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Incidents of potential public health significance identified using national surveillance of US poison center data (2008–2012)

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Abstract

Background—The Centers for Disease Control and Prevention (CDC) and the American Association of Poison Control Centers conduct national surveillance on data collected by US poison centers to identify incidents of potential public health significance (IPHS). The overarching goals of this collaboration are to improve CDC's national surveillance capacity for public health threats, identify early markers of public health incidents and enhance situational awareness. The National Poison Data System (NPDS) is used as a surveillance system to automatically identify data anomalies.

Purpose—To characterize data anomalies and IPHS captured by national surveillance of poison center data over 5 years.

Methods—Data anomalies are identified through three surveillance methodologies: call-volume, clinical effect, and case-based. Anomalies are reviewed by a team of epidemiologists and clinical toxicologists to determine IPHS using standardized criteria. The authors reviewed IPHS identified by these surveillance activities from 2008 through 2012.

Results—Call-volume surveillance identified 384 IPHS; most were related to gas and fume exposures (*n*=229; 59.6%) with the most commonly implicated substance being carbon monoxide (CO) (*n*=92; 22.8%). Clinical-effect surveillance identified 138 IPHS; the majority were related to gas and fume exposures (*n*=58; 42.0%) and gastrointestinal complaints (*n*=84; 16.2%), and the most commonly implicated substance was CO (*n*=20; 14.4%). Among the 11 case-based surveillance definitions, the botulism case definition yielded the highest percentage of identified agent-specific illness.

Conclusions—A small proportion of data anomalies were designated as IPHS. Of these, CO releases were the most frequently reported IPHS and gastrointestinal syndromes were the most commonly reported illness manifestations. poison center data surveillance may be used as an

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Disclaimer

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention/Agency for Toxic Substances and Disease Registry.

Declaration of interest

The authors report no declarations of interest. The authors alone are responsible for the content and writing of the paper.

approach to identify exposures, illnesses, and incidents of importance at the national and state level.

Keywords

Public Health; Poisonings; Surveillance

Introduction

Since 2002, the Centers for Disease Control and Prevention (CDC) has worked with the American Association of Poison Control Centers (AAPCC) to identify incidents of potential public health significance (IPHS) related to a chemical, radiological, or infectious agent. The overarching goals of this collaboration are to (1) improve CDC's national surveillance capacity for public health threats; (2) identify early markers of chemical incidents to ensure rapid and effective public health response; and (3) enhance situational awareness and inform public health response during a suspected or known public health threat. [1,2] These goals are accomplished by conducting surveillance on poison center data.

The United States (U.S.) network of 57 poison centers provides free information and advice daily to telephone callers about the potentially hazardous substances and exposures to them. They collect demographic, exposure, health, management, and outcome data that are uploaded in near real-time into a national database known as the National Poison Data System (NPDS). Since 2001, NPDS has collected data on more than 40 million calls. [2–4] The CDC in collaboration with AAPCC is responsible for all operational-related surveillance activities using NPDS, which begin with identifying IPHS. The objective of this study is to characterize data anomalies and IPHS captured by national surveillance of poison center data from 2008 through 2012.

Methods

The CDC Institutional Review Board (IRB) reviewed and determined that this study does not involve identifiable human subjects and further review was not required. IPHS are identified by three different automated surveillance methods: call-volume, clinical-effect, and case-based. These methods identify data anomalies that represent either individual or clusters of exposures and illnesses. Clusters of illnesses are often, but not always, associated with a specific event. Call-volume data anomalies are detected when the hourly poison center-specific call volume exceeds a historical baseline. The historical baseline is the average call volume for that hour during the same 14-day period (7 days preceding the day of interest, the day of interest, and 6 days after the day of interest) for the preceding 3 years. [3] Poison centers use any of the 131 signs, symptoms, and laboratory abnormality options available to describe the callers' clinical presentations, also known as clinical effects. Clinical effect data anomalies are identified when the national, cumulative number of calls to all poison centers reporting a particular clinical effect exceeds an historical baseline. [3] Case-based data anomalies are identified when any call meets specific, user-defined criteria and is uploaded from a poison center into NPDS. These criteria are customizable and can include specific clinical effects, demographic characteristics such as age, certain product exposures, clinical outcomes, and other variables. CDC has 11 active, national case-based surveillance definitions considered potentially high-priority exposures including arsenic, botulism, ciguatera, cyanide, nerve agents, paralytic shellfish, puffer fish, ricin, smallpox, radiation, and acute radiation syndrome. [3]

