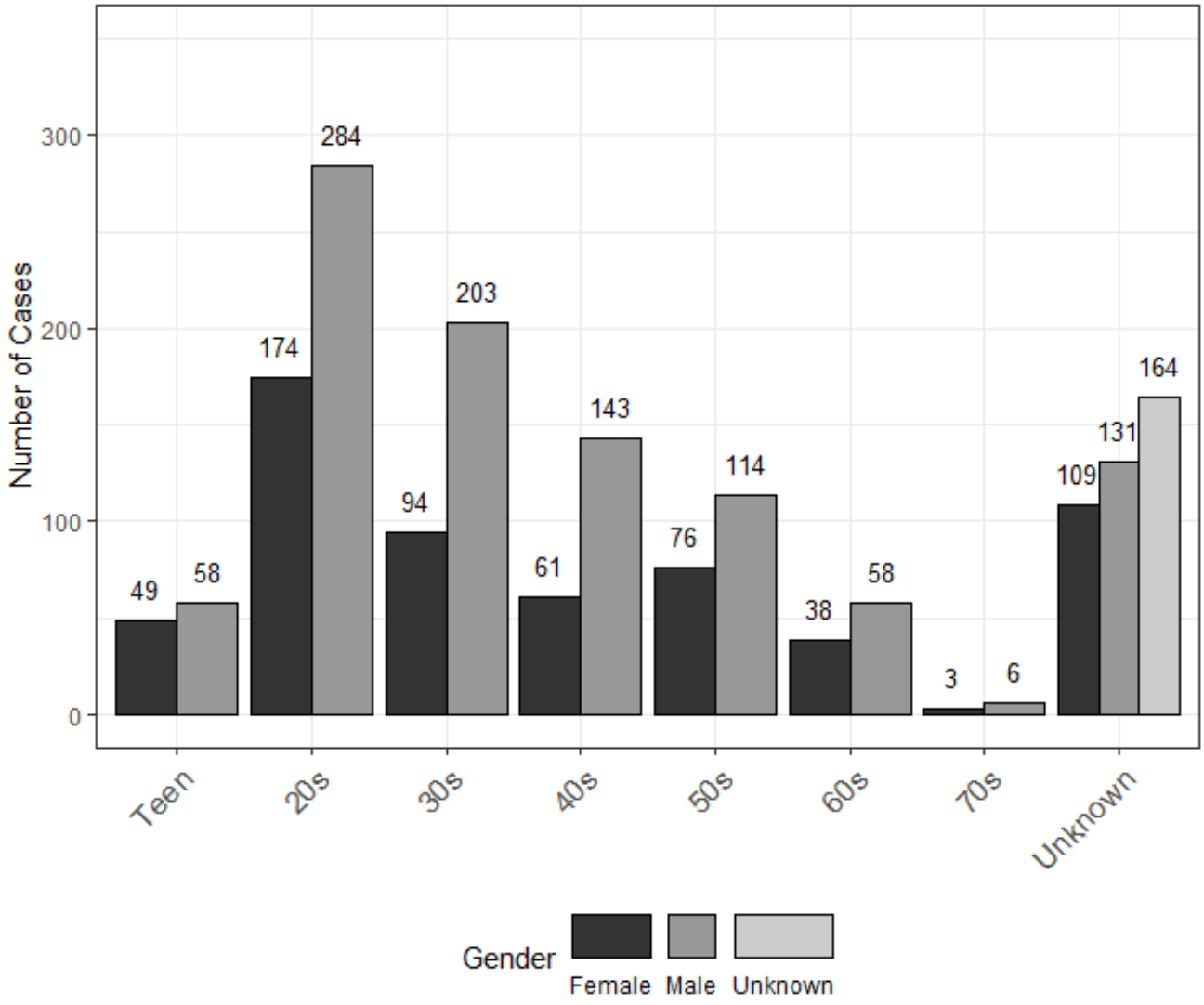
Age and Gender

Males in all age groups are observed to have a higher incidence of exposure when compared to females. Workers in their 20s are the most common age group exposed to a substance. The following table summarizes the number of reports which did and did not include age and/or gender.

