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Acute Illnesses Associated With Insecticides Used to Control Bed Bugs — Seven States, 2003–2010

The common bed bug, *Cimex lectularius*, is a wingless, reddish-brown insect that requires blood meals from humans, other mammals, or birds to survive (*1*). Bed bugs are not considered to be disease vectors (*2,3*), but they can reduce quality of life by causing anxiety, discomfort, and sleeplessness (*4*). Bed bug populations and infestations are increasing in the United States and internationally (*3,5*). Bed bug infestations often are treated with insecticides, but insecticide resistance is a problem, and excessive use of insecticides or use of insecticides contrary to label directions can raise the potential for human toxicity. To assess the frequency of illness from insecticides used to control bed bugs, relevant cases from 2003–2010 were sought from the Sentinel Event Notification System for Occupational Risks (SENSOR)-Pesticides program and the New York City Department of Health and Mental Hygiene (NYC DOHMH). Cases were identified in seven states: California, Florida, Michigan, North Carolina, New York, Texas, and Washington. A total of 111 illnesses associated with bed bug–related insecticide use were identified; although 90 (81%) were low severity, one fatality occurred. Pyrethroids, pyrethrins, or both were implicated in 99 (89%) of the cases, including the fatality. The most common factors contributing to illness were excessive insecticide application, failure to wash or change pesticide-treated bedding, and inadequate notification of pesticide application. Although few cases of illnesses associated with insecticides used to control bed bugs have been reported, recommendations to prevent this problem from escalating include educating the public about effective bed bug management.

To evaluate illnesses associated with insecticides used to control bed bugs, data from 2003–2010 were obtained from states participating in the SENSOR-Pesticides program* and from NYC DOHMH.† Acute illnesses associated with an insecticide used to control bed bugs were defined as two or more acute adverse health effects resulting from exposure to an insecticide used for bed bug control. Cases were categorized as definite, probable, possible, and suspicious based on three criteria: certainty of exposure, reported health effects, and

* The SENSOR-Pesticides program consists of 12 states that conduct surveillance of pesticide-related illness. California, Florida, Michigan, North Carolina, New York, Texas, and Washington reported cases of acute illness associated with insecticides used for bed bug control. The other five states participating in the SENSOR-Pesticides program (Arizona, Iowa, Louisiana, New Mexico, and Oregon) did not identify any cases of acute illness associated with insecticides used for bed bug control during 2003–2010. The California Department of Public Health reported one case of acute illness associated with insecticides used for bed bug control. The other case in California was reported through the California Department of Pesticide Regulation.

† New York City Poison Control Center, a component of NYC DOHMH, contributed data from 2003–2010, in addition to data received from New York State Department of Health and Mental Hygiene. Because the New York City Poison Control Center does not report data to the New York State Department of Health, their data were reported separately.

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TABLE 2. Characteristics of acute illnesses associated with insecticides used for bed bug control — seven states, 2003–2010

Characteristic	Total	
	No.	(%)*
Total	111	(100)
Year of exposure		
2003	3	(3)
2004	4	(4)
2005	9	(8)
2006	6	(5)
2007	8	(7)
2008	23	(21)
2009	19	(17)
2010	39	(35)
Location		
California	2	(2)
Florida	3	(3)
Michigan	8	(7)
North Carolina	4	(4)
New York	18	(16)
New York City	64	(58)
Texas	3	(3)
Washington	9	(8)
Age group (yrs)		
0–5	6	(5)
6–14	9	(8)
15–24	11	(10)
25–44	26	(23)
≥45	27	(24)
Unknown	32	(29)
Sex		
Male	51	(46)
Female	60	(54)
Case definition category		
Definite	3	(3)
Probable	14	(13)
Possible	91	(82)
Suspicious	3	(3)
Illness severity		
Fatal	1	(1)
High	—	—
Moderate	20	(18)
Low	90	(81)
Body part/System affected†		
Nervous system	45	(40)
Respiratory	45	(40)
Gastrointestinal	37	(33)
Skin	35	(32)
Eye	11	(10)
Cardiovascular	8	(7)
Other	15	(14)
Work related§		
Yes	13	(12)
Pesticide applicator certification		
Certified applicator	2	(2)
Uncertified/Unsupervised applicator	15	(14)
Home occupant not certified to apply pesticides	43	(39)
Unknown certification of applicator	51	(46)
Site where case was exposed		
Single family home	10	(9)
Mobile home/Trailer	1	(1)
Multiunit housing	44	(40)
Private residence/Type not specified	48	(43)
Residential institution¶	2	(2)
Hotels	3	(3)
Unknown	3	(3)
Reporting source		
Physician report	4	(4)
Poison control center	90	(81)
State health department	7	(6)
Other	10	(9)
Toxicity category**		
I – Danger	1	(1)
II – Warning	13	(12)
III – Caution	64	(58)
Missing/Unknown	32	(29)
Insecticide chemical class†		
Pyrethroid	77	(69)
Pyrethrin	28	(25)
Carbamate	3	(3)
Organophosphate	2	(2)
Other††	9	(8)
Unknown	3	(3)

* Percentages might not add to 100 because of rounding.

