

An Evaluation of New Hampshire Poison Center Data for Occupational Poisoning Exposures from 2005 to 2011

INTRODUCTION

Over 85,000 chemicals are on the US market today, with approximately 2,000 new substances introduced yearly.^{1,2} 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.^{2,3,4} Poison centers provide a critical resource for monitoring the occurrence of occupational exposures and poisonings at both state and national levels. In 2010, 37,707 workplace exposures were reported to poison centers across the US, accounting for 1.6% of all poison center exposure calls.^{2,5} In comparison, approximately 1.4% of all New Hampshire exposure calls during 2010 were occupational.⁶

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.^{2,7} 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.⁸ Long latency periods from the time of exposure to a harmful substance to onset of clinical symptoms may result

in misclassifying the source of exposure.^{2,9} Furthermore, poisoning symptoms may be misdiagnosed as symptoms of other common illness and injury.^{2,9}

The extent of work-related poisonings across New Hampshire and the nation remains largely undocumented, but the associated morbidity and mortality, healthcare costs, and losses due to decreased productivity are significant. The objective of this study was to use poison center data to describe the distribution and trends of occupational poisoning exposures among New Hampshire's employed population from 2005 to 2011. Findings will be used to assist in developing targeted prevention strategies designed to reduce work-related exposures to harmful substances and inform occupational health surveillance and prevention efforts.

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 155 of which are New Hampshire occupational poisonings. A New Hampshire case means the call to the poison center came from New Hampshire, not necessarily the state where the workplace poisoning occurred or the residence of the patient.

An 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. A person may also only be calling to obtain information about a potential exposure.

METHODOLOGY

Data

We analyzed occupational exposure data for New Hampshire reported to the NNEPC from January 1, 2005 to December 29, 2011. Only information necessary to do this study was transcribed and included in the analysis. Any identifiers (names, phone numbers, industry names, etc.) were excluded from the data analyzed.

Workplace exposures collected during the study period were evaluated for the following criteria:

- Number of cases per year
- Age and sex distribution

- Caller site
- Management site
- Route of exposure
- Clinical effect
- Medical outcome
- Poison exposure substance

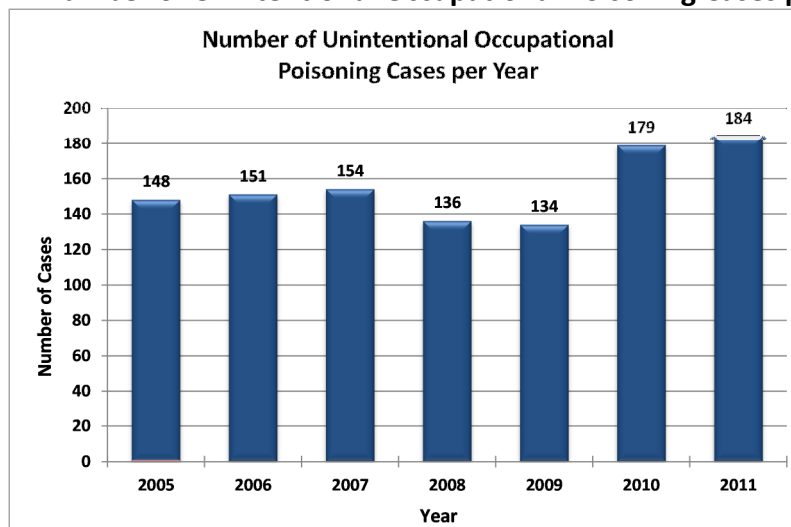
RESULTS

Number of Cases

During the 7-year period from 2005 to 2011, a total of 1,086 poison center workplace exposure calls from New Hampshire reported exposures to harmful substances or environments. In some cases, the calls consisted of multiple substances, which is recorded in the NNEPC as a duplicate case number (same case number because it is the same caller, but different substance which warrants its own set of data). Therefore, there are 1,086 unique cases when evaluating patient calls and 1,213 cases when accounting for substances rather than patients.