Table 3. Age and Gender Missing Information

Gender Status	Age Not Reported	Age Reported
Gender Not Reported	164	0
Gender Reported	240	1361

Figure 3. Age and Gender



Cases were notably higher among males in their 20s as opposed to females in their 20s. The same is true for callers who were in their 30s, as well as their 40s and 50s. The disparity was slightly smaller among callers who were teenagers, and callers in their 60s and 70s. Genders and ages were not always reliably available for mass exposure events, and are reflected in the unknown data above.

Route of Exposure

The following table summarizes the percentage of reported routes of exposure to hazardous substances.

Table 4. Route of Exposure Percentages

Route	Percent
Inhalation	43.8%
Dermal	28.1%
Ocular	26.6%
Ingestion	15.0%
Unknown	0.8%
Parenteral	0.7%
Optic	0.2%
Other	0.1%

Figure 4. Route of Exposure

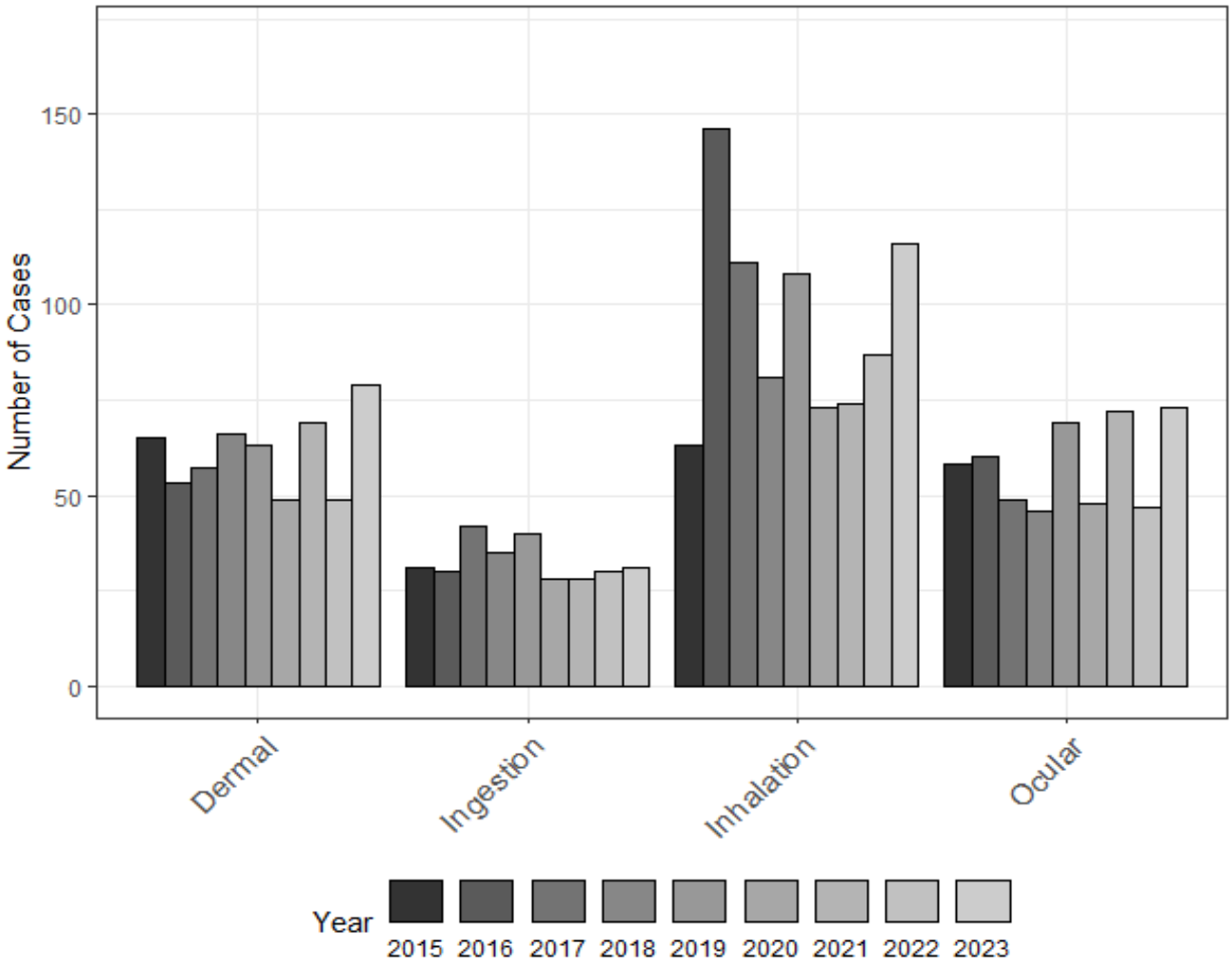


Table 5a. Route of Exposure Cases

Year	Ingestion	Inhalation	Ocular	Dermal
2015	31	63	58	65
2016	30	146	60	53
2017	42	111	49	57
2018	35	81	46	66
2019	40	108	69	63
2020	28	73	48	49
2021	28	74	72	69
2022	30	87	47	49
2023	31	116	73	79
Total	295	859	522	550