† The sums exceed the number of cases because some persons had more than one body part or system affected and some had exposure to more than one insecticide. Pyrethroids, pyrethrins, or both were implicated in 99 (89%) of cases.

§ By occupation, the exposed workers included two pest control workers, two emergency medical technicians, two carpet cleaners, one health educator, one caregiver, one medical technician, one support staff member at a shelter, one hotel manager, one hotel maintenance worker, and one person whose occupation was unknown.

¶ One case occurred in an independent living facility, and the other case occurred at a shelter.

** Toxicity categories as classified by the Environmental Protection Agency, based on established criteria, with category I being the most toxic.

†† Includes the following active ingredients: DEET (four), hydroprene (two), chlorfenapyr (one), coal tar (one), and acetamiprid (one). DEET and hydroprene are not insecticides, but were pesticides used to control bed bugs.

and dyspnea; and gastrointestinal symptoms (33%), including nausea and vomiting.

Among cases, 13 (12%) were work-related. Of these, three illnesses involved workers who applied pesticides, including two pest control operators, of whom one was a certified applicator. Four cases involved workers who were unaware of pesticide applications (e.g., two carpet cleaners who cleaned an apartment recently treated with pesticides). Two cases involved hotel workers (a maintenance worker and a manager) who were exposed when they entered a recently treated hotel room, and two cases involved emergency medical technicians who responded to a scene where they found white powder thought to be an organophosphate pesticide. Contributing factors were identified for 50% of cases. Factors that most

TABLE 3. Contributing factors in acute illnesses associated with insecticides used for bed bug control — seven states, 2003–2010

Contributing factor	Total	
	No.	(%)*
One or more contributing factors identified†	56	(100)
Excessive application	10	(18)
Failure to wash or change pesticide-treated bedding	9	(16)
Notification lacking/ineffective	6	(11)
Failure to vacate premises	5	(9)
Spill/Splash of liquid or dust	4	(7)
Inadequate ventilation§	3	(5)
Early reentry	2	(4)
Mixing incompatible chemicals	2	(4)
Improper storage	1	(2)
Label violation not otherwise specified¶	16	(29)
No label violation but person still ill	2	(4)

* The sum of proportions exceeds 100 because some cases had more than one contributing factor.

† For the remaining 55 (50%) cases, information was insufficient to identify contributing factors for acute illness.

§ Inadequate ventilation of the treated area resulting from failure to follow label instructions.

¶ Among these 16 cases, five involved indoor use of an insecticide that was labeled for outdoor use only, eight involved use of an insecticide not labeled for use on a person or for use on bed bugs, one involved insecticide use in an enclosed space, one was in a child who licked the floor near a pesticide application, and in one case, a blind person inadvertently sprayed a piece of furniture, which he touched with his hand, and then put his hand in his mouth.

frequently contributed to insecticide-related illness were excessive insecticide application (18%), failure to wash or change pesticide-treated bedding (16%), and inadequate notification of pesticide application (11%) (Table 3).

The one fatality, which occurred in North Carolina in 2010, involved a woman aged 65 years who had a history of renal failure, myocardial infarction and placement of two coronary stents, type II diabetes, hyperlipidemia, hypertension, and depression. She was taking at least 10 medications at the time of exposure. After she complained to her husband about bed bugs, he applied an insecticide†† to their home interior baseboards, walls, and the area surrounding the bed, and a different insecticide§§ to the mattress and box springs. Neither of these products are registered for use on bed bugs. Nine cans of insecticide fogger¶¶ were released in the home the same day. Approximately 2 days later, insecticides were reapplied to the mattress, box springs, and surrounding areas, and nine cans of another fogger*** were released in the home. On both days the insecticides were applied, the couple left their home for 3–4 hours before reentering. Label instructions on the foggers to air out the treated area for 30 minutes with doors and windows open were not followed on either day. On the day of the second application, the woman applied a bedbug and flea insecticide††† to her arms, sores on her chest, and on her hair before covering it with a plastic cap. She also applied the insecticide to her hair the day before the second application. Two days following the second application, her husband found her nonresponsive. She was taken to the hospital and remained on a ventilator for 9 days until she died.

Another example of insecticide misuse to control bed bugs occurred in Ohio in 2010. An uncertified pesticide applicator applied malathion to an apartment five times over the course of 3 days to treat a bed bug infestation. The malathion product was not registered for indoor use and was applied liberally such that beds and floor coverings were saturated. A family resided in the apartment that consisted of a father, mother, four children, and an adult roommate. One of the children, aged 6 years, attended kindergarten and arrived home around the time of the afternoon malathion applications. The father and roommate also were in the home during the applications. The child began experiencing diarrhea on the first application day, and headache and dizziness began on the second application day. The two adults present during the applications reported nausea, vomiting, headaches, and tremors. During the malathion applications, three younger children were in child care while their mother was at work, and they did not exhibit symptoms of insecticide poisoning. Each night following application of

What is already known on this topic?