Figure 1, there is an upward trend in the number of total cases since 2009; however, there are no statistically significant differences.

Figure 1: Number of Unintentional Occupational Poisoning Cases per Year



TOP FIVE SUBSTANCE GROUPS

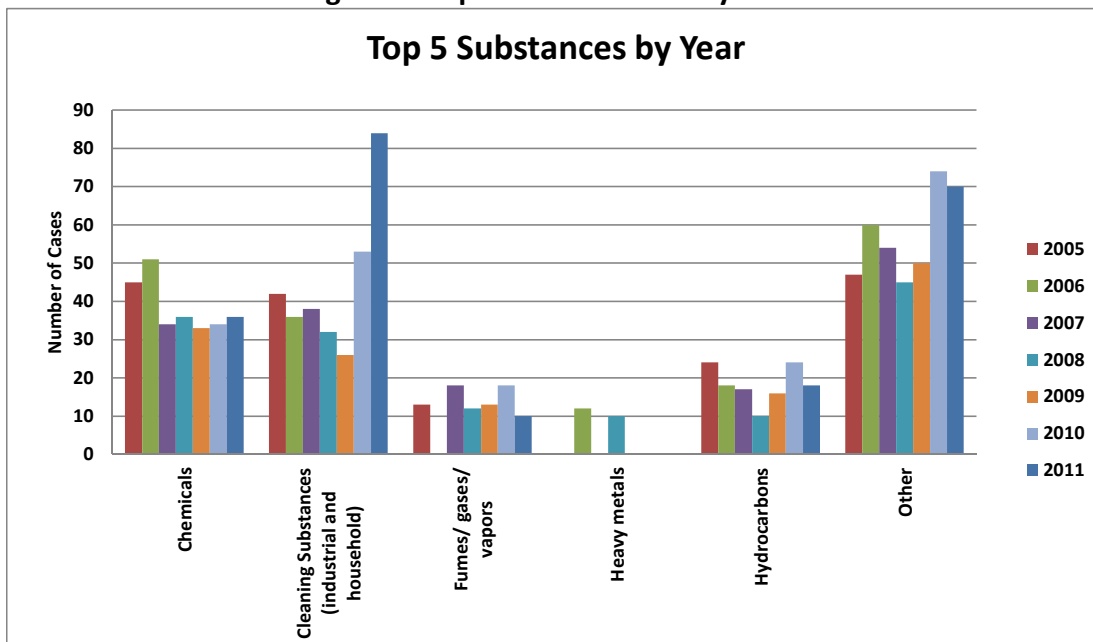
We analyzed the data for the top five substances that contributed to the most number of exposures involved in occupational poisonings, based on the American Association of Poison Control Centers generic categories.⁵ A patient may be exposed to one or more substances (n=1,213 substances over 7 years). It was discovered that chemicals, household and industrial cleaning substances,

fumes/gases/vapors, heavy metals, and hydrocarbons are among the top contributors to occupational exposures in New Hampshire. Refer to

Figure 3 for examples of substances in each group.

Exposures related to cleaning substances (both industrial and household) have increased significantly since 2009.

Figure 2: Top Five Substances by Year*



* There were 10 documented cases of pesticides in 2011, but this data point was excluded from this analysis because there were no cases documented in the previous years; the 10 cases were included in the “other” group for 2011).