The majority of exposure cases came through inhalation, more than 300 cases higher than dermal and ocular routes. Ingestion was lower than all other routes of exposure. Inhalation exposures were particularly high in 2016 (again due to the single 60-person exposure event).

Table 5b. Route of Exposure Events

Year	Ingestion	Inhalation	Ocular	Dermal
2015	30	48	55	61
2016	27	63	59	49
2017	37	56	49	48
2018	31	43	42	46
2019	28	65	61	51
2020	26	52	45	42
2021	27	49	66	59
2022	26	62	46	44
2023	29	76	71	67
Total	261	514	494	467

When looking at only exposure events, as seen above, the increase in 2016 inhalation is not nearly as impactful. Furthermore, when looking at exposure cases per exposure event, as

seen in the following table, one can see that inhalation is more likely to involve multiple patients (1.7 cases per event).

Table 5c. Exposure Cases Per Event, by Route of Exposure and Year

Year	Ingestion	Inhalation	Ocular	Dermal
2015	1.0	1.3	1.1	1.1
2016	1.1	2.3	1.0	1.1
2017	1.1	2.0	1.0	1.2
2018	1.1	1.9	1.1	1.4
2019	1.4	1.7	1.1	1.2
2020	1.1	1.4	1.1	1.2
2021	1.0	1.5	1.1	1.2
2022	1.2	1.4	1.0	1.1
2023	1.1	1.5	1.0	1.2
Total	1.1	1.7	1.1	1.2

Caller Relationship to Patient

A majority of calls (42%) to the Center were reported by medical providers (medical doctor or registered nurse n = 742). Approximately 25% were self-reported, with the balance coming mostly from registered pharmacists and other health professionals (OHP).

