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Total release fogger exposures reported to Texas poison centers, 2000–2009

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Total release foggers or ''bug bombs'' are products designed to fill an area such as a home or workplace with insecticide. Because of their method of action, unintentional exposures may occur. Cases for this retrospective study were all fogger exposures reported to Texas poison centers during 2000–2009. The distribution of cases was identified for various demographic and clinical factors. There were 2855 fogger exposures. Among the patients 56.0% were females and 69.5% were 20 years or older. Considering the exposure circumstances 95.6% were unintentional and 62.2% occurred through inhalation. The management site was 75.2% on site. The medical outcomes were no effect (11.8%), minor effect (25.1%), moderate effect (7.4%), major effect (0.1%), not followed (no effects expected) (3.5%), not followed (minimal effects expected) (39.3%), not followed (potentially toxic) (4.9%), and effects probably unrelated to exposure (7.7%). The most frequently reported clinical effects were cough (25.4%), vomiting (13.3%), nausea (9.2%), dyspnea (8.7%), throat irritation (7.9%), and headache (5.6%). The public needs to be educated about the potential hazard of exposures to foggers. However, most fogger exposures reported to poison centers are not likely to be seriously toxic and can be managed at home.

Keywords: fogger; insecticide; poison center; pyrethrin; pyrethroid

Introduction

Total release foggers, also known as ''bug bombs'', are pesticide products that use aerosol propellants to release insecticide to fill an enclosed area. Commercially available to the public, foggers are often used in homes and workplaces for control of pests such as cockroaches, fleas, and flying insects. Most foggers contain as active ingredients pyrethrin, pyrethroid, or a combination of the two. Pyrethrins are derived from the chrysanthemum plant and pyrethroids are synthetic compounds. Humans can usually metabolize these compounds rapidly and render them harmless. The toxic oral dose for mammals is more than $100\,mg\,kg^{-1}$ (Lamb 2007).

Because of their method of action, unintentional exposures to the foggers may occur. One study examined 466 fogger exposures in eight states over a 5-year period. The investigation found that many of the exposures resulted from not leaving the enclosed space before the fogger discharged, returning too soon after discharge, using an excessive number of foggers, or failing to notify others that foggers were used. The majority of

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exposures occurred in private residences. The most common reported symptoms were respiratory, followed by gastrointestinal, neurological, ocular, dermatologic, and cardiovascular. Most exposures were considered to be of low severity, although one death was reported (Centers for Disease Control and Prevention 2008).

Poison centers manage exposures to a variety of substances, including pesticides. Out of 2,491,049 total exposures reported to US poison centers in 2008, 93,454 (3.8%) involved pesticides. The intent of this investigation was to describe the pattern of fogger exposures reported to a group of poison centers.

Methods

This retrospective study used data from the Texas Poison Center Network (TPCN), a system of six poison centers that service the entire state. Texas poison centers record a variety of demographic and clinical information on all reported exposures in a common electronic database. The data are recorded as text or as coded fields with the code options defined by the American Association of Poison Control Centers (AAPCC). When possible, every substance involved in an exposure is assigned a numeric PoisIndex code created by Micromedex®. PoisIndex codes for related substances are grouped together in major categories (e.g., alcohols, plants, pesticides, analgesics, topical preparations).

Cases included all exposures during 2000–2009 which were assigned PoisIndex codes in the pesticides category and where the description for the code included the word "fogger" or "bomb". The distribution of cases by selected demographic and clinical factors was determined. The subgroups for many of the variables were based on the definitions provided by the AAPCC.

The final medical outcome or severity of the exposure is a somewhat subjective evaluation made by the poison center agents managing the exposure and is based on the adverse clinical effects that are observed or anticipated. Medical outcome is classified according to the following criteria: no effect (no symptoms due to exposure), minor effect (some minimally troublesome symptoms), moderate effect (more pronounced, prolonged symptoms), major effect (symptoms that are life-threatening or cause significant disability or disfigurement), and death. Because of time constraints and lack of accurate contact information, Texas poison centers cannot follow all exposures to a final medical outcome. Such exposures are classified as "not followed" or "unable to be followed" and the potential outcome judged as a "nontoxic exposure (clinical effects not expected)", "minimal clinical effects possible (no more than minor effect possible)", or a "potentially nontoxic exposure". The poison center agents may also consider the outcome to be an unrelated effect where the exposure was probably not responsible for the observed adverse clinical effects, or where there is doubt that the exposure actually occurred at all.

The Texas Department of State Health services institutional review board considers this investigation exempt from ethical review.

Results

During 2000–2009, 2855 total release fogger exposures were reported to Texas poison centers, representing 4.0% of the 71,164 total pesticide exposures and 0.2% of the 1,714,886 total exposures of any type.

Table 1 presents the monthly distribution of cases. There was a seasonal trend, with a higher proportion of fogger exposures reported during the summer. May–August

Table 1. Monthly distribution of total release fogger exposures reported to Texas poison centers during 2000–2009.

Month	Number	(%) total
January	95	3.3
February	83	2.9
March	109	3.8
April	214	7.5
May	391	13.7
June	404	14.2
July	398	13.9
August	326	11.4
September	280	9.8
October	232	8.1
November	205	7.2
December	118	4.1
Total	2855	

accounted for 1519 (53.2%) of the exposures. The patient was female in 1600 (56.0%) exposures, male in 1229 (43.0%), and of unknown gender in 26 (0.9%) reported exposures. The distribution by patient age group was 453 (15.9%) 0–5 years, 362 (12.7%) 6–19 years, 1983 (69.5%) 20 years or older, and 57 (2.0%) unknown age.

The most common routes of exposure were inhalation in 1777 (62.2%) cases, ingestion in 695 (24.3%), dermal in 650 (22.8%), and ocular in 129 (4.5%). A single exposure might involve multiple routes, so the categories are not mutually exclusive. The general circumstances of (reason for) the exposure was 2729 (95.6%) unintentional, 75 (2.6%) intentional, 46 (1.6%) other, and 5 (0.2%) unknown. When the general location where the exposure occurred was examined (Table 2), the majority of exposures were found to have occurred at the patient's own residence.

The patient was managed on site (i.e., at home) in 2147 (75.2%) cases, already at or en route to a healthcare facility in 451 (15.8%), referred to a healthcare facility in 215 (7.5%), and managed at another or unknown site in 42 (0.5%) cases. Table 3 gives the distribution of cases by final medical outcome. The majority of exposures were known or expected to result in at most minor effects.

Over 80 specific types of adverse clinical effects were reported with fogger exposures (Table 4). The most frequently reported effects were respiratory (cough, dyspnea), gastrointestinal (vomiting, nausea, throat irritation), neurological (headache, dizziness), dermal (irritation/pain), and ocular (irritation/pain). Although no deaths were reported, one fetal death occurred. When the reported treatments were examined (Table 5), the most common were some sort of decontamination, particularly dilution or washing and fresh air. The next most common treatment was administration of oxygen.

Discussion

This study described the pattern of total release fogger exposures reported to a statewide poison center system serving more than 20 million people over a 10-year period. Although fogger exposures may cause serious illness and injury, information on such exposures is limited (Centers for Disease Control and Prevention 2008).

Table 2. General location where total release fogger exposures reported to Texas poison centers during 2000–2009 occurred.

Location	Number	(%) total
Own residence	2620	91.8
Other residence	144	5.0
Workplace	46	1.6
Public area	20	0.7
Healthcare facility	2	0.1
School	2	0.1
Restaurant	2	0.1
Other	13	0.5
Unknown	6	0.2
Total	2855	

Table 3. Final medical outcome of total release fogger exposures reported to Texas poison centers during 2000–2009.

Final medical outcome	Number	(%) total
No effect	338	11.8
Minor effect	718	25.1
Moderate effect	211	7.4
Major effect	2	0.1
Not followed – nontoxic	101	3.5
Not followed – minimal clinical effects	1123	39.3
Not followed – potentially toxic	141	4.9
Unrelated effect	220	7.7
Possible nonexposure	1	0.0
Total	2855	

This investigation is subject to several limitations. Reporting of potentially adverse pesticide exposures to Texas poison centers is not mandatory. Thus, the exposures included in this study are likely to underestimate all such exposures that occur in the state. Moreover, those that were reported might not be representative of all such exposures that occur in the state. In addition, fogger exposures were usually based on the self-report of patients and not verified clinically. In general, diagnosis of pyrethrin and pyrethroid exposure is usually based on reported history since there are no characteristic symptoms or laboratory tests specific to these insecticides (Lamb 2007). Analytical methods are available for determination of some pyrethroid metabolites, such as DCCA, DBCA, FPBA, and CDCA, but these analyses were not necessarily performed on many of the exposures in this investigation and/or were not available in the TPCN database. Moreover, the reported adverse clinical effects may not be related to the primary ingredients in the fogger but to adjuvants in the product. Adverse clinical effects may also be related to exposure to other substances such as foods, medications, or other chemicals or may be unspecified reactions in individuals suffering from airway hyper-responsiveness. Finally, the exact circumstances of the exposure (e.g., not leaving the enclosed space before

Table 4. Reported adverse clinical effects with total release fogger exposures reported to Texas poison centers during 2000–2009.