All data anomalies from the above surveillance methods initiate an automated e-mail to members of the NPDS surveillance team, made up of CDC epidemiologists and medical toxicologists and AAPCC managing directors, who review the data anomaly details within 24 hours and contact the regional poison center where the data anomaly originated for additional information if needed. [1] The team member documents any additional information about the incident in a separate, CDC-accessible field within NPDS. The data anomaly is then determined to be of public health significance or not based on several criteria which have been refined over the years. [1] Basic consensus criteria were established to help team members determine potential public health significance, including anomalies associated with a reportable exposure, related to an outbreak of illness of unusual severity, associated with suspected terrorism, or part of a state of national public health investigation. [1] Examples of past IPHS include persons with adverse health effects following exposure to occupational and transportation spills, and foodborne outbreaks at restaurants. Lastly, the NPDS surveillance team member and/or involved poison center then notifies the appropriate state or federal public health organizations if appropriate. Additional information on the process of how an incident is determined to be IPHS is available online. [1]

In NPDS, potential public health significance determinations were coded in one of four ways: “yes,” “no,” “unknown,” or “other.” All IPHS were defined as data anomalies that were coded “yes” for potential public health significance. For this study, the analysis was restricted to all IPHS “yes” determinations that were captured by national surveillance from 2008 through 2012 for call-volume, clinical-effect, and case-based anomalies. The authors reviewed the NPDS surveillance team member’s original review notes for each IPHS to ensure correct characterization.

For call-volume surveillance, the total number of call-volume anomalies and number of IPHS were reported. The following general substance type categories were used for IPHS: airborne agents (gas, vapor, fumes, and smoke), non-pharmaceutical chemicals, product contamination or tampering, food poisoning or water contamination, environmental (e.g., red tide, Gulf oil spill), drug or product misuse, and unknown/other. The most frequently reported specific agent and the location of each IPHS was identified and grouped by year. The location was described as one of the following: occupational (in the workplace), school (on school grounds or in the classroom), residential (home setting), public place (e.g., restaurant, store), or unknown/other.

For clinical-effect surveillance, the total number of clinical-effect anomalies and number of IPHS were reported by year. Incidents were categorized by general, substance-type categories, and identified the most frequently reported specific agent by year. Signs and symptoms were grouped by the following body systems: gastrointestinal, neurologic, cardiovascular, respiratory, dermatologic, ophthalmologic, genitourinary, musculoskeletal, hematologic, metabolic, and general or other. The symptom and laboratory abnormality most reported were grouped by year.

Two coauthors evaluated data from all IPHS identified using case-based surveillance during the study period. Reviewers analyzed the following case-based surveillance definitions: arsenic; nerve agents, organophosphates, carbamates; botulism; puffer fish; paralytic shellfish; ciguatera; and cyanide. Definitions identify anomalies either via the exposure to the high-priority substance or via specific clinical effects that may suggest exposure to a high-priority substance. [3] For example, a reported exposure to arsenic will be identified as a data anomaly, and an exposure with clinical effects consistent with arsenic even without explicit reported exposure to arsenic will likewise be identified as a data anomaly. Reviewers defined suspected true cases as any data anomaly identified using case-based surveillance that reported (1) an exposure to the substance of interest and (2) accompanying signs and symptoms or laboratory abnormalities, or both, consistent with agent-specific illness, as judged by a physician study investigator. Reviewers identified and reported suspected cases for each substance by year. Amongst suspected true cases, reviewers identified the number of IPHS. Upon reviewing all surveillance methods, coauthors looked for duplications in identified incidents for different methodologies in the study period by comparing by date, state, and implicated substance. IPHS of different methodologies with corroborating incident information were defined as duplications; percentages of duplications were calculated amongst the three methodologies.

Results

Call-volume surveillance anomalies

The total number of call-volume data anomalies reported during the study period was 11,491. A relatively small number of these anomalies was determined to be IPHS (*n*=384; 3.3%). Among IPHS, airborne agents (gases, fumes, vapors, and smoke) were the most frequently reported substance type, regardless of year. Public place was the most commonly reported location (*n*=99; 24.6%); carbon monoxide (CO) was the most commonly reported specific agent when a cause was reported (*n*= 92, 22.8%). Detailed data regarding these IPHS are presented in Table 1.

Clinical effect surveillance anomalies

The total number of data anomalies identified by clinical-effect surveillance was 4,402. Among all IPHS, airborne agents (gases, fumes, vapors, and smoke; *n*=58, 42.0%) were the most frequently reported substance type. CO was the most commonly reported specific agent when a cause was reported (*n*=20, 14.4%). The gastrointestinal system (*n*= 84, 16.2%) was the most commonly affected organ system; diarrhea was the most frequently reported individual clinical effect (*n*= 22, 4.3%). Detailed data regarding these IPHS are presented in Table 2.

Case-based surveillance anomalies

The total number of data anomalies identified using case-based surveillance was 9,537. The total number of data anomalies for each specific surveillance definition was: arsenic 646;

carbamates 2,623; botulism 77; puffer fish 136; paralytic shellfish 677; ciguatera 909; and cyanide 4,469. Of the 9,537 data anomalies representing possible cases of illnesses to specific hazardous agents of interest to CDC, [1] 1,388 were determined to be suspected true cases of agent-specific illness (14.6%). Botulism (53.2%), puffer fish (39.0%), and ciguatera (34.8%) were the surveillance definitions with the highest percentage of suspected cases of agent-specific illness. Amongst suspected true cases, botulism (70.7%), followed by paralytic shellfish (57.3%), were the surveillance definitions with the highest percentage of IPHS. Detailed data regarding these data anomalies are presented in Table 3. Reported events for the botulism-associated IPHS (*n*=29) included ingesting canned food (*n*=10, 34.5%) and injecting black-tar heroin (*n*=5, 17.2%). Amberjack (*n*=43, 25.3%), barracuda (23, 13.5%), and grouper (13, 7.6%) were among the most commonly reported suspected sources of reported events for the ciguatera-associated IPHS (*n*=170).

For the study period, reviewers identified 12% of the IPHS identified using call-volume surveillance that was also identified using clinical-effect surveillance. Reviewers identified no instances of IPHS identified using case-based surveillance that was also identified using call-volume surveillance or clinical-effect surveillance.

Discussion

Airborne exposures to gases, fumes, vapors, and smoke were the most consistently reported among all IPHS identified using call-volume and clinical effect-based surveillance. Within this category, CO was the most frequently reported substance implicated among IPHS over the previous 5 years (excluding the results of case-based surveillance). During 2000–2009, a total of 68,316 calls were made to U.S. poison centers about potential contact with CO, the majority of which occurred in the home. [5] Annually, approximately 15,000 non-fire–related, unintentional, CO-associated emergency department visits occur, with close to 500 subsequent deaths. [6] Furthermore, CO poisoning in the home is a documented major cause of morbidity and mortality, surpassed only by natural disasters such as hurricanes and ice storms. [7–9] Thus, many public health campaigns to prevent CO poisoning have targeted efforts on promoting installation of home CO alarms and educating the public about the dangers of using generators and gas stoves improperly to heat the home. [10] This study suggests that most IPHS identified by poison center data involving CO occurred in schools or public places rather than residential locations. Potential areas of research to further characterize these NPDS-captured public health incidents include correlating reported CO-related IPHS to the occurrence of both natural disasters and seasonal or regional trends. Moreover, these activities can supplement surveillance activities with CO in implementing a comprehensive CO poisoning surveillance framework. [11]

Gastrointestinal symptoms were among the most common illness manifestations reported for IPHS identified by clinical-effect surveillance; the next most frequently reported category was neurological symptoms (e.g., confusion, dizziness, headache). These categories are not unexpected because adverse health effects caused by gastrointestinal and neurological agents, including CO, typically present with nonspecific symptoms such as nausea and dizziness, respectively. Of note, CO poisoning is often misdiagnosed as gastroenteritis or food poisoning. [12] Furthermore, because exposures and illnesses associated with food poisoning and water contamination were frequently reported, gastrointestinal signs and symptoms would be expected. Further research is warranted to determine whether these incidents are identified by other state and national surveillance systems.