Figure 5. Caller Relationship to Patient

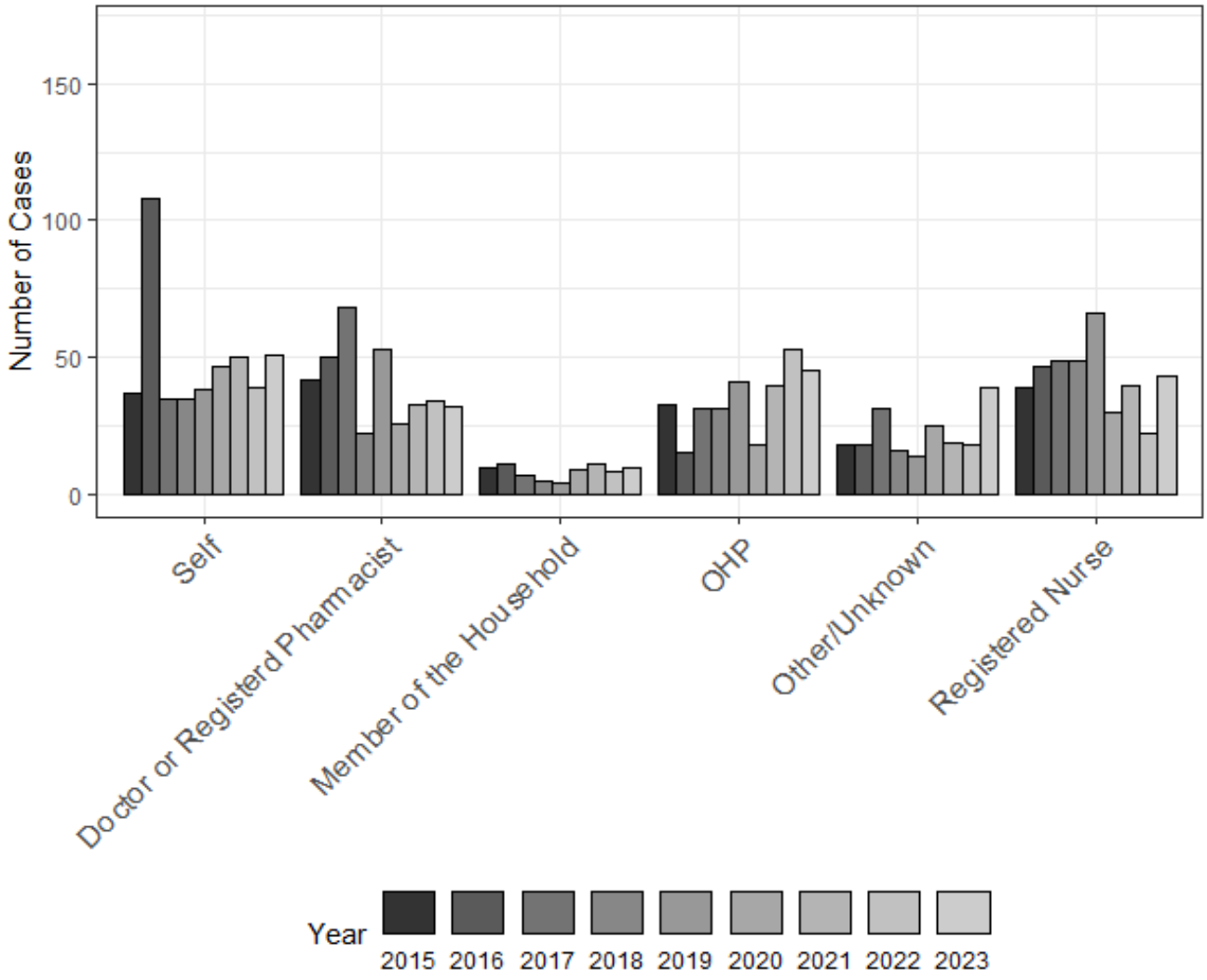


Table 6. Caller Relationship to Patient

Year	Doctor or Registered Pharmacist	Member of the Household	OHP	Other/Unknown	Registered Nurse	Self
2015	42	10	33	18	39	37
2016	50	11	15	18	47	108
2017	68	7	31	31	49	35
2018	22	5	31	16	49	35
2019	53	4	41	14	66	38
2020	26	9	18	25	30	47
2021	33	11	40	19	40	50
2022	34	8	53	18	22	39
2023	32	10	45	39	43	51
Total	360	75	307	198	385	440

Of calls that are not self-report, most came from an individual's doctor or pharmacist, an OHP, or a registered nurse. A far smaller number of calls came from members of the household.

Management Site

A majority of calls occurred while the patient was already at or enroute to the healthcare facility (HCF). The next highest call management site was non-healthcare facility.