Adverse clinical effect	Number	(%) total	Reported in toxicological profile*
Respiratory	880	30.8	
Cough	725	25.4	X
Dyspnea	248	8.7	X
Bronchospasm	27	0.9	
Hyperventilation	9	0.3	
Respiratory depression	5	0.2	X
Abnormal X-ray findings	2	0.1	
Cyanosis	1	0.0	
Pneumonitis	1	0.0	X
Pulmonary edema	1	0.0	
Respiratory arrest	1	0.0	
Gastrointestinal	790	27.7	
Vomiting	381	13.3	X
Nausea	262	9.2	X
Throat irritation	226	7.9	X
Diarrhea	52	1.8	X (dogs)
Abdominal pain	48	1.7	
Oral irritation	38	1.3	X
Hematemesis	4	0.1	
Weight loss	3	0.1	X (rabbits)
Bloody rectum	1	0.0	
Constipation	1	0.0	
Neurological	337	11.8	
Headache	159	5.6	X
Dizziness	117	4.1	X
Drowsiness	35	1.2	X
Confusion	17	0.6	X
Muscle weakness	15	0.5	
Numbness	15	0.5	X
Agitation	12	0.4	
Syncope	6	0.2	
Tremor	6	0.2	X
Ataxia	3	0.1	X (cats)
Coma	3	0.1	X
Muscle rigidity	3	0.1	
Seizure (single)	3	0.1	X
Hallucination/delusion	2	0.1	
Seizure (multiple)	2	0.1	X (dogs)
Dystonia	1	0.0	
Fasciculations	1	0.0	X
Paralysis	1	0.0	
Peripheral neuropathy	1	0.0	X
Slurred speech	1	0.0	
Tinnitis	1	0.0	
Dermal	216	7.6	
Irritation/pain	123	4.3	X
Rash	38	1.3	X
Erythema	36	1.3	
Pruritus	34	1.2	
Edema	19	0.7	
Burns (superficial)	10	0.4	

(*Continued*)

Table 4. Continued.

Adverse clinical effect	Number	(%) total	Reported in toxicological profile*
Wound	5	0.2	
Hives	4	0.1	
Burns (2nd–3rd degree)	2	0.1	
Pallor	2	0.1	
Bullae	1	0.0	
Ocular	173	6.1	
Irritation/pain	122	4.3	X
Red eye	44	1.5	
Lacrimation	42	1.5	
Blurred vision	11	0.4	
Miosis	4	0.1	
Mydriasis	2	0.1	
Visual defect	2	0.1	
Corneal abrasion	1	0.0	
Nystagmus	1	0.0	
Cardiovascular	88	3.1	
Chest pain	52	1.8	X
Tachycardia	31	1.1	
Hypertension	11	0.4	
Bradycardia	2	0.1	
Cardiac arrest	1	0.0	
Hematological	1	0.0	
Cytopenia	1	0.0	
Renal	1	0.0	
Urinary retention	1	0.0	
Miscellaneous	330	11.6	
Other (not specified)	279	9.8	
Diaphoresis	18	0.6	
Fever	18	0.6	
Pain (other)	17	0.6	
Secretions	11	0.4	X
Bleeding (other)	4	0.1	
Hyperglycemia	2	0.1	
Acidosis	1	0.0	
Fetal death	1	0.0	
Total	2855		

Source: Available at http://www.atsdr.cdc.gov/ToxProfiles/tp155.pdf (accessed January 28, 2011).
Notes: *Toxicological profile for Pyrethrins and Pyrethroids. Department of Health & Human Services; Atlanta, Georgia. September 2003. Available at http://www.atsdr.cdc.gov/ToxProfiles/tp155.pdf (accessed on January 28, 2011).
X indicates clinical effect was mentioned in profile.

the fogger discharged) were not recorded for many of the cases and so could not be evaluated.

Fogger exposures represented only 0.2% of all exposures reported to Texas poison centers and 4% of all pesticide exposures reported to Texas poison centers. This suggests that fogger exposures are relatively uncommon when compared to other reported exposures, even all pesticide exposures. In spite of the numbers, fogger exposures may still represent a large number of exposures. Almost 300 fogger exposures were reported to Texas poison centers each year. Because of this, as well as the potential for serious

Table 5. Reported treatments with total release fogger exposures reported to Texas poison centers during 2000–2009.