Figure 3: Examples of Substances from the Top Five Substance Groups

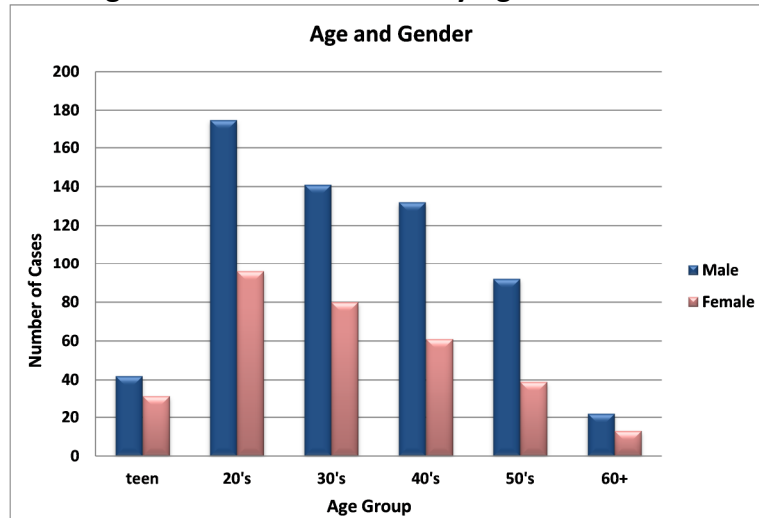
Chemicals	Hydrocarbons	Cleaning substances	Fumes/gases/vapors
Acids (hydrochloric, hydrofluoric)	Freon Gasoline Oil	Bleach Industrial cleaner (alkali, cationic, disinfectant)	Propane and other simple asphyxiates Carbon monoxide Chlorine gas
Ammonia Alkali Formaldehyde	Heavy metals Arsenic Lead Mercury	Oven cleaner All-purpose cleaner	

AGE AND GENDER

We analyzed the data for age and gender (n=1,071). Among all age groups, the number of cases was greater for males than for females, and the most common age group for both genders was the 20's.

*Out of a total of 1,086 cases, 147 cases (93 cases of male patients and 54 cases of female patients) did not report the age of the patient and 15 cases did not report either the age or the gender. Therefore, these cases were excluded from this analysis (n=1,071 cases).

Figure 4: Number of Cases by Age and Gender*

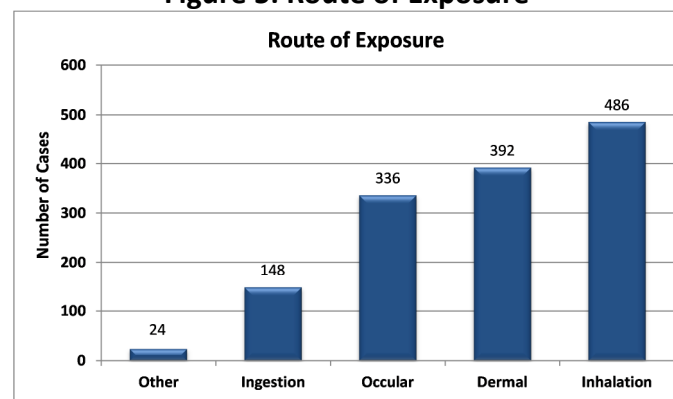


ROUTE OF EXPOSURE

Data from 2005 to 2011 were analyzed for exposure routes: inhalation (35%), dermal (28%), ocular (24%), and ingestion (11%), amounting to 98% of all exposure routes. More than one route of exposure (e.g., a chemical that was both inhaled and came into contact with the skin) may be reported (n=1,386).

*Other included: aspiration, bite, parenteral, rectal, vaginal, or it was not documented at the time of the call to the NNEPC.

Figure 5: Route of Exposure*

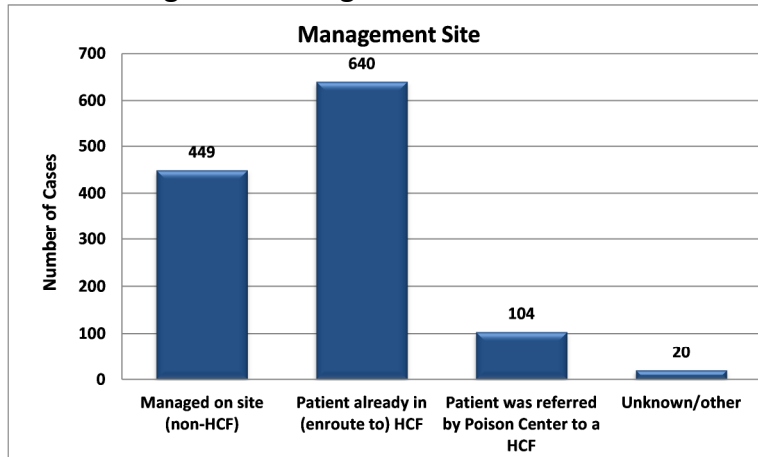


MANAGEMENT SITE

When a patient calls the NNEPC, the management site is documented to indicate where a patient was treated. Many cases were managed on site, with an expert consultation from the poison center staff (37%).

For the majority of the cases the patient was already in or en route to a healthcare facility (HCF) (55%) or the patient was referred by the poison center to go to a HCF (6%) (Figure 6).

Figure 6: Management Site of Patient



MEDICAL OUTCOME

Occupational exposures most commonly resulted in minor effects. Poisonings serious enough to require medical management in a health care

facility have more severe outcomes than those managed on-site (non-health care facility) (Figure 7).

Figure 7: Medical Outcome by Management Site

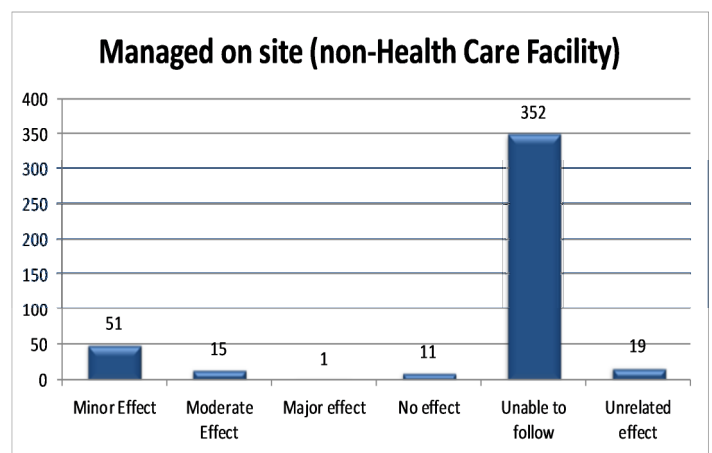
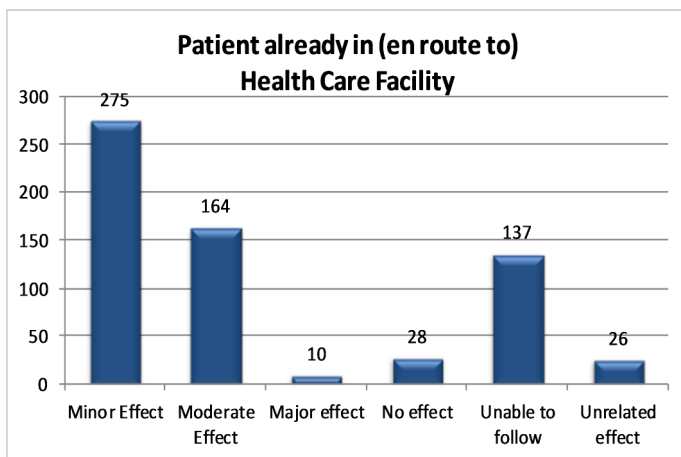
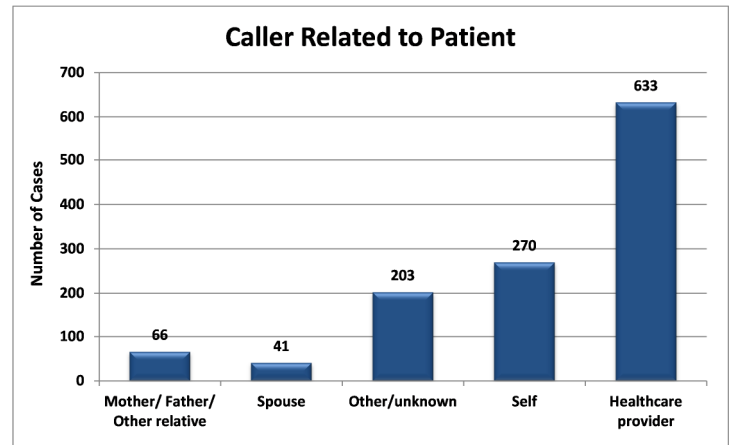