Call-volume and clinical-effect–based surveillance yielded low proportions of anomalies that were elevated to IPHS. These circumstances occur because the anomaly detection algorithms were created to maximize sensitivity without overburdening the NPDS surveillance team with anomaly analysis of PHS determination. Increasing the sensitivity of the system by lowering the threshold for anomaly detection not only results in better detection capability for PHS events but also increases the number of false positives of the system. Actual sensitivity values cannot be calculated due to the lack of information regarding PHS events that are not identified by NPDS.

To ensure efficient use of resources for surveillance activities, we sought to review the amount of duplication of IPHS identified by the three different surveillance methodologies. A high number of duplications would suggest that the methodologies are not unique and significant resources are being utilized to follow-up on the same incident. Reviewers identified that 12% of IPHS identified using call-volume surveillance were also identified using clinical-effect surveillance and there was no overlap amongst case-based surveillance with the other surveillance methodologies. These results imply that, even though both call-volume and clinical-effect surveillance yielded similar aggregate results in substance type and implicated specific agent, these methodologies are inherently unique in their approach in identifying data anomalies within this dataset.

Case-based surveillance was able to detect high percentages of suspected true cases for botulism and marine toxins. Each state mandates that healthcare providers report certain notifiable diseases such as botulism and marine toxin exposure to state and local health departments. However, suspected true cases that may not go through healthcare channels, such as residential calls to poison centers, may be missed by active reporting of healthcare providers. Using these case-based definitions for state and local public health may help close the gap between healthcare-reported and self-reported notifiable disease manifestations. Further research is warranted to determine the proportion of suspected true cases identified by NPDS that are not reported to public health authorities.

The overall proportion of suspected true cases among case-based anomalies was low compared to the total number of anomalies, suggesting that modifying current case-based definitions likely would improve specificity. The NPDS surveillance team continues to refine existing definitions and create new definitions to help meet anticipated public health needs. In early 2012, CDC implemented 51 new case-based surveillance categories, including the entire Category A and most of the Category B bioterrorism agents.

Upon determination of IPHS, the NPDS surveillance team and the involved poison center worked together to make sure that the appropriate state and federal public health organizations were aware of the IPHS. This may elicit a state or local public health response if officials were not previously aware. The poison centers that take these calls often identify these incidents and notify their respective health departments without CDC involvement.

However, the authors have found this practice to be somewhat inconsistent across the country. This may be due to a variety of factors, including a lack of resources to sustain such an activity and an unfamiliarity of what incidents may be of interest to public health. The authors hope that this activity continues to build collaboration and familiarity between poison centers and public health as well as optimize state health department situational awareness. CDC members of the NPDS surveillance team will also notify other federal public health organizations if appropriate (i.e., Food and Drug Administration, Consumer Product Safety Commission, Environmental Protection Agency). In May 2013, CDC began directly notifying state health departments and involved poison centers about IPHS.

Surveillance of poison center data helps identify exposures and illnesses associated with large incidents, as well as detect the incidents themselves. This information may be used to inform public health response, facilitate public health messaging and education, identify exposures and illnesses associated with chemical events, and enhance situational awareness during outbreaks. [2] Regional poison centers and state health departments have used poison center-based surveillance to detect and identify adverse health effects associated with numerous incidents. Incidents which poison center-based surveillance provided benefit include the Deepwater Horizon oil spill in 2010, the Fukushima radiation incident in 2011, and selenium-associated illness linked to an improperly formulated health product in 2008. [1,13] Additionally, many published studies using poison center data describe features and characteristics of calls made to poison centers regarding exposures to a variety of substances (e.g., bath salts, [14] spice or synthetic marijuana, [15] CO[16]). The results presented here provide a prospective approach to poison center data analysis that may be of use to state and local public health organizations to identify cases of illness related to state-specific agents and associated incidents in near real-time. Since NPDS is readily available for poison centers and health departments, these surveillance strategies may be a cost-efficient option to conduct syndromic surveillance. The surveillance methods presented provide insight to the types of incidents and illnesses that can be identified at the state and local level.