Bed bug populations and infestations are increasing in the United States and internationally. Bed bugs have an increased prevalence of insecticide resistance, including resistance to commonly used agents such as pyrethroids.

What is added by this report?

During 2003–2010, seven states reported 111 acute illnesses associated with insecticides used to control bed bugs. The most frequently identified causes of illness were excessive application of insecticides, failure to wash or change pesticide-treated bedding, and inadequate notification of pesticide application.

What are the implications for public health practice?

Inappropriate use of insecticides to control bed bugs can cause harm. Media campaigns to educate the public on nonchemical methods to control bed bugs, methods to prevent bed bug infestation, and the prudent use of effective insecticides, can reduce insecticide-related illness. Making insecticide labels easy to read and understand also might prevent illnesses associated with bed bug control.

†† Ortho Home Defense Max (Ortho Business Group), EPA registration number: 239-2663, with the active ingredient bifenthrin.

§§ Ortho Lawn and Garden Insect Killer (Ortho Business Group), EPA registration number: 239-2685, with the active ingredient bifenthrin.

¶¶ Hot Shot Fogger (Spectrum Group), EPA registration number: 9688-254-8845, with active ingredients tetramethrin and cypermethrin.

*** Hot Shot Bedbug and Flea Fogger (Spectrum Group), EPA registration number: 1021-1674-8845, with the active ingredient pyrethrins, piperonyl butoxide, MGK 264 (an insecticide synergist), and pyriproxyfen.

††† Hot Shot Bed Bug and Flea Killer (Chemisco), EPA registration number: 9688-150-8845, with active ingredients pyrethrins and piperonyl butoxide.

consistency of health effects with known toxicology of the insecticide (causal relationship) (Table 1). Data were analyzed for demographics, health effects, report source, case definition category, illness severity,§ insecticide toxicity,¶ insecticide chemical class, work-relatedness, and factors contributing to illness. A 2010 case report from Cincinnati Children's Hospital Medical Center (CCHMC) in Ohio also was obtained.**

For 2003–2010, a total of 111 cases were identified in seven states (Table 2). The majority of cases occurred during 2008–2010 (73%), were of low severity (81%), and were identified by poison control centers (81%). New York City had the largest percentage of cases (58%). Among cases with known age, the majority occurred among persons aged ≥25 years (67%). The majority of cases occurred at private residences (93%); 40% of cases occurred in multiunit housing. Among cases, 39% of pesticide applications were performed by occupants of the residence who were not certified to apply pesticides. The majority of insecticide exposures were to pyrethroids, pyrethrins, or both (89%) and were in toxicity category III (58%) (Table 2). The most frequently reported health outcomes were neurologic symptoms (40%), including headache and dizziness; respiratory symptoms (40%), including upper respiratory tract pain and irritation

TABLE 1. Case classification matrix* for acute illness associated with insecticides used for bed bug control — seven states, 2003–2010

Classification criteria	Classification category				
	Definite	Probable†		Possible	Suspicious
Exposure	1	1	2	2	1 or 2
Health effects	1	2	1	2	1 or 2
Causal relationship	1	1	1	1	4

Source: CDC. Case definition for acute pesticide-related illness and injury cases reportable to the national public health surveillance system. Cincinnati, OH: US Department of Health and Human Services, CDC, National Institute for Occupational Safety and Health; 2005. Available at http://www.cdc.gov/niosh/topics/pesticides/pdfs/casedef2003_revapr2005.pdf.

* Cases are placed in a classification category based on scores received on available evidence for exposure, health effects, and causal relationship. Scores relating to exposure criteria are 1 = clinical, laboratory, or environmental finding supporting the exposure, 2 = evidence from written or verbal report; criteria for health effects are 1 = two or more abnormal signs after exposure and/or test or laboratory results that are reported by a licensed health-care professional, 2 = two or more symptoms postexposure are reported by the patient; and criteria for a casual relationship are 1 = health effects are consistent with known toxicity, 4 = insufficient toxicologic information to determine if a causal relationship exists between exposure and health effects.

† Based on either combination of scores for exposure, health effects, and causal relationship.

§ Low severity cases usually resolve without treatment and cause minimal time lost from work (<3 days). Moderate severity cases are non–life threatening but require medical treatment and result in <6 days lost from work. High severity cases are life threatening, require hospitalization, and result in >5 days lost from work.

¶ The toxicity category of an insecticide is determined by the Environmental Protection Agency (EPA) under guidance from CFR Title 40 Part 156. Insecticides in category I have the greatest toxicity, and insecticides in category IV have the least toxicity.

** This case was not included in the analysis because Ohio does not participate in the SENSOR-Pesticides program. However, this case received media coverage in Ohio and represents misuse and excessive application of pesticides. The case demonstrates the need for consumers to be diligent in choosing a certified or licensed pesticide applicator.

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