Figure 8: Caller Related to Patient

Caller Related to Patient

Figure 8 indicates caller relationship to patient. Most often it is a healthcare provider (e.g. doctor or registered nurse) that calls the poison center on behalf of the patient (54%), followed by calls from the patient themselves (25%).



EXPOSURE TYPE

Data to determine the exposure type for each call were also analyzed. The majority of the calls were from acute exposures (90%) followed by calls related to chronic exposures (6%), acute-on-chronic exposures (4%), and exposures that are unknown (<1%).

Acute Cases:

Characterized by a single, repeated, or continuous exposure occurring over 8 hours or less. For example: Carbon monoxide or cyanide poisoning)

Chronic Cases:

Characterized as continuous or repeated exposures occurring over 8 hours.

For example: Lead or mercury poisoning, cancer)

Acute-on-Chronic Cases:

Characterized as a single exposure that was preceded by a continuous, repeated, or intermittent exposure occurring over a period greater than eight hours.

For example: A scientist works in the lab with hydrofluoric acid every day. They wear the proper protective equipment when handling these substances (chronic exposure), but one time their glove ripped and the hydrofluoric acid got on their hands (acute exposure)

DISCUSSION

Despite existing intervention and education efforts, reported occupational exposure rates have remained relatively steady since 2005 (an average of approximately 150 calls a year). In this study, the most common routes of exposure were from inhalation (35%), dermal (27%), and ocular (26%) and were most commonly ascribed to cleaning substances, both household and industrial, followed by chemicals, fumes/gases/vapors, heavy metals, and hydrocarbons. These substances are widely used in workplace environments, and should be a focus of public health injury prevention efforts.

The majority of calls to the NNEPC for exposures in the workplace were made by a healthcare provider (54%) or it was the patient themselves (25%) calling for information. Most patients called for an acute exposure (90%), and 6% of the calls were made to get information related to a chronic exposure and

treatment advice. While this percentage is small, it is important to recognize the value of poison centers as a place for workers to get information on potential health effects from chronic exposures.

Patients were also more likely to be managed (37%) with an expert poison center staff consultation or at a health care facility (54%). In some cases (6%), the poison center referred the patient to a health care facility, however it is unknown as to whether the patient was actually treated or not. The majority of cases that were managed on site were not followed (76%) because serious health effects were unlikely. There was a much higher percentage of cases that were followed for patients that were already in, or en route to, a healthcare facility. The majority of these cases had minor (52%) to moderate (20%) injuries. These data suggest that perhaps many cases could have been managed on site without the need for emergency treatment.

Nearly a quarter of all workplace exposures (23.8%, or 119 cases) occurred among the 20-29 year old age group. Additionally, there were almost twice as many exposures in males compared with females in all age groups except for the teenage group. However, approximately 18% of the occupational exposure calls did not report age. These findings should be interpreted with caution. Though these data suggest that young working males appear to be at higher risk for occupational exposure, NNEPC 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.

STRENGTHS AND 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 results in several sources of information and reporting biases which may affect the quality of the data used for this analysis:

- 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 healthcare facility.
- 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.
- 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. In addition to this, it is unknown whether the caller was calling because of an exposure, or if it was a true poisoning.
- The NNEPC 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. The poison center makes every effort to identify and resolve duplicate cases that may result from such multiple calls; however a portion of reports may not reflect unique cases.²

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. Incomplete and non-reporting of key variables such as industry and occupation reduce the ability to accurately describe the true distribution and burden of poisonings in various employment groups.