There are some limitations to this study. An inherent limitation of NPDS is that the data represent exposures but not necessarily confirmed poisonings. However, by reviewing the NPDS incident, the team can determine with more certainty whether the reported exposure represents an actual poisoning. Changes to the PHS criteria in 2011 may have affected interpretation and findings of the captured incidents. The changes altered the overall number of captured incidents and the number determined to be of PHS, but these changes may not have affected the trend in outcome variables (e.g., gas/vapor/fumes/smoke is still the most reported substance type for call-volume anomalies). Another limitation of the PHS process is the subjectivity of PHS determination. Because each anomaly is reviewed by a person, it is subject to reviewer bias. During the initial stages of surveillance using NPDS, the NPDS surveillance team had relative freedom to identify an anomaly as an IPHS. As surveillance progressed into 2008 and 2009, the team standardized relative definitions of IPHS and the necessary follow-up steps with this determination, which reduced the inconsistency of reviewer anomaly analysis.

Conclusions

In this study, a small proportion of the total data anomalies were designated as IPHS. Of these, CO releases were the most frequently reported IPHS and gastrointestinal syndromes were the most commonly reported illness manifestations. Poison center data surveillance may be used as an approach to identify exposures, illnesses, and incidents of importance at the national and state level. These surveillance strategies can potentially be adapted or replicated by state health departments and collaborating poison centers to bolster surveillance activities and reduce public health morbidity and mortality.

References

1. Understanding Chemical Exposures—National Chemical and Radiological Surveillance Program. Centers for Disease Control and Prevention; Available at: http://www.cdc.gov/nceh/hsb/chemicals/ncrs.htm [Accessed May 25, 2012]
2. Wolkin AF, Patel M, Watson W, Belson M, Rubin C, Schier J, et al. Early detection of illness associated with poisonings of public health significance. Ann Emerg Med. 2006; 47:170–176. [PubMed: 16431230]
3. Wolkin AF, Martin CA, Law RK, Schier JG, Bronstein AC. Using poison center data for national public health surveillance for chemical and poison exposure and associated illness. Ann Emerg Med. 2012; 59:56–61. [PubMed: 21937144]
4. Bronstein AC, Spyker DA, Cantilena JR, Green JL, Rumack BH, Giffin SL. 2008 annual report of the American Association of Poison Control Centers' National Poison Data System (NPDS): 26th annual report. Clin Toxicol. 2009; 47:911–1084.
5. Centers for Disease Control and Prevention. Carbon monoxide exposures—United States, 2000–2009. MMWR Morb Mortal Wkly Rep. 2011; 60:1014–1017. [PubMed: 21814164]
6. Centers for Disease Control and Prevention. Unintentional non-fire-related carbon monoxide exposures—United States, 2001–2003. MMWR Morb Mortal Wkly Rep. 2005; 54:36–39. [PubMed: 15660017]
7. Hampson NB, Stock AL. Storm-related carbon monoxide poisoning: lessons learned from recent epidemics. Undersea Hyperb Med. 2006; 33:257–263. [PubMed: 17004412]
8. Lutterloh EC, Iqbal S, Clower JH, Spiller H, Riggs M, Suggs T, et al. Carbon monoxide poisoning after an ice storm —Kentucky, 2009. Public Health Rep. 2011; 126:108–115. [PubMed: 21563718]
9. Centers for Disease Control and Prevention. Carbon monoxide exposures after Hurricane Ike—Texas, September 2008. MMWR Morb Mortal Wkly Rep. 2009; 58:845–849. [PubMed: 19680219]
10. Centers for Disease Control and Prevention. [Accessed April 27, 2012] Carbon Monoxide Poisoning. Available athttp://www.cdc.gov/co.htm
11. Iqbal S, Clower J, King M, Bell J, Yip F. National carbon monoxide poisoning surveillance framwork and recent estimates. Public Health Rep. 2012; 127:486–496. [PubMed: 22942466]
12. Goldfrank, LR. Goldfrank's Toxicological Emergencies. 9. New York: McGraw-Hill; 2006. p. 1660-1661.
13. Law R, Schier J, Martin C, Thomas R, Bronstein A, Chang A. Use of the National Poison Data System after the 2011 Japan radiological incident for surveillance of incident-related exposures in the United States. Emerg Health Threats J. 2011; 4:s37–38.
14. Spiller HA, Ryan ML, Weston RG, Jansen J. Clinical experience with and analytical confirmation of "bath salts" and "legal highs" (synthetic cathinones) in the United States. Clin Toxicol. 2011; 49:499–505.
15. Hoyte C, Jacob J, Monte AA, Al Jumaan M, Bronstein AC, Heard KJ. A characterization of spice exposures reported to the NPDS in 2010. Clin Toxicol. 2011; 49:524.
16. Spiller HA, Slavova SS, Bunn TL. Epidemiology of unintentional carbon monoxide (Co) exposure in the United States (Us) 2000–2009: a review of NPDS. Clin Toxicol. 2011; 49:566–567.