Figure 6. Management Site

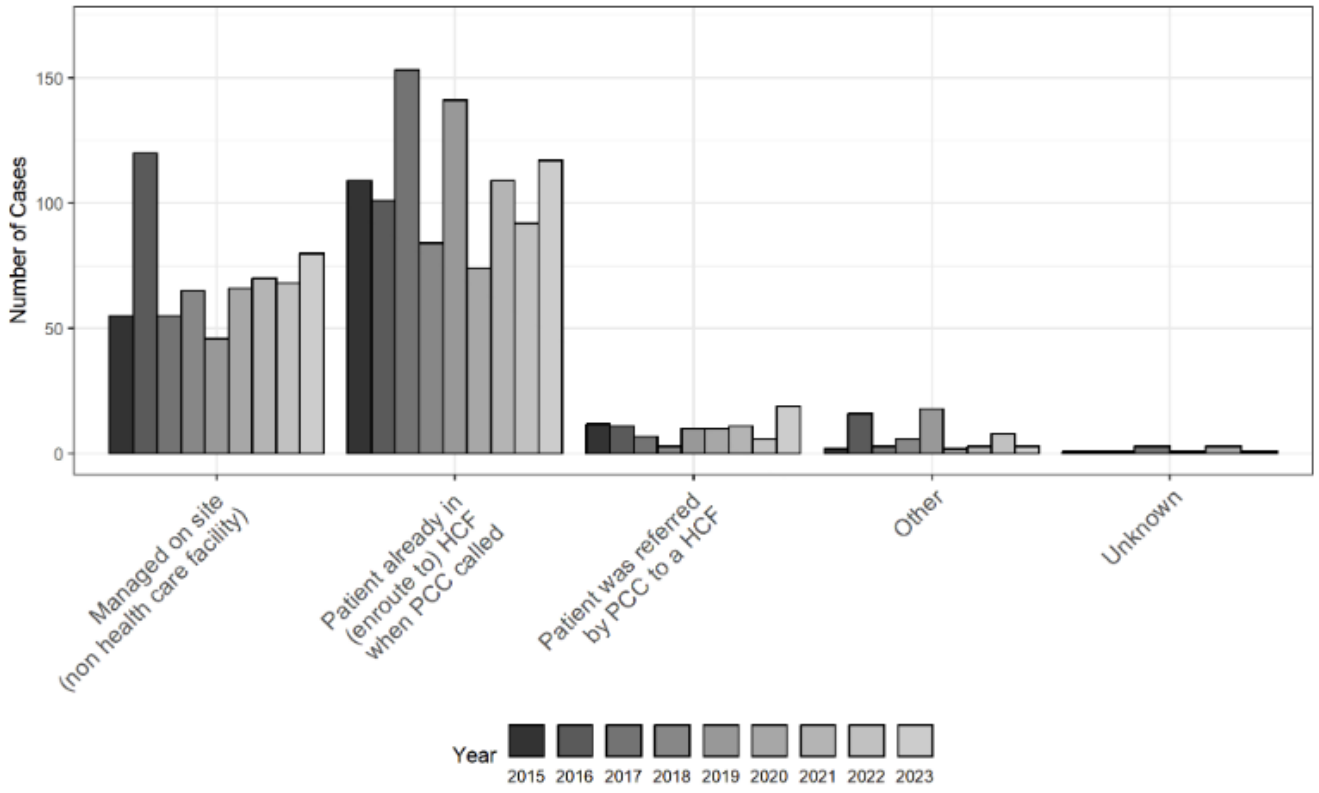


Table 7. Management Site

Year	Managed on site (non-health care facility)	Patient already in (enroute to) HCF when PCC called	Patient was referred by PCC to a HCF	Other	Unknown
2015	55	109	12	2	1
2016	120	101	11	16	1
2017	55	153	7	3	3
2018	65	84	3	6	0
2019	46	141	10	18	1
2020	66	74	10	2	3
2021	70	109	11	3	0
2022	68	92	6	8	0
2023	80	117	19	3	1
Total	625	980	89	61	10

Medical Outcome

There were 1,748 cases with a logged medical outcome, regardless of the exposure management site. Of these, the majority (n=1,160) resulted in minor effect (or were presumed to have minimal to minor effect, as determined at the time of the call).

Figure 7. Medical Outcome

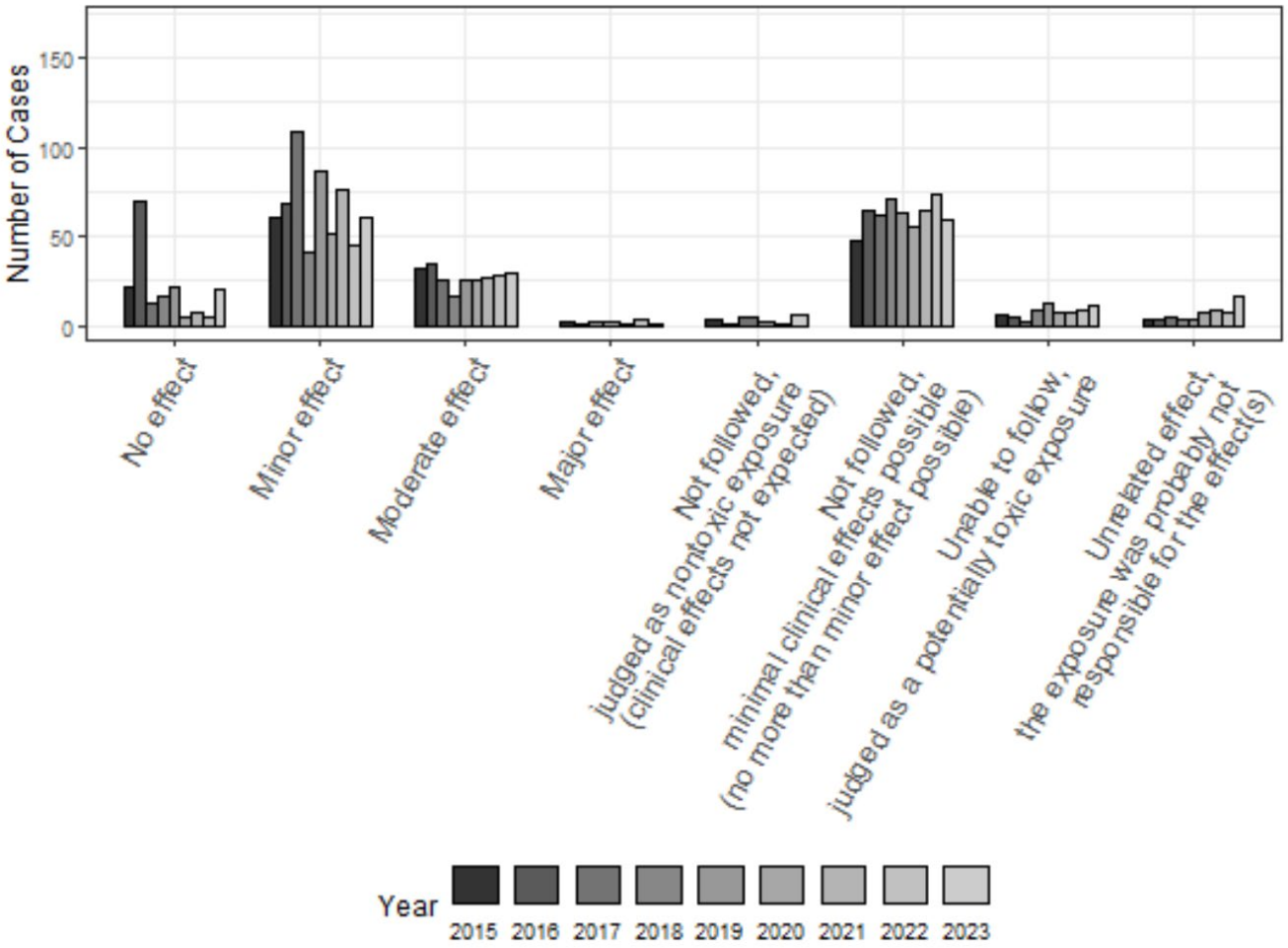


Table 8a. Medical Outcome Effect

Year	No effect	Minor effect	Moderate effect	Major effect
2015	22	60	32	2
2016	70	69	35	1
2017	12	109	26	0
2018	16	41	17	0
2019	22	86	25	2
2020	5	52	26	2
2021	7	76	27	1
2022	5	45	28	4
2023	20	61	30	1
Total	179	599	246	13

Table 8b. Medical Outcome Not Followed/Unable to Follow/Unrelated Effect

Year	Not followed, judged as nontoxic exposure (clinical effects not expected)	Not followed, minimal clinical effects possible (no more than minor effect possible)	Unable to follow, judged as a potentially toxic exposure	Unrelated effect, the exposure was probably not responsible for the effect(s)
2015	4	48	6	4
2016	1	64	5	4
2017	5	62	2	5
2018	0	71	9	4
2019	2	63	12	4
2020	0	55	8	7
2021	0	65	8	9
2022	1	74	9	8
2023	6	59	11	16
Total	19	561	70	61

Industry

Table 9: Industry

Industry	Number of Cases
No Industry Information	560
Manufacturing	225
Health Care and Social Assistance	187
Accommodation and Food Services	113
Retail Trade	96
Administrative and Support and Waste Management and Remediation Services	89
Construction	88
Other Services (except Public Administration)	86
Finance and Insurance	61
Professional, Scientific, and Technical Services	54
Transportation and Warehousing	46
Public Administration	44
Educational Services	43
Utilities	26
Arts, Entertainment, and Recreation	19
Agriculture, Forestry, Fishing and Hunting	12
Wholesale Trade	8
Information	4
Real Estate and Rental and Leasing	2
Mining, Quarrying, and Oil and Gas Extraction	1
U.S. Armed Forces, Military - NIOSH	1

The highest prevalence of exposures was detected among workers in the manufacturing and health care industry (of the cases with sufficient information to classify the worker's industry). The next highest prevalence was in the accommodation and food service, retail, and administrative support, and construction industries.

