Health & Safety Report

Worker Health and Safety Branch

HS-1854

A Review of Non-Handler Illnesses Associated with Structural Pesticide Applications, 1996-2001

Marylou Verder-Carlos, DVM, MPVM
Associate Toxicologist
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California Environmental Protection Agency
Department Of Pesticide Regulation
1001 I Street, Sacramento, Ca 95812

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Executive Summary

Structural pest control has become one of the facets of urban living. The California Pesticide Illness Surveillance Program (PISP) received reports of illnesses that occurred when individuals with very minimal expectation for exposure entered a structure during or after treatment with pesticides. This evaluation includes illnesses that resulted from applications to or around structures made by professional applicators, maintenance personnel and homeowners.

The data for this analysis was extracted from the PISP database and included cases for the years 1996-2001. The cases were identified by specific criteria, retrieved by standard query language and imported into a separate database.

For the years 1996 through 2001, there were 357 pesticide-related exposure incidents involving 686 people. There were 188 males, 490 females and eight of unknown gender. Of the total people involved, 470 occurred at work while 216 were affected by pesticide exposure outside the workplace. The majority of illnesses (364 cases, 53%) are from the workforce age group of 18-55 years.

In a majority of the cases (52%), the person experienced a combination of systemic, respiratory and topical effects. An additional 26% experienced only systemic symptoms and 22% experienced a combination of topical and respiratory symptoms. Fifty-five percent of the individuals reported smelling an odor prior to developing symptoms. Additionally, 24% of the total cases were potentially more susceptible individuals who had histories of allergies, asthma, and/or multiple chemical sensitivity, pregnancy, and previous exposure to pesticides.

Thirty-eight percent involved combinations of insecticides, 33% were attributed to cholinesterase inhibitors, 12% were attributed to pyrethrins and pyrethroids while 17% were attributed to other pesticides.

Based on the information available at the time of evaluation, PISP scientists concluded that factors already prohibited by pesticide safety regulations contributed to 30% of the total incidents or 37% of the total number of cases. Investigations identified no violations in 48% of the incidents, and only technical violations in 1% of incidents.

One factor to consider is the use of widely available household insecticide products. Since household use pesticide products can be purchased anywhere without license requirements, business establishments, schools and service establishments purchase them either for regular pest control or to control isolated incidents of pest infestation. Although the regulations specify employee training in the use of pesticides in all establishments and schools, many employers are unaware of these requirements. As a result, any untrained individual can misuse the pesticides and result in exposure and illness.

Analyses of application equipment, exposure and involvement of licensed structural pest control operators (SPCO) were also done. Among the 231 drift cases, 71 (31%) involved licensed SPCOs or their employees while 160 cases (69%) involved unlicensed

applicators. Hand pump-sprayer applications were involved in 29 cases (13%) and aerosol cans were involved in 25 cases (11%). For the 455 residue cases, 277 (58%) involved licensed SPCOs while 178 (42%) involved unlicensed applicators. Hand pump sprayer applications were involved in 143 cases (31%), 113 cases of which involved SPCOs.

Misuse of pesticides seems to be a very common precedent to the illnesses seen from this analysis. Although the labels have explicit instructions and warning statements, pesticide users, especially those that use household use insecticides, are not following the label instructions. The following are recommendations to reduce this type of exposure:

Notification. Notification requirements are already in place. However, this analysis shows that illnesses resulted from the applicator's failure to inform tenants and office workers about the pesticide application. DPR and county agricultural commissioners staff should initiate discussions to explore ways to ensure that tenants and office workers are notified of pesticide applications.

Ventilation After Indoor Application. Although ventilation information is stated on labels, several illnesses resulted from the failure to ventilate the structure after pesticide application. This label requirement needs to be emphasized during applicator training.

Spraying in the Presence of Other Persons. Regulations prohibiting exposures of non-target species (humans) to pesticides are already in place. Occasionally, applicators hurriedly perform their duties without paying attention to their surroundings. Furthermore, some pesticide labels do not explicitly prohibit the presence of individuals in an ongoing application. We recommend evaluating options for prohibiting baseboard treatment, broadcast spray, crack and crevice spray, fogging, space/surface spray and spot spray treatments when people are present.

Training. Although training is mandated, businesses that employ individuals with duties that include maintenance and pest control do not consistently train their employees nor document their training sessions. Evaluate the development of a Pesticide Safety Information (PSIS) N-Series leaflet targeted at structural pest control applicators as a training tool and encourage employers to post them where visible.

Enforcement of Existing Regulations. Several regulations pertain specifically to structural pest control in the Food and Agricultural Code and the Business and Professions code. DPR and the County Agricultural Commissioners Association recently developed a new enforcement response policy with the objective of promptly responding to events that can potentially harm the health and welfare of the environment of California and it's citizens and taking appropriate enforcement action towards the violators.

Chloropicrin Measurements. Since chloropicrin is used as a warning agent in structural fumigations, fumigators should measure the air concentration of chloropicrin after structural aeration as part of the structure clearance requirements.

BACKGROUND

The Department of Pesticide Regulation (DPR) Pesticide Illness Surveillance Program (PISP)[1] database[2, 3] is a compilation of data from physician reports, worker's compensation reports and other sources[4] of pesticide illness or injury. These reports are sent to the county agricultural commissioners (CACs) for investigation and when the investigation is completed, PISP scientists evaluate the correlation of illness and injury to pesticide exposure on each case according to defined criteria (Table 1, Appendix A). Indoor exposure evaluation is interpreted differently because these exposures tend to be prolonged and dissipation may be inhibited.[5] The differences in classification of these illnesses are also discussed in Table A-1, Appendix A.

Structural pest control has become one of the facets of urban living. It is defined in the Business and Professions Code as "the control of household pests and wood-destroying pests or organisms, or such other pests which may invade households or other structures, including railroad cars, ships, docks, trucks, airplanes or other contents thereof (excluding the application of tributyltin antifouling paints to ship hulls).[6]" PISP receives reports of illnesses that occur when individuals with very minimal expectation for exposure to pesticides enter a structure during or after treatment with pesticides. Although those individuals do not handle pesticides, they may have been exposed to them while inside structures, such as offices, businesses and residences where ventilation may be impeded. This type of activity is characterized as a "*routine indoor*" activity in the PISP classification scheme of pesticide illnesses. For purposes of this report, exposure categories "*drift*" and "*residue*" are included in the evaluation. "Drift" exposure occurs during an application or during pesticide mixing and loading activities when the spray, mist, fumes, or odor from the application or mixing and loading activity is carried from the target site by air. "Residue" exposure occurs when an individual comes into contact with that part of a pesticide that remains in the environment after a pesticide application or drift. This report includes illnesses that occurred during and after an application to a structure (homes, offices, residential buildings, apartments, etc.), but excludes illnesses that occurred during or after applications to railroad cars, ships, docks, trucks, airplanes, or other contents. It also attempts to analyze the circumstances surrounding the illness events and proposes mitigation measures to prevent future illnesses.

METHODS

The data for this analysis was extracted from the PISP database. Cases classified as definitely, probably, or possibly pesticide-related illnesses or injuries with a "routine indoor" activity and exposure categories "drift" or "residue" were included in this report (see Table A-1 for definitions). For purposes of analysis, a pesticide illness incident refers to a one-time exposure event. An incident may involve one or several individuals (cases) in an exposure event. If an incident involved other individuals in a different activity category, only the cases meeting the selection criteria were included in the analysis.

The cases (cases represent a single individual involved in an incident) were identified by specific criteria, retrieved by standard query language and imported into a separate project database.[7] All selected cases were individually reviewed for consistency and

accuracy including data variables[8] that were not incorporated into the database before 1998. Those data variables, namely violations and application equipment, were reviewed for the years 1996 and 1997 and entered into the project database as well. Additionally, application methods and circumstances that may have contributed to drift exposures were evaluated.

After reviewing each case, queries were performed to assist in a detailed analysis of the selected cases. These queries consisted of several procedures that categorized the cases by demographics, occupation, location of the incident, symptomatology, predisposing conditions, pesticides involved, involvement of licensed structural pest control operators (SPCO) or their employees, application equipment, application methods, circumstances affecting drift exposures and whether or not regulation violations contributed to the illness. In addition, a summary of group incidents that involved structural fumigants was also presented. For the purposes of this report, the terms SPCO and licensed applicator refer to a licensed applicator or an employee of a licensed applicator.

In describing case demographics, several factors including age and gender were included in the analysis. We also noted whether or not individuals were at work during their reported pesticide exposure. An "occupational" category designation indicated that the individual was at their workplace during the reported exposure. Otherwise, the case was designated "non-occupational". We also described the "incident setting" as information on the individuals' location at the time of reported pesticide exposure. Table A-2, Appendix A, describes the different types of incident setting locations used in the PISP classification scheme.

Documentation of symptomatology remains very crucial in classifying the cases received by PISP. Several queries described the relationship of the symptoms to the presence or absence of other factors that may contribute to the illness. In addition, symptomatology was also related to the pesticides involved in the cases. Table A-3, Appendix A, describes the symptomatology as used in classifying illnesses in the PISP database while Table A-4, Appendix A describes the predisposing conditions that may make an individual additionally susceptible to the adverse effects of chemicals in their environment.

Structural fumigant illnesses are described in a separate section due to the nature of their pesticide components. Both sulfuryl fluoride and methyl bromide have been widely used in structural applications to control termites, wood boring insects and other household pests. Both fumigants require the use of chloropicrin as a warning agent and when used as such, chloropicrin is not considered a pesticide. Hence, it is not listed as one of the active ingredients in this report. However, PISP keeps track of illness symptoms attributed to measures intended to be protective. Since chloropicrin use as a warning agent in structural pest control is a protective measure, the illness cases associated with chloropicrin exposure are classified as "indirect" exposure. This evaluation includes a brief discussion of cases resulting from chloropicrin use in structural fumigation. However, those cases are not included in the total numbers presented.

Several regulations pertain to structural pesticide applications. In the PISP database, recorded violations are based on the following:

- Statements in the investigative report that a violation occurred or did not occur,
- The issuance of an enforcement or compliance action, or
- In the absence of either of the above, PISP scientists will identify a possible violation based on information available at the time of case evaluation.

Within the database, identified or possible violations are classified as contributory or non-contributory. If the identified violation did not contribute directly to the illness, PISP staff records such an offense as a "non-contributory" violation. Examples of non-contributory violations are: 1) failure to record pesticide safety training; 2) failure to report the correct label registration number or 3) failure to maintain safety-training record. If the identified or possible violation contributes directly to an illness, it is called a contributory violation (examples include failure to provide training, early reentry into a structure, etc).

The types of application equipment used in structural applications were also evaluated in this report to determine if certain types increase the likelihood of pesticide exposure leading to illness. The types of application equipment used in PISP are summarized in Table A-5, Appendix A. Additionally each case was evaluated according to the type of application method used to determine if illnesses may be related to a particular application method. Table A-6, Appendix A defines the types of application methods used in the case evaluations.

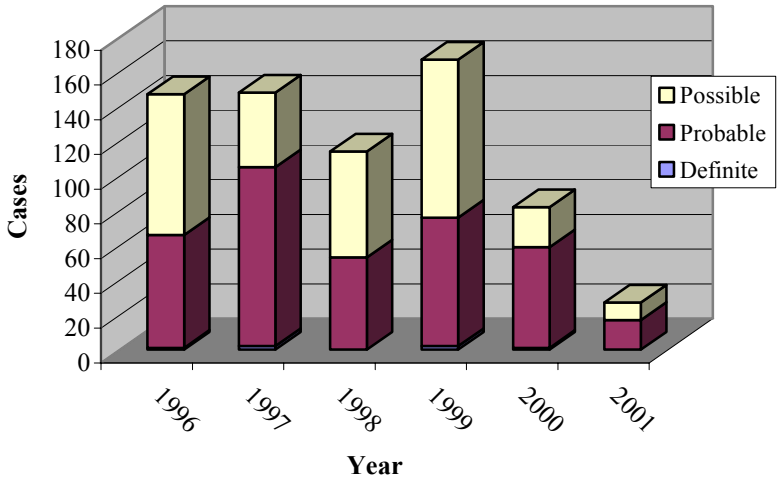
Human illness priority investigations were also described in this report. The term "priority investigation" refers to an episode that meets one or more of the criteria stated in the Cooperative Agreement Between the State of California Department of Pesticide Regulation, California Agricultural Commissioners and Sealers Association and the United States Environmental Protection Agency, Region IX. For purposes of this report, only those incidents that met the human illness priority investigation criteria were evaluated. Before the year 2001, the following conditions initiated a human illness priority investigation: death, any pesticide illness requiring hospitalization greater than 24 hours and medically diagnosed illness, and injury involving five or more people from a single pesticide exposure. However, in 2001, the criteria changed slightly to include any hospital admission categorized as "in-patient status" and deleted the clause "...medically diagnosed…" from those incidents affecting five or more people in a single exposure source. Therefore, cases classified as priority incidents after the criteria changes *may not* have been classified as priority incidents before the changes were initiated.

RESULTS AND DISCUSSION

From 1996 through 2001, there were 357 pesticide-related exposure incidents following a structural pesticide application involving 686 cases classified as definite, probable or possible. Of the 686 cases, only six cases were definitely related to pesticide exposure, while 371 were probable and 309 were possible. Figure 1 shows the distribution of definite, probable and possible illnesses by year from 1996-2001. The apparent decrease in cases seen in this graph is a reflection of the overall decreasing number of reports that PISP has received through the workers' compensation system since 1998. (In 2001, there was a 14% decline relative to the total number of cases investigated in 2000, 30% decline relative to 1999 and 26% relative to1998[9].) Although DPR scientists have not identified

any demonstrable factor that may have caused such a decline, they continue to investigate other sources that may explain the trend.

Figure 1: Summary of Illnesses Associated[1] with Structural Pesticide Applications, 1996-2001



California Department of Pesticide Regulation, Pesticide Illness Surveillance Program database query
[1]Descriptions of relationships as used in PISP are listed on Table A-1, Appendix A.

Demographics

Of the 686 cases, 188 were males, 490 were females and eight were unknown. Exposure incidents that occurred at work affected 470 individuals while there were 216 individuals affected by pesticide exposure outside the workplace. Of the individuals affected outside the workplace, 57 (26%) belonged to the 18-55 year age group, 31 (14%) were 10 years or under, 17 (8%) were between the ages 56-65, seven (3%) belonged to the 11-17 year age group, 11 (5%) belonged to the 66-80 year age group and 93 (43%) were of "unknown" age. Table 1 summarizes the cases by gender, age group and occupational status.

Since the PISP database historically collects more data on occupational illnesses due to its access to reports from the worker's compensation system, it is not surprising that 69% of the cases occurred in an occupational setting. Additionally, the highest number of illnesses (364 cases, 77%) is from the workforce age group of 18-55 years. A closer look reveals that these incidents seem to affect females more than males. This differs from the results of the 2001 annual illness report where non-agricultural illnesses equally affected males and females[10]. Several studies conducted have shown that anatomically, females' lungs tend to be smaller[11], which could potentially account for the difference in response to respiratory irritants such as smoke and other chemicals. In addition, environmental studies evaluating gender differences in acute health effects after controlled short-term chamber exposure to vapors of two common organic solvents concluded that women are slightly more sensitive than men to the acute irritative effects of those organic solvents[12].

Table 1. Summary of Cases in the Routine Indoor Activity[a] According to Gender, Age Group and Occupational Status, 1996-2001

Age in Years	Non-Occupational			Occupational		
	Male	Female	Unknown Gender	Male	Female	Unknown Gender
≤ 10	14	17	0	0	0	0
11-17	4	3	0	1	0	0
18-55	18	39	0	84	280	0
56-65	5	12	0	5	19	0
66-80	3	8	0	0	4	0
Unknown	34	52	7	20	56	1
TOTAL	78	131	7	110	359	1

California Department of Pesticide Regulation, Pesticide Illness Surveillance Program database query

[a] Routine indoor activity means the person was exposed while indoors and was not part of the application.

Incident Setting

In the occupational setting, 214 (46% of 470) occurred in offices or businesses, 60 (13%) occurred in the school setting, another 55 (12%) occurred in establishments that provide service to individuals, businesses or government (service establishments), 39 (8%) occurred in hospital or medical facilities, 23 (5%) occurred in industrial facilities and 79 (17%) occurred in other locations. In the non-occupational setting, 109 (50%) occurred in single-family homes, 35 (16%) occurred in multi-unit housing such as condominiums or apartments, 62 (28%) occurred in schools, and 10 (5%) occurred in other locations. Table 2 summarizes the cases by incident setting.

Structural pest control is performed regularly in homes, offices and businesses to prevent indoor pests[13] and ventilation is a major factor in the control of air movement in enclosed spaces[14]. The same is true for service establishments, which usually have regular pest control treatments. Before January 1, 2001, regular pest control was also done in schools but since implementation of the Healthy Schools Act of 2000 in September 2000, school districts have implemented several guidelines for pest control in the schools. These include integrated pest management (IPM), which focuses on long-term prevention or suppression of pest problems using a combination of pest population monitoring and the use of non-chemical practices to discourage pest development. Chemical pest control may be used but users need to follow strict guidelines.

Table 2. Summary of Cases in the Routine Indoor[a] Activity Category According to Incident Setting, 1996-2001

Incident Setting[b]	Non-Occupational	Occupational	Total
Crop/Livestock Processing Facility	0	9	9
Hospital/Medical	1	39	40
Industrial or Other Manufacturing Facility	0	23	23
Multi-Unit Housing	35	7	42
Office/Business	0	214	214
Prison	0	19	19
Residential Institution	2	7	9
Retail Establishment	2	18	20
Road/Rail or Utility Right of Way	0	1	1
School	62	60	122
Service Establishment	5	55	60
Single Family Home	109	9	118
Wholesale Establishment	0	2	2
Other	0	6	6
Unknown	0	1	1
TOTAL	216	470	686

California Department of Pesticide Regulation, Pesticide Illness Surveillance Program database query
[a] Routine Indoor activity means the person was exposed while indoors and was not part of the application.
[b] Descriptions of Incident Settings are listed on Table A-2, Appendix A.

Symptomatology

Table 3 summarizes the symptoms exhibited by individuals categorized by systems affected according to the definitions in Table A-3, Appendix A. Of the 686 cases, 132 (19%) exhibited systemic, respiratory and topical effects, 185 (27%) experienced systemic and respiratory symptoms, while 179 (26%) exhibited only systemic symptoms. Forty-four (6%) individuals exhibited a combination of respiratory and topical effects while 45 (6.5%) exhibited systemic and topical symptoms. Sixty-five (9%) individuals exhibited only respiratory symptoms, while 36 (5%) exhibited only topical effects.

Table 3 also describes whether or not odor was detected prior to experiencing symptoms. Three hundred seventy four (55%) of the cases reported smelling an odor before experiencing symptoms. Of those 374 cases, 92 (25%) exhibited a combination of topical, respiratory and systemic symptoms; 119 (32%) exhibited systemic and respiratory effects and 76 (20%) exhibited systemic symptoms alone.

Table 3. Summary of Cases According to the Type of Illness and the Presence or Absence of Odor, 1996-2001.

Type of Symptoms[a]	Odor		Total
	Present	Not Present	
Systemic with Respiratory and Topical Effects	92	40	132
Systemic with Respiratory Effects	119	66	185
Systemic with Topical Effects	31	14	45
Systemic Only	76	103	179
Respiratory with Topical Effects	21	23	44
Respiratory Only	27	38	65
Eye Only	5	7	12
Skin Only	2	20	22
Eye and Skin	1	1	2
TOTAL	374	312	686

California Department of Pesticide Regulation, Pesticide Illness Surveillance Program database query
[a] Descriptions of Types of Illness are listed on Table A-3, Appendix A.

Of the 312 cases where odor was not reported, 40 (13%) exhibited a combination of topical, respiratory and systemic symptoms; 66 (21%) exhibited systemic and respiratory effects and 103 (33%) developed solely systemic symptoms.

In addition to odor, PISP records "predisposition conditions." These conditions are other factors that may make an individual susceptible to the adverse effects of pesticides or other chemicals in their environment. Table 4 lists the type of conditions recorded in the database and the numbers observed for those conditions.

Twenty-four percent (162 of the 686 cases) of those who developed symptoms after exposure were predisposed individuals. The majority of those cases had histories of allergies, asthma, or multiple chemical sensitivities. Pregnancy and previous exposures to pesticides were also taken into account. Eighty-eight (54%) of those cases also noted an odor before developing symptoms while 72 (45%) individuals developed symptoms without noticing an odor.

Table 4. Summary of Predisposition Conditions that May Affect Exposures to Pesticides and/or Their Components, 1996-2001

Type of Predisposition[a]	No Odor Recorded	Odor Recorded	Direct Contact with Chemical	Total
OCCUPATIONAL				
Allergies	5	13	0	18
Allergies, Asthma	2	2	0	4
Allergies, Asthma, Previous Episodes	1	0	0	1
Allergies, Multiple Chemical Sensitivity	1	1	0	2
Allergies, Previous Episodes	1	0	0	1
Asthma	15	13	0	28
Asthma, Multiple Chemical Sensitivity	3	2	0	5
Asthma, Multiple Chemical Sensitivity, Previous episodes	1	0	0	1
Asthma, Other Preexisting Condition	0	1	0	1
Asthma, Pregnancy	1	0	0	1
Asthma, Previous Episodes	0	2	0	2
Concurrent Infection	1	5	0	6
Multiple Chemical Sensitivity	7	12	0	19
Multiple Chemical Sensitivity, Previous Episodes	1	0	0	1
Pregnancy	2	7	0	9
Previous Episodes	6	3	0	9
Other Preexisting Condition	6	6	0	12
NON-OCCUPATIONAL				
Allergies	4	5	0	9
Allergies, Asthma	1	1	0	2
Asthma	4	7	0	11
Asthma, Other Preexisting Condition	1	0	0	1
Concurrent Infection	2	5	1	8
Multiple Chemical Sensitivity	2	1	0	3
Pregnancy	1	0	0	1
Previous Episodes	2	0	0	2
Other Preexisting Condition	3	2	0	5
TOTAL	73	88	1	162

California Department of Pesticide Regulation, Pesticide Illness Surveillance Program database query

[a] Predisposition conditions as used in PISP are listed on Table 4, Appendix A.

Several studies have documented that ventilation in an enclosed structure plays a major role in dissipation of any indoor air contaminant since proper air movement can prevent or minimize the build up of compounds in the structure.[15, 16, 17] It is possible that illness may be attributed to either the characteristic odor or toxic effects of the solvents used in pesticide formulations or to the toxic effects of the active ingredients in the formulation. Residue case studies done after structural applications of permethrin, chlorpyrifos and bifenthrin indicated no harmful concentrations in the structures that would cause acute health effects, but noted that pesticide odor and their effects are still a concern.[18, 19, 20] This issue has been increasingly recognized and deserves consideration especially when a group of individuals with documented respiratory disorders and skin rashes are identified.[21] In the same light, 162 individuals in this study reported some health condition that may make them more susceptible to the adverse effects of pesticides and their components. Additionally, a study in 1990 that evaluated workers with symptoms most likely associated with pesticides and their solvents stated the possibility of continuing exposures in the building because of repeated applications in the same indoor environment.[22]

Types of Pesticides

Licensed applicators and operators are required to report pesticide use; unlicensed applicators (maintenance personnel, homeowners, etc.) are not required to report use of non-restricted pesticides. According to the annually published pesticide use reports, the total amount of pesticides used for structural pest control[A] from 1996 through 2001 ranged from 4,738,168 pounds in 1996 to a peak of 5,930,988 pounds in 1998. In 2001, 4,922,554 pounds were used. Additionally, structural applications ranked 10th on the top 100 sites in total statewide pesticide use.[23, 24, 25, 26, 27, 28] The top five structural pesticides used in 2001 by total pounds applied, included the fumigant sulfuryl fluoride, followed by diazinon, liquefied nitrogen, disodium octaborate tetrahydrate, and chlorpyrifos.[29]

Table 5 summarizes the pesticides involved, the relationship between illness and exposure and the symptoms experienced by the individuals. Of the 686 cases, 368 were attributed to the effects of a single pesticide while 318 involved combinations of pesticides including 29 unknown insecticides. Of the 368 cases, 225 (33%) were attributed to cholinesterase inhibitors, 83 cases (12%) were attributed to pyrethrins and pyrethroids and 60 were attributed to miscellaneous pesticides.

Among the pesticides used to protect wood, six incidents involved 11 individuals who developed symptoms related to residue of copper naphthenate. One of those incidents involved a family of four who moved into a house where the landlord had misapplied the pesticide creating an intense odor. One family member's blood test showed an elevated blood copper level and was evaluated as a definite case. The landlord replaced all the contaminated wood from the house to resolve the problem. Another incident involved another pesticide misapplication to wood beams in the basement of an office building. The application also resulted in an odor that caused the illness of business owners who occupied the basement. Another copper naphthenate incident involved a woman who

[A] Structural Pest Control includes all applications to structures by licensed structural pest control operators, their employees and those applied by apartment managers, custodians, etc.

developed symptoms while construction workers applied the preservative to the deck above her studio.

Table 5. Summary of Cases According to Symptomatology[a], Relationship[b] and Pesticides, 1996-2001

Pesticide	Systemic		Eye and Skin		Total	
	Definite/ Probable	Possible	Definite/ Probable	Possible	Definite/ Probable	Possible
CHOLINESTERASE INHIBITORS[c]						
Acephate	3	1	0	0	3	1
Chlorpyrifos	34	29	0	0	34	29
DDVP	2	5	0	0	2	5
Diazinon	25	70	0	0	25	70
Malathion	4	5	0	0	4	5
Propetamphos	42	1	1	0	43	1
Bendiocarb	1	0	0	0	1	0
Propoxur	2	0	0	0	2	0
PYRETHRINS AND PYRETHROIDS						
Bifenthrin	0	1	0	1	0	2
Cyfluthrin	21	8	2	1	23	9
Cyhalothrin	4	3	0	0	4	3
Cypermethrin	9	1	1	0	10	1
Esfenvalerate	2	2	0	0	2	2
Permethrin	12	4	2	0	14	4
Resmethrin	7	0	0	0	7	0
Tralomethrin	2	0	0	0	2	0
OTHER PESTICIDES						
Aluminum Phosphide	0	1	0	0	0	1
Boric Acid	3	4	1	0	4	4
Citronella	1	0	0	0	1	0
Copper Naphthenate	10	1	1	0	11	1
Creosote	1	0	2	0	3	0
D-limonene	0	1	0	0	0	1
Diuron	1	0	0	0	1	0
Glyphosate	0	1	0	1	0	2
Imidacloprid	0	2	0	0	0	2

Table 5 (Continued). Summary of Cases According to Symptomatology[a], Relationship[b] and Pesticides, 1996-2001

Pesticide	Systemic		Eye and Skin		Total	
	Definite/ Probable	Possible	Definite/ Probable	Possible	Definite/ Probable	Possible
Methyl Bromide	1	0	0	0	1	0
Naphthalene	1	0	0	0	1	0
Oil of Peppermint	1	0	0	0	1	0
Oxadiazon	1	0	0	0	1	0
Para-Dichlorobenzene	0	8	0	0	0	8
Sodium Hypochlorite	1	0	0	0	1	0
Sulfur	1	0	0	0	1	0
Sulfur Dioxide	0	1	0	0	0	1
Sulfuryl Fluoride	4	7	0	0	4	7
Trifluralin	0	3	0	0	0	3
Combinations of Fumigants	0	2	0	0	0	2
Combinations of Insecticides Including Cholinesterase Inhibitor(s)	74	63	2	7	76	70
Combinations of Insecticides without Cholinesterase Inhibitor(s)[c]	58	47	4	9	62	56
Miscellaneous Combinations	16	7	0	0	16	7
Unknown Pesticides	17	11	0	1	17	12
TOTAL	361	289	16	20	377	309

California Department of Pesticide Regulation, Pesticide Illness Surveillance Program database query

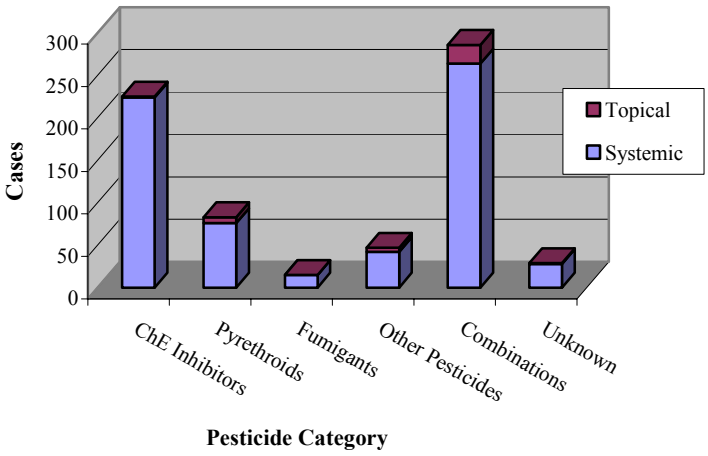
[a] Refer to Table A-2, Appendix A: Description of Symptomatology as Used in the PISP Classification Scheme

[b] For a detailed description of relationship classification, refer to Table A-1, Appendix A: Degree of Correlation between Pesticide Exposure and Resulting Symptomatology; Definite indicates that both physical and medical evidence document exposure and consequent health effects; Probable indicates that limited or circumstantial evidence supports a relationship of pesticide exposure; Possible indicates that evidence neither supports nor contradicts a relationship.

[c] Cholinesterase inhibitors are those pesticides that inhibit cholinesterase , these are the organophosphates and n-methyl carbamates.

Figure 2 illustrates that most of the illnesses involved pesticide combinations and cholinesterase inhibitors. Forty-five percent (95 of 225 total illnesses involving cholinesterase inhibitors) of illnesses that involved cholinesterase inhibitors were related to diazinon, followed by chlorpyrifos (28%) and propetamphos (19%). However, majority of the illnesses that involved diazinon occurred in one incident that affected 62 individuals in a high school. When evaluating illnesses by incident, those that involved diazinon accounted for only 15 incidents (4% of the total 357 incidents), while chlorpyrifos accounted for 36 incidents (10%) and propetamphos for 8 incidents (2%). Therefore, while diazinon accounted for more affected individuals, chlorpyrifos was involved in more illness incidents than diazinon.

Figure 2: Distribution of Cases According to Pesticide Categories, 1996-2001



Both diazinon and chlorpyrifos insecticides were readily available in retail stores for household use until late 2002. These were widely used by licensed and unlicensed applicators in homes, businesses and other structures until 2001. Because of health concerns, U.S. EPA canceled most structural uses of chlorpyrifos[30] and retailers stopped selling all chlorpyrifos-containing products to consumers on December 31, 2001. Currently, chlorpyrifos use is allowed only as a termiticide at a 0.5% concentration and can only be applied by licensed applicators. U.S. EPA also canceled all indoor uses of diazinon on December 31, 2002 and non-agricultural outdoor uses of diazinon were canceled on December 31, 2004.[31]

Insecticides are commonly sold in retail stores with several active ingredients in the formulation. Licensed applicators also combine insecticides to attain a broader range of action against several pests. In addition, maintenance crews and homeowners sometimes use several insecticides to control pests in various situations contrary to label instructions. The misuse of these readily available products and their combinations may therefore result in illnesses.

Structural Fumigants

The fumigants sulfuryl fluoride and methyl bromide have been widely used in structural applications to control termites, wood boring insects and other household pests. According to the 2001 Annual Pesticide Use Report,[32] 16,475 pounds of methyl bromide and 2,581,982 pounds of sulfuryl fluoride were used in structural pest control. Both require the use of chloropicrin as a warning agent. With methyl bromide, chloropicrin is incorporated into the formulation but with sulfuryl fluoride, it is neither formulated with the product nor mixed with the product before application. For sulfuryl fluoride applications, chloropicrin is poured on to a cotton ball in a non-corrosive pan and the pan is placed "in the air stream of a fan 5-10 minutes prior to the introduction of the fumigant."[33] The label also specifies the amount of chloropicrin to use per cubic feet of the structure and the removal of the pan during the one-hour aeration period to aid in its dissipation. After aeration is complete, sulfuryl fluoride and methyl bromide levels are measured using specific technical instruments to detect those chemical levels in the environment. When levels are acceptable, residents are allowed to reenter the structure. However, chloropicrin levels are not measured.

There were 14 structural pest control illness incidents that involved fumigants and chloropicrin. (An additional 16 cases resulted from the warning properties of chloropicrin after the structures had been cleared for reentry. These 16 cases are not part of this analysis since its use as a warning agent is not considered pesticidal.) Of the 14 cases evaluated as definitely, probably or possibly related to the fumigant, one case resulted in a fatality that proved to be definitely related to inhalation of toxic levels of methyl bromide; the structural pest control operator failed to seal conduits from the fumigated structure to the guesthouse where the individual lived and worked. Four cases were determined to be probable; three of these cases were reentry violations, which meant that the structure might still have had unacceptable levels of sulfuryl fluoride when the individuals entered the structure. One case, also evaluated as "probable," involved fumigant drift from a tarp hole that emergency services contained after receiving a complaint. Another nine were determined to be "possible" cases because the individuals' symptoms were compatible to health effects of the fumigant. Table 6 summarizes the symptomatology, the pesticides involved and the exposure categories of the fumigant illnesses recorded in PISP from 1996 through 2001. Descriptions of the individual cases are in Table B-1, Appendix B.

Table 6. Summary of Structural Fumigant Illnesses Categorized by Symptomatology[a], Exposure and Relationship[b] Classification, 1996-2001

Symptomatology	Pesticide Involved	Drift		Residue	
		Definite/ Probable	Possible	Definite/ Probable	Possible
Eye, Respiratory	Sulfuryl Fluoride	0	1	1	0
Eye, Respiratory, Systemic	Sulfuryl Fluoride	0	1	1	0
Eye, Respiratory, Systemic	Methyl Bromide	0	0	0	1
Eye, Systemic	Sulfuryl Fluoride	0	0	0	1
Respiratory	Sulfuryl Fluoride	0	1	0	0
Respiratory, Systemic	Sulfuryl Fluoride	1	2	0	0
Skin, Eye, Respiratory, Systemic	Sulfuryl Fluoride	0	0	0	0
Systemic	Methyl Bromide	1	0	0	1
Systemic	Sulfuryl Fluoride	0	1	1	0
TOTAL		2	6	3	3

California Department of Pesticide Regulation, Pesticide Illness Surveillance Program database query

[a] Refer to Table 2, Appendix A: Description of Symptomatology as Used in the PISP Classification Scheme

[b] For a detailed description of relationship classification, refer to Table 1, Appendix A: Degree of Correlation between Pesticide Exposure and Resulting Symptomatology; Definite indicates that both physical and medical evidence document exposure and consequent health effects; Probable indicates that limited or circumstantial evidence supports a relationship of pesticide exposure; Possible indicates that evidence neither supports nor contradicts a relationship.

As discussed earlier, studies done after structural applications of some insecticides indicated no harmful concentrations in the structures that would cause acute health effects, but noted that pesticide odor and their effects are still a concern.[34, 35, 36] This concern also supports those cases attributed to the effects of chloropicrin as a warning agent during structural fumigations. Chloropicrin has a very high vapor pressure (23.8 mm Hg at 25ºC) and low adsorptivity so that it readily volatilizes.[37] These chemical properties make it a very effective warning agent when used according to label directions. However, according to the American Conference of Governmental Industrial Hygienists, airborne exposure to 0.3-0.37 ppm for 3-10 seconds results in eye irritation; inhalation exposure to 4 ppm for a few seconds may cause some degree of incapacitation and an exposure of a few seconds to 15 ppm can cause injury to the respiratory tract.[38] Other symptoms may be excessive tearing, shortness of breath, tightness in the chest, and difficulty breathing. Ideally, chloropicrin would have dissipated by the time residents are allowed to enter fumigated structures especially after proper aeration and observation of reentry intervals. The occurrence of 16 cases attributed to the effects of chloropicrin as a

warning agent deserves further evaluation. Its' use may need to be evaluated or monitored in the same manner as sulfuryl fluoride and methyl bromide, which means the structure may need to be cleared of chloropicrin for reentry by measuring the indoor air.

Violations

As described earlier, PISP scientists rely on investigation reports to identify factors that contributed to pesticide illness episodes. Often, enforcement actions are still under consideration when DPR receives investigative reports, so identification of violations may be incomplete. Based on the information available at the time of evaluation, PISP scientists concluded that factors already prohibited by pesticide safety regulations contributed to 105 incidents (30% of 357 total incidents) involving 251 cases (37% of the 686 total cases). Investigations identified no violations in 172 incidents (48%), involving 278 (41%) of the cases, and only technical violations in 45 incidents involving 113 cases. Unavailable or conflicting information prevented evaluation of compliance in 35 incidents involving 44 cases.

Illness occurrence among 278 individuals (41% of the total cases) despite the applicator's adherence to regulations deserves attention. Further case evaluation revealed some connection to the circumstances that may have contributed to their illness: the presence of odor and other health conditions that may have predisposed them to the effects of the pesticide products. Of these 278 cases, 54 individuals (19%) did not report having any predisposing conditions, while 133 individuals (48%) reported an odor, 45 (16%) also reported an odor in addition to predisposing health conditions while 38 (14%) reported only having health conditions. Of the remaining eight individuals, three had substantial contact with the pesticide, two were accidentally exposed and predisposing conditions were not ascertained for the other three cases. The predisposing health conditions in 83 individuals include asthma, pregnancy, multiple chemical sensitivities, concurrent infections or other health conditions that may have compromised one's reaction to the pesticide products.

Among the 105 incidents recognized as resulting from violations of existing regulations, early reentry into treated structures accounted for six incidents with seven cases. Two people returned too soon after fogging their own homes, and one teacher entered a treated classroom before completion of the time lapse and ventilation that the label required. In this episode, the classroom was also over-treated. The four other cases resulted from three applications by licensed applicators. In one of these, the applicator asked an office worker to open the door and inactivate the alarm before ventilating a fumigated building.

Among the other 99 incidents, the largest affected 62 individuals, mostly high school students, who developed symptoms after a school groundskeeper applied diazinon with a hose-end sprayer about 15 feet from the air conditioner intake. The odor entered the ventilation system and reached the first floor classrooms. The untrained applicator failed to follow general standards of care in applying pesticides, and the school was cited for his violations. Another incident involved 13 individuals in an office building where pesticides were applied on three separate occasions. Five individuals developed symptoms after a licensed applicator applied a pesticide not labeled for indoor use. Eight

other people in the same facility developed symptoms after subsequent applications that, according to investigative reports, complied with regulations.

A fatality resulted from several violations including the applicator's failure to completely check for conduit outlets from the main house to the guesthouse. The main house was fumigated with methyl bromide that drifted into the guesthouse through the open conduit. The self-employed tenant started feeling ill on the day of the application but continued to work at the guesthouse. She was found comatose and seizing the next day and was hospitalized. Blood bromine levels were elevated and the person was in a coma for several days before she succumbed 16 days later.

Among the different types of violations, 44 cases resulted from applications not specified in the product label (e.g., applying pesticide indoors when label specified outdoor use only, used pesticide as a fogger when label stated only crack and crevice etc); 30 cases resulted from failure to follow specific label directions such as failing to secure drilled holes after a termiticide application, failure to check for leaks before fumigations, failure to clear the area before applying pesticides etc. Some cases also resulted from applications where other persons and non-target areas were contaminated, therefore causing illness. There were 19 cases resulting from failure to ventilate the structure before reentry, 20 cases from applications over the required label rate and 96 from a host of violation combinations. Table 7 summarizes the cases that involved regulation violations.

Table 7. Summary of Cases With Violations, 1996-2001

Type of Violation	Number of Illnesses
Prohibited Type of Application	44
Failure to Follow Label Directions	30
Overapplication	20
Failure to Ventilate	19
Lack of Notification	18
Lack of Training	9
Premature Reentry	7
Unsafe Application	5
Other Violations	3
Any Combination of Above Violations	96
TOTAL	251

California Department of Pesticide Regulation, Pesticide Illness Surveillance Program database query

A separate analysis of the 231 drift cases was done to evaluate various circumstances that may have contributed to the illnesses. It was noted that on some occasions, individuals were allowed to remain in the treatment areas during an on-going application. Table 8 summarizes cases that resulted in violations and evaluates them according to

circumstances that may have contributed to drift exposures. It also categorizes them according to involvement of licensed applicators.

Table 8. Summary of Drift Cases in Structural Pesticide Applications Which Involved Cited Violations[a], According to Involvement of Licensed Applicators, 1996-2001

Circumstances of Application	SPCO[b]	Non-SPCO[c]	Total
Pesticide Pulled Inside by Swamp Cooler or Intake Vent	3	67	70
Present During Application	14	7	21
Individual Located Adjacent to Application Site	3	9	12
Illegal Application Methods	9	0	9
Fumigation to Main House Not Contained	1	0	1
TOTAL	30	83	113

California Department of Pesticide Regulation, Pesticide Illness Surveillance Program database query

a "Cited violations" include those cases where the investigator explicitly stated misuse that contributed to the illness and cited specific code regulation violations.

[b] SPCO – Structural Pest Control Operator; for the purposes of this document an SPCO refers to a licensed applicator or employees under the supervision of a licensed applicator.

[c] Non-SPCO refers to an unlicensed applicator (i.e., building maintenance, school custodian, etc.)

Twenty-nine incidents with 113 total drift cases resulted in cited violations. Among the 29 incidents, 15 involved licensed applicators while 14 involved non-licensed applicators. The school incident with 61 cases involved an unlicensed applicator and the fatal incident involved a licensed applicator. Both were described earlier in this report.

Among the other 14 drift incidents (29 cases) that involved licensed applicators, 14 cases developed illness while they were present during the application. One individual reported that an applicator sprayed under his feet while eating at a restaurant while two similar cases involved applications along an establishment's entryway when customers walked through. One unusual case involved an office employee who walked-in on a demonstration for application equipment. The office employee was drifted on by the application, developed symptoms and the licensed applicator was cited for negligent application.

The nine individuals exposed to drift who developed symptoms from illegal application methods were from one incident, which involved 11 employees. An unlicensed applicator applied diazinon to the basement room with a fog-generating equipment and initially affected nine employees. An additional two employees became ill after they tried to clean up the room and were affected by pesticide residue. The only legal use for that pesticide was crack and crevice treatment. Among the three ill individuals located adjacent to the application site, one incident involved two hotel employees who developed symptoms from a pesticide overapplication and the other incident had similar circumstances.

Omitting the school incident described earlier, 13 incidents with a total of 21 cases involved non-licensed applicator related drift cases. Seven individuals (33%) were present during the application; nine (45%) were located in a room or area adjacent to an on-going application while six (29%) developed symptoms from an application pulled-in by an intake vent or by ventilation system distribution. Among the seven cases where individuals were present during an application, various scenarios described how they were exposed, including unauthorized use of insecticides in the office, mixing the insecticide with diesel instead of mineral oil, and a restaurant customer affected by an automatic pesticide dispenser above the eating areas.

Among the nine cases affected while located in an adjacent area from the application site, six hospital employees became ill when maintenance workers fogged the first floor without notifying or evacuating any of the employees upstairs. A similar incident involved a school groundskeeper who applied foggers to squirrel burrows next to the cafeteria. Two school cafeteria employees developed symptoms as a result of the application. The groundskeeper failed to check all possible burrow exits and the school was cited for the violation. One incident involved a home-use insecticide application to an office by a maintenance employee that affected another employee in the next room. Six individuals in three incidents developed symptoms when the pesticide was pulled-in by an intake vent or was distributed by the ventilation system. One incident involved a store manager who wiped-on undiluted malathion on a shelf when he saw insects. The ventilation system distributed the odor throughout the store resulting in a store evacuation and four employees developing symptoms. A similar case involved an untrained employee who set off a fogger in a storage room without turning off the air conditioner that affected another employee who decided to stay in the next room to finish his work.

Violations that occur when handling and using pesticides used for structural pest control are a concern. By law, anyone using a pesticide product must follow all label statements and instructions. People applying pesticides as part of their employment are required to have proficient and documented training in addition to applying pesticides in a safe manner to ensure that no persons are affected by the application. Several violations were noted in the case of the school custodian who applied diazinon adjacent to the air conditioner intake valve and subsequently caused illness to 62 individuals. Other violations such as misapplications, overapplications, failure to ventilