Occupational Poisonings: Lessons Learned from Poison Center Narratives

INTRODUCTION

Poison center data offer a valuable source of information that can help us better understand the magnitude and characteristics of work-related poisonings. Harmful chemical substances are common in manufacturing, construction, and service-sector workplaces. Often workers perform activities involving these substances, resulting in inhalation, ingestion, and dermal and ocular exposures. Workers concerned about exposures to hazardous substances often call their local poison center to seek advice about any harm they may experience as a result of their exposure.

Most occupation-related calls to poison centers are the result of exposures to known workplace chemical hazards where concern of adverse health effects prompts a call. Information on occupational poisonings in other data sets, such as hospital discharges, is limited in that the capture of work-related events is based on the *workers' compensation as payer* field and on an accompanying *external cause code* for poisoning. These often lack any descriptive data of the event (aside from information in the medical record itself).

To address the need for more descriptive information about work-related poisonings, we developed and piloted a methodology to qualitatively analyze the circumstance-related narrative text provided in the Northern New England Poison Center's (NNEPC) unintentional occupational poisoning cases.

Data Source: Northern New England Poison Center

The Northern New England Poison Center (NNEPC) is the regional, nationally accredited poison center serving Maine, New Hampshire, and Vermont. It provides a free, 24-hour poison emergency and information hotline that serves the general public and health care professionals and has interpretation services for over 150 languages. Each year, the NNEPC manages more than 30,000 poisoning exposures or cases, approximately 500 of which are occupational poisonings. New Hampshire's portion of these cases is about 150 annually. A New Hampshire case is defined as a call to the poison center originating from New Hampshire, regardless of the state in which the workplace poisoning occurred or the residence of the patient.

A poison center occupational poisoning case represents a single individual's contact with a potentially toxic substance and can be self-reported or reported by someone calling on behalf of the patient (for example, a health care professional or co-worker). Not all NNEPC poisoning cases represent an injury. Sometimes the substance is not toxic or the amount to which the patient is exposed is not enough to cause toxicity. A patient can be exposed to one or multiple substances. In addition, the call may be only to seek information about a potential chemical exposure.

A call to the NNEPC prompts over-the-phone triage and treatment of poisonings. All callers are asked questions to properly determine the poison risk, the treatment plan for the patient, patient demographics (such as age, weight, gender, and postal code), and the poisoning event details (such as chemical substance(s), dose, exposure route, acute versus chronic, time of exposure and call, location of exposure, and caller). Occupational poisoning cases are classified by the poison center based on exposure site (workplace) and the nature of the poisoning (unintentional, excluding medication errors). All related information is captured in the case record. As with any medical record, only the information related to assessment and treatment of the patient is required. Callers may voluntarily share information that can provide valuable insights into the exposure circumstances. Callers may also, however, be reluctant to share these details because they may fear employer retaliation (such as losing their job or work-related privileges) for such disclosures.[1] In addition, these details may or may not be captured in the narrative text, depending on how critical they are to the treatment recommendations, poison center staff available time and complexity of case load, and the individual staff person doing the documentation.

METHODS

This study received Institutional Review Board approval by BRANY, Lake Success, NY. Written informed consent was not obtained because we were accessing existing surveillance data and not contacting any patients. Names and any other identifying information of individual patients were removed.

All NNEPC New Hampshire unintentional occupational poisoning cases (n=417 cases) from January 1, 2005 to October 27, 2007 were included in this study. The case narrative text was analyzed in a case-series manner to determine circumstances surrounding occupational poisonings. Researchers were Masters and Doctorate level specialists in occupational health epidemiology and surveillance. A panel of two experts in occupational health and injury surveillance (specializing in poison center data) performed qualitative assurance on the results. There were three main steps to this study.

Step 1. Transcribe literal version of information contained in the case narratives. Only information necessary to do this study was transcribed and included in the analysis. Any identifiers (names, phone numbers, company names, etc.) were excluded from the data collected.

Step 2. Create a qualitative variable matrix. When available, the case's poisoning circumstance details were extracted from the narrative text and recorded in a variable matrix (Table I). The columns represent cases and the rows the study variables. Only data literally stated or reasonably inferred in the narrative text were documented and included in the matrix; therefore, some of the cases had matrix variables with missing information.

Many of the circumstantial variables included in the matrix (task and event) were used to assist in developing the possible contributing factors (PCFs). Up to two PCFs were documented for each case. The PCFs are not necessarily causal, but may possibly be involved in the exposure etiology. The PCFs are not in order of importance or sequence.

Determining the PCFs was based on the practice of not inferring or documenting beyond what was stated in the narrative. However, even with careful effort to meet this criterion, in practice, some ambiguity did result. Names for PCFs were developed in the process of reading narratives. As knowledge about exposures increased, categories were developed and redefined into those representing the most common PCFs.

Step 3. Tabulate frequency distributions of some study variables.

Cases listed in the matrix were then qualitatively grouped into clusters representing similar events and circumstances. These qualitative groupings were performed ad hoc. The most common business/job type and PCFs are presented. Business type and job type are not independent variables. A case narrative may have included 'store employee' as a descriptor. In this situation, 'store' was coded for business type and 'store employee' was coded for job type.

RESULTS

The 417 New Hampshire unintentional occupational poisoning cases analyzed in this study represented mostly acute exposures. There were no known deaths reported during this period. The amount and type of information included in the narrative section of the poison center medical record was inconsistent. When the details related to the circumstance of the poisoning were included in the narrative, they varied from "caller was splashed, resulting in a dermal and/or ocular exposure" to "caller was drinking soda, while applying a pesticide in a floral shop, and suffered an ingestion exposure." This could be indicative of how critical the case was, poison center staff available time, and the individual staff person doing the documentation. The limited cases with more detail provided rich circumstance information, allowing for greater insight into the conditions leading to the exposure.

Table I. Poisoning Circumstance Variable Matrix

Variable	Variable Explanation	Case Example 1	Case Example 2	Case Example 3
Transcribed case narrative	Literal version of information contained in the case narrative.	*Working on roof air conditioner. Antifreeze sprayed out. Unable to change clothes for 8 hours.*	*Works filling barrels with chlorine gas. Fellow worker left line open while they went to lunch. Upon returning, inhaled gas.*	*Plumber was draining heating oil into a cup. Thought he grabbed his water to drink. Ingested small amount of #2 heating oil.*
Task	What job task was being performed at the time of the exposure? *Brief description (note some of the employees were simply occupying the workplace and are exposed)*	*Maintenance or installation*	*Filling barrels with chlorine gas*	*Draining heating oil into a cup*
Event	What circumstances caused the event?	*Working on roof air conditioner*	*Left line open*	*Drinking from wrong cup*
Job Type	What was the patient's job type (function) determined or inferred?	*Maintenance employee*	*Unknown*	*Plumber*
Business Type	What was the business type (sector) determined or inferred?	*Unknown*	*Chemical Industry*	*Maintenance/ Furnace repair*

Possible Contributing Factor 1 (PCF 1)	What are the possible reasons or contributing factor the exposure happened? *Brief summary drawn from event, task and activity data*	*Mechanical failure*	*Unsafe work practices*	*Employee was eating and/or drinking while working*
Possible Contributing Factor 2 (PCF 2)	What are the possible reasons or contributing factor the exposure happened? *Brief summary drawn from event, task and activity data*	*Personal protective equipment inadequate*	*Not applicable*	*Unsafe work practices*

Business type

Ascertaining business type (Table II) was possible with varying degrees of specificity in only 138 (33 percent) of the 417 cases examined.

Table II. Business Type Classification
(n=138, Missing = 279)

Business Type	Frequency	Percent
Factory/manufacturing/mill	24	17.4
Store (retail)	22	15.9
Building trades	19	13.8
Other*	19	8.0
Maintenance	17	12.3
Laboratory	12	8.7
Health care	9	6.5
Restaurant	9	6.5
Cleaning Service	7	5.1
Total	**138**	**100%**

**Includes groups of all business types with fewer than 5*

Possible Contributing Factors

Possible contributing factors (PCFs) described the multi-dimensional nature of occupational exposures. The PCFs presented were identified from the reviewed case narratives. Sixteen cases were related to chronic exposure to a potentially toxic substance. Most of these were requests for information about health risks associated with a chronic exposure. Two examples are listed below:

- *Worried about long-term exposure to methanol.*
- *A shipyard employee, with 30 years of service, tested positive for lead and arsenic.*

It was possible to determine one or more PCFs in 95 of the acute occupational poisonings. Only 4 cases had two PCFs. Table III provides a complete listing of the PCFs in order of frequency. We

separated the PCFs having to do with personal protective equipment (PPE) even further in order to learn more about each case (inadequate versus malfunctioning PPE). Examples to help describe each contributing factor are listed below the table.

Table III. Possible Contributing Factors (n=99)

Possible Contributing Factors	Frequency
Malfunction or mechanical failure of equipment	25
Unsafe practices	15
Personal protective equipment - inadequate	14
Mixing two or more substances	10
Unsafe practices - delay in first aid response	7
Substance under pressure	7
Eating or drinking while working	6
New procedure*	6
Personal protective equipment - malfunction	5
Substance heated	4
Total	**99**

**Five of the six cases related to one incident/event*

New application or process (n=6)

- *Five patients in emergency department after working with a new fuel oil degreaser.*
- *Fume fever received by welder. Does not normally work with galvanized metal so tolerance was low.*

Malfunctioning or mechanical failure of equipment (n = 25)

- *Heating system not working properly for a few days. Exposed to carbon monoxide.*
- *Received burn from a punctured line leaking Freon 134.*

Mixing two or more substances (n=10)

- *Exposed to vapors while mixing hydrofluoric and nitric acid.*
- *Put a drain cleaner in a dishwasher. There was bleach already in the dishwasher.*

Substance heated (n=4)

- *Substance heated to 160°F. Received a splash/vapor exposure.*
- *Inhaled vapors (maybe sulfuric acid) from overheated battery.*

Substance under pressure (n=7)

- *Bottle of ammonium hydroxide exploded.*
- *Hit in face with stream of hydraulic fluid from a machine. Fluid under pressure.*

Unsafe practices (n=15)

- *Using oven cleaner to remove pinstripes on a car.*
- *Works filling barrels with chlorine gas. Fellow worker left line open while they went to lunch. Upon returning, inhaled gas.*

Unsafe practices - delay in first aid response (n=7)

- *Working on roof air conditioner. Antifreeze sprayed out. Unable to change clothes for 8 hours.*
- *Exposed in eye. Did not flush immediately.*

Eating and drinking while working (n=6)

- *Caller said maid drank some floor cleaner. Thought it was a soft drink.*
- *Draining furnace. Put kerosene into soda bottle. Drank and swallowed.*

Personal protective equipment - inadequate (n=14)

- *Had mask on and off while using a flooring product for about three days.*
- *Dumping bags of cement into mixer. Hot day and no shirt on. Sweat mixed with cement residue and burned skin.*

Personal protective equipment - malfunction (n=5)

- *Always wears respirator when working in silo. Respirator may not have been working.*
- *Had small tear in glove. Site was decontaminated.*

DISCUSSION

Poison center narrative data provide us with important information about occupational poisonings. Poison centers define occupational poisonings based on the exposure site (workplace) and the nature of the poisoning (unintentional, excluding medication errors). These data provide similar information regarding the event's circumstances in the case record's narrative text on medically treated and non-medically treated poisonings, compared with medical record data found in other health databases (for example hospital discharge and private insurance claims data). Ideally, merging poison center cases with hospital discharge records would offer a complete synopsis of an event, however, many poison center calls do not result in hospitalizations. Access to poison center data narratives may also be easier to obtain and manage than patient medical record data from a hospital or doctor visit.

Many of the poisonings in our study were the result of an unintended use (for example, placing toxins in a soda bottle or drinking cup) or equipment malfunction (for example, leaks from punctured hoses or torn gloves). These results show that when a potential poison is used in a workplace there is the risk for unintentional poisonings. While safety training, better enforcement of safe practices, and improved preventive maintenance of equipment are important interventions for these risks, ultimately the most effective intervention would be to limit the use of potential poisons in the workplace. It is noteworthy that a number of the poisonings in our study occurred during a cleaning activity, performed across different types of businesses. Cleaning is necessary in all industrial sectors, but usually specific cleaning chemicals are not essential per se to the production process or final product.

Thus, cleaning could be targeted as a high priority for toxics use reduction to prevent workplace poisonings.

LIMITATIONS

While important information was gleaned from analyzing the narratives of poison center cases, we recognize that many cases were missing study variable data. Not all calls or exposures represent an actual poisoning. Any circumstantial information about the event is provided by the patient or by a healthcare professional. In addition, not all circumstantial information is documented in the medical record.

The data used for this study were not current, however, for the purposes of this study, it was not necessary to obtain the most recent year(s) of data. The focus of the study was to explore how narratives in poison center data might lead to a better understanding of the circumstances surrounding an occupational poisoning event. Reviewing a "snapshot in time" serves this purpose. Future follow up studies will include several more years of more current data in order to work with larger numbers and obtain more reliable results.

From this study, we see that exposures to toxic substances occur in a wide variety of business types (from manufacturing to retail to health care and education). Most of the calls were categorized into eight major business types. However, it was not possible to directly code business and job information into standard classification codes given the lack of specificity contained in the narrative information. Therefore, the distribution of business type should be interpreted broadly.

Finally, this pilot study was qualitative in nature and grew organically as data were produced and examined. There was no reliability or validity testing performed.

CONCLUSIONS

This study highlights that analyzing the circumstance-related narrative text provided in poison center cases can lead to a better understanding of the conditions that result in exposures from work with hazardous chemical substances and potential poisons. This information would assist in developing more targeted public health prevention strategies.

It is important to note that calls to a poison center indicate some sort of emergency. Callers are concerned about a real or potential exposure. They may be afraid to report an exposure to their workplaces directly. We saw calls on both acute and chronic exposures. Poison centers often represent the first line of defense, before the caller seeks medical attention. Poison centers assuage the uncertainty that callers experience, allowing for a more efficient triage of symptoms and possible harm.

Due to the widespread incidence of poisonings across job activities and sectors, it is unlikely that a single or a few prevention measures will work to address the risks. Additional prevention strategies may require better tailoring to specific incidents/exposures or findings if additional gains are to be made in preventing occupational poisoning events. These prevention efforts can be enhanced with more education of poison center staff around assuring callers of their anonymity and of their rights if reporting exposure events to their supervisors. More work also needs to be done by poison centers to better document in the narrative text details about the work-related poisoning scenario, as well as to capture standardized industry and occupational information. Additional funding and training for poison centers to do this should be made available.

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