CONCLUSION

The results of this study support the need for poison center data in occupational and public health surveillance efforts. NNEPC is the only New England 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 37% of 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.

The majority of exposures in the work-place are preventable as long as there are appropriate and targeted interventions. Successful approaches to making the workplace safer begin with having the most accurate and current occupational health surveillance data, which are necessary to understand the root causes of the problems that lead to occupational injury and illness.¹⁰ Unfortunately federal occupational health surveillance reporting requirements result in data gaps and shortfalls that do not accurately capture the true nature of work-related injuries and illnesses. This likely results in an inaccurate view that occupational injuries and illnesses are on a downward trend.¹⁰ More studies need to be done using non-traditional public health occupational surveillance data, such as poison center data, to better understand occupational injury risk factors and develop effective public health prevention strategies.

ACKNOWLEDGEMENTS

Laura Moore, MPH, University of New Hampshire,
Master of Public Health Field Study

CONTACT INFORMATION

Karla R. Armenti, ScD, Principal Investigator
Occupational Health Surveillance Program
Bureau of Public Health Statistics & Informatics
Division of Public Health Services
29 Hazen Drive, Concord, NH 03301
Phone: (603) 271-8425
Email: karmenti@dhhs.state.nh.us

NH OHSP is supported by the National Institute for Occupational Safety and Health (NIOSH) and the Council of State and Territorial Epidemiologists (CSTE). This project was supported by Grant # 5U60OH009853-02 from CDC-NIOSH. Its contents are solely the responsibility of the authors and do not necessarily represent the official views of NIOSH.

REFERENCES

1. Lichterman, J., Brown-Williams, H., Delp, L., & Quinn, M. (2010, July). *Preventing toxic exposures: Workplace lessons in safer alternatives*. Perspectives, 5(1). Retrieved from <http://www.healthresearchforaction.org>.
2. Tran, Armanda; Towle, Meredith; Bol, Kirk; Warner, Amy; Bronstein, Alvin. *Review of Work-Related Exposures Reported to A Poison Center Helpline, Colorado, 2000-2010*. Colorado Department of Public Health and Environment. Occupational Health and Safety Surveillance Program. November 2012.
3. Warner, M. (2011). *Injury surveillance workgroup 7: Poisoning surveillance*. [Presentation]. United States: Safe States Alliance. Retrieved from <http://www.safestates.org/displaycommon.cfm?an=1&ubarticlenbr=255>.
4. American Association of Poison Control Centers. (2012). *Poisoning prevention*. Retrieved from <http://www.aapcc.org/dnn/PoisoningPrevention/FAQ/ta/bid/117/Default.aspx>.
5. Bronstein, A.C., Spyker, D.A., Cantilena, L.R., Green, J.L., Rumack, B.H. & Dart, R.C. (2011). *2010 Annual Report of the American Association of Poison Control Centers' National Poison Data System (NPDS): 28th Annual Report*. Clinical Toxicology, 49, 910-941.
6. Northern New England Poison Center.

7. Blanc, P.D., Rempel, D., Maizlish, N., Hiatt, P., & Olson, K.R. (1989). Occupational illness: Case detection by poison control surveillance. *Annals of Internal Medicine*, 111(3), 238-244.
8. Azaroff LS, Levenstein C, Wegman DH. (2002) *Occupational Injury and Illness Surveillance: Conceptual Filters Explain Underreporting*. American Journal of Public Health. Vol 92:1421-9.
9. Shannon, M.W., Borron, S.W., & Burns, M.J. (2007). Haddad and Winchester's Clinical Management of Poisoning and Drug Overdose (4th ed.). Philadelphia, PA: Saunders Elsevier.
10. Friedman, L.S. and L. Forst. (2007), *The impact of OSHA recordkeeping regulation changes on occupational injury and illness trends in the US: a time series analysis*. Occupational Environmental Medicine. Vol. 64(7): p. 454-60.