Table 10: Occupation

Occupation	Number of Cases
No Occupation Information	1099
Building and Grounds Cleaning and Maintenance	104
Healthcare Practitioners and Technical	97
Production	83
Transportation and Material Moving	75
Construction and Extraction	67
Installation, Maintenance, and Repair	52
Protective Service	43
Food Preparation and Serving Related	29
Life, Physical, and Social Science	24
Personal Care and Service	16
Sales and Related	15
Education, Training, and Library	14
Healthcare Support	14
Office and Administrative Support	10
Management	7
Farming, Fishing, and Forestry	5
Business and Financial Operations	4
Architecture and Engineering	3
Arts, Design, Entertainment, Sports, and Media	2
Community and Social Service	2

The highest prevalence of exposures was detected among building and grounds cleaning maintenance occupations, followed by healthcare practitioners, production workers, transportation and material moving, construction workers, and finally installation maintenance and repair workers.

Limitations

The data used in this study included only those calls to the NNEPC, and therefore do not represent all workplace injuries and/or illnesses. The NNEPC is a passive surveillance system relying on self-reports. This can potentially result in several sources of information and reporting limitations.

Regarding the sparsity of industry and occupation in the dataset, many of the cases analyzed did not have information about industry, occupation, or both. Most call the NNEPC to request assistance with managing health concerns. The caller, sometimes a doctor or nurse not related to the patient, often does not have information about occupation or industry when asked. Because the objective of the call is focused on the patient's health, it is not a priority for the health care provider to try to obtain this information.

Incomplete and non-reporting of key variables such as industry and occupation can reduce the ability to accurately describe the true distribution and burden of exposures in various employment groups. Further complicating this analysis is that the industry and occupation information are annotated within a notes field by the resource receiving the call. To aggregate the industry and occupation of workers exposed in a meaningful way (to allow for consistent and reproducible analysis), one must take these open text fields and produce standardized industry (NAICS 2017) and occupation (SOC 2018) codes. This process can result in some loss of nuance, and at worst, can result in misclassification of these work environment variables.

This work utilized the NIOSH Industry and Occupation Computerized Coding System (NIOCCS) to generate these standardized codes [5]. The NIOCCS autocoder is trained on industry and occupation free-text data from NIOSH data sets that are internally reviewed by expert industry and occupation coders. The autocoder has some limitations, the most important of which in this application is its difficulty recognizing some free-text phrases. Sometimes, the autocoder is provided free-text phrase inputs that lie near coding boundaries, areas between multiple coding possibilities, and the autocoder chooses what appears to be the incorrect result. Frequently, this happens because the autocoder has seen more training data examples closer to the codes it selects than the alternative coding possibilities. What is true for most machine-learned algorithms is also true for the NIOCCS autocoder. The autocoder will achieve the best results when coding data with inputs similar

to the inputs in the autocoder's training data, and expected outputs are similar to the outputs in the autocoder's training data.

The NIOCCS autocoder successfully matches expert coders' selections in excess of 90% of the time on our internally reviewed data. These numbers include duplicate records in the expert-reviewed data.[5]

Conclusions

The results of this study support the need for poison center data in occupational and public health surveillance efforts. Exposure cases captured through poison centers reflect a significant burden of occupational injury that may not require extensive medical care (with nearly half of the cases not receiving care in a health care facility). Poison centers may also identify novel cases that are not reported through other hospital or clinic-based surveillance programs, or workplace injury and workers' compensation systems. Though the NNEPC dataset is rich in clinical information about exposure circumstances, inclusion of more detailed demographic and employment data would greatly enhance its public health utility. Understanding the business type of calls to the poison center allows us to better target prevention strategies.

Sources

[1] *About the Northern New England Poison Center*. Northern New England Poison Center. https://www.nnepc.org/about

[2] North American Industry Classification System. NAICS. (https://www.census.gov/naics/)

[3] US Bureau of Labor Statistics Standard Occupational Classification. SOC. (https://www.bls.gov/soc/)

[4] NIOCCS - SOC and NAICS Coding Post-Processing. https://rpubs.com/UNHIoD/1012492

[5] NIOSH (2024). NIOSH Industry and Occupation Computerized Coding System (NIOCCS). U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health, Division of Field Studies & Engineering, Health Informatics Branch. Date accessed 2024-12-12.