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Table 1

Distribution and description of call-volume data anomalies reported to poison centers identified by national surveillance, 2008–2012.

	2008	2009	2010	2011	2012	Total
Call-volume anomalies	2,292	2,568	2,010	2,720	1,901	11,491
Number of incidents of public health significance	105 (4.6%)	67 (2.6%)	78 (3.9%)	66 (2.4%)	68 (3.6%)	384 (3.3%)
Gas/vapor/fumes/smoke*	61 (58.1%)	33 (49.2%)	48 (61.5%)	42 (63.6%)	45 (66.2%)	229 (59.6%)
Food poisoning/Water Contamination	17 (16.2%)	15 (22.4%)	14 (17.9%)	13 (19.7%)	11 (16.2%)	70 (18.2%)
Nonpharmaceutical chemicals	21 (20.0%)	14 (20.9%)	10 (12.8%)	7 (10.6%)	10 (14.7%)	62 (16.1%)
Unknown/Other	10 (9.5%)	1 (1.5%)	3 (3.8%)	2 (3.0%)	3	16 (4.2%)
Environmental	4 (3.8%)	2 (3%)	4 (5.1%)	–	2 (2.9%)	12 (3.1%)
Product contamination/tampering	3 (2.9%)	1 (1.5%)	2 (2.6%)	1 (1.5%)	–	7 (1.8%)
Drug/Product misuse	5 (4.8%)	1 (1.5%)	–	1 (1.5%)	–	7 (1.8%)
Most frequently reported specific agent	Carbon monoxide (13; 12.4%)	Carbon monoxide (16; 23.9%)	Carbon monoxide (21; 26.9%)	Carbon monoxide (19; 28.8%)	Carbon monoxide (16, 23.5%)	Carbon monoxide (92; 24.0%)
Most frequently reported location**	Occupational (43; 41.0%)	Public place (20; 29.9%)	Public place (27; 34.6%)	School (17; 29.3%); Residential (17; 29.3%)	School (18, 26.5%); Public Place (18, 26.5%)	Public Place (99; 25.8%)

*More than one substance type can be reported under a single call-volume incident.

**Not all incidents had a reported location.

Table 2

Distribution and description of clinical effect data anomalies reported to poison centers identified by national surveillance, 2008–2012.

	2008	2009	2010	2011	2012	Total
Clinical Effects Anomalies	892	567	960	1,005	978	4,402
Number of incidents of public health significance	38 (4.3%)	34 (6.0%)	11 (1.1%)	28 (2.8%)	27 (2.8)	138 (3.1%)
Gas/vapor/fumes/smoke	14 (36.8%)	14 (41.2%)	2 (18.2%)	14 (50%)	14 (51.9%)	58 (42.0%)
Food poisoning/Water contamination	9 (23.7%)	7 (20.6%)	4 (36.4%)	2 (7.1%)	8 (29.6%)	30 (21.7%)
Product contamination/tampering	2 (5.3%)	11 (32.4%)	–	–	–	13 (9.4%)
Nonpharmaceutical chemicals	8 (21.1%)	–	–	1 (3.6%)	3 (11.1%)	12 (8.7%)
Unknown/Other	5 (13.2%)	1 (2.9%)	2 (18.2%)	2 (7.1%)	2 (7.4%)	12 (8.7%)
Drug/Product misuse	–	–	–	9 (32.1%)	–	9 (6.5%)
Environmental	–	1 (2.9%)	3 (27.3%)	–	–	4 (2.9%)
Most frequently reported specific agent	Carbon monoxide (7, 18.4%)	Salmonella contaminated peanut butter (11, 32.4%)	Gulf Oil spill (3, 27.3%)	Synthetic marijuana/ bath salts (8, 28.6%)	Carbon monoxide (4, 14.8%)	Carbon monoxide (20, 14.4%)
Clinical effects[**]	(*n*=103)	(*n*=118)	(*n*=45)	(*n*=149)	(*n*=102)	(*n*=517)
Body system most effected	Gastrointestinal (20, 19.4%)	Gastrointestinal (27, 22.9%)	Neurological (13, 28.9%)	Neurological (29, 19.5%)	Gastrointestinal (22, 21.6%)	Gastrointestinal (84, 16.2%)
Symptom/lab abnormality most reported	Diarrhea (6, 5.8%);	Diarrhea (13, 11%)	Edema (3, 6.7%);	Chest pain (7, 4.7%);	Throat irritation (6, 5.9%)	Diarrhea (22, 4.3%)

[*] An incident can be triggered by more than substance type.

[**] More than one clinical effect can be reported under a single incident.

Table 3

Distribution and description of case-based anomalies reported to poison centers identified by national surveillance, 2008–2012.

	2008	2009	2010	2011	2012	Total
Case-based anomalies	N (%)	N (%)	N (%)	N (%)	N (%)	N (%)
Arsenic	–	–	191	175	280	646
Suspected true arsenic cases	–	–	6 (3.1)	14 (8.0)	31 (11.1)	51 (7.9)
Number of suspected arsenic cases of public health significance	–	–	–	1 (7.1)	1 (3.2)	2 (3.9)
Nerve Agents/Organophosphates/Carbamates (NAOC)	525	565	561	838	134	2623
Suspected true NAOC cases	77 (14.7)	73 (12.9)	76 (15)	74 (12.5)	33 (24.6)	333 (12.7)
Number of suspected NAOC cases of public health significance	1 (1.3)	–	–	2 (1.9)	–	3 (1.0)
Botulism	–	4	16	29	28	77
Suspected true botulism cases	–	3 (75)	3 (18.8)	20 (69.0)	15 (53.6)	41 (53.2)
Number of suspected botulism cases of public health significance	–	3 (100)	2 (66.7)	18 (90.0)	6 (40.0)	29 (70.7)
Puffer fish	73	9	20	20	14	136
Suspected true puffer fish cases	40 (54.8)	–	8 (40)	3 (15.0)	2 (14.2)	53 (39.0)
Number of suspected puffer fish cases of public health significance	11 (27.5)	–	2 (25)	–	–	13 (24.5)
Paralytic shellfish	149	139	111	134	144	677
Suspected true paralytic shellfish cases	18 (12.1)	12 (8.6)	10 (9)	9 (6.7)	19 (13.1)	68 (10.0)
Number of suspected paralytic shellfish cases of public health significance	10 (55.6)	2 (16.7)	9 (90)	5 (55.6)	13 (68.4)	39 (57.3)
Ciguatera	189	208	191	195	126	909
Suspected true ciguatera cases	71 (37.6)	67 (32.2)	65 (34)	81 (41.5)	32 (25.4)	316 (34.8)
Number of suspected ciguatera cases of public health significance	33 (46.5)	48 (71.6)	52 (80)	25 (30.9)	12 (37.5)	170 (53.8)
Cyanide	740	807	841	985	1,096	4,469
Suspected true cyanide cases	136 (18.4)	94 (11.6)	63 (7.5)	101 (10.3)	132 (12.0)	526 (11.8)
Number of suspected cyanide cases of public health significance	16 (11.8)	12 (12.8)	1 (1.6)	19 (18.8)	–	48 (9.1)