Treatments	Number	(%) total
Decontamination	2269	79.5
Dilution/wash	1579	55.3
Fresh air	1267	44.4
Food	66	2.3
Other emetic	5	0.2
Cathartic	2	0.1
Activated charcoal	2	0.1
Ipecac	1	0.0
Lavage	1	0.0
Oxygen	166	5.8
Bronchodilators	95	3.3
Antihistamines	78	2.7
Steroids	46	1.6
IV fluids	41	1.4
Antibiotics	12	0.4
Antiemetics	11	0.4
Atropine	9	0.3
Intubation	7	0.2
Benzodiazepines	5	0.2
Ventilator	5	0.2
Pralidoxime	4	0.1
Naloxone	3	0.1
Vasopressors	2	0.1
Alkalinization	1	0.0
Antihypertensive	1	0.0
CPR	1	0.0
Flumazenil	1	0.0
Insulin	1	0.0
Octreotide	1	0.0
Sedation	1	0.0
Other (not specified)	393	13.8
Total	2855	

outcomes, poison centers might want to have in place standardized guidelines for the management of such exposures.

The fogger exposures demonstrated a seasonal pattern, with over half occurring during May–August. Insect infestations might be more common during the warmer months, in which case people are more likely to use foggers.

Most of the patients were female. The previous study likewise reported a female preponderance (Centers for Disease Control and Prevention 2008). This might be due to either women being more likely to use foggers or more likely to report potentially adverse exposures to poison centers if they occur. The majority of patients were also adults, as might be expected since adults are likely to be the ones to use foggers.

Although reported exposures occurred by a variety of routes, the majority involved inhalation, followed by ingestion, dermal, and ocular. Since foggers operate through the release of aerosol propellants, inhalation being the primary route of exposure would be

expected. Ingestion might occur if individuals ate or drank foods that were not properly covered when the fogger was used. Dermal and ocular exposures might occur through contact with the fogger chemicals both while they are in the air and as a residue on exposed surfaces.

Most of the exposures were found or expected to have at most minor effects, a result consistent with the previous study (Centers for Disease Control and Prevention 2008). Since the majority of exposures were not seriously toxic, it might be expected that most of the patients could be managed at home without having to undergo the time and expense of visiting a healthcare facility. In fact, of the 2404 patients not already at or en route to a healthcare facility when the poison center was contacted, only 215 (8.9%) were referred to a healthcare facility by the poison center. This would suggest that many of the 451 patients who were already at or en route to a healthcare facility could have been successfully treated at home if the poison center had been consulted first.

Reported adverse clinical effects were most often respiratory (cough, dyspnea), followed by gastrointestinal (vomiting, nausea, throat irritation), neurological (headache, dizziness), dermal (irritation/pain), and ocular (irritation/pain). The reported clinical effects were consistent with the literature (Centers for Disease Control and Prevention 2008; Lamb 2007). Many of the specific adverse clinical effects, and almost all of the most commonly reported adverse clinical effects, have been listed in the toxicological profile for pyrethrins and and pyrethroids (Table 4).

The most common treatment was decontamination, primarily through dilution or washing and fresh air, methods that can be performed at home. According to the literature, there is no specific antidote for pyrethrin or pyrethroid exposure. The recommended management of exposure to these insecticides is supportive measures and decontamination through exposure to fresh air or administration of oxygen if necessary and irrigation of the skin or eyes to dilute the chemicals from the fogger (Lamb 2007).

It is important to increase awareness of the potential hazards of foggers, particularly with their misuse. One way is through public health education activities both to warn about the potential hazard of foggers and what to do should an adverse exposure occur. Since most exposures occur at private residences, this would suggest that such campaigns should target the general public. Moreover, education activities might be launched prior to the summer months, when exposures are more likely to occur.

Another way to increase awareness is through product labeling. In response to recommendations from Washington State, the Centers for Disease Control and Prevention article issued in 2008, and a petition by the New York City Department of Health to reclassify foggers as restricted use pesticides, on 23 March 2010, the US Environmental Protection Agency sent pyrethrin and pyrethroid registrants a letter notifying them that labeling changes must be implemented by 30 September 2011 (US Environmental Protection Agency 2010). By that date, labels must be written in plain English; incorporate pictograms to illustrate directions including not to use multiple canisters in the same room, not to use in small areas, to turn off ignition sources, to remove or cover food, and to air out the room before entering it; and to provide door tags to warn people to stay out of treated rooms.

In conclusion, although relatively uncommon, poison centers are likely to be contacted about fogger exposures. Most such exposures do not result in more than minor effects and can be managed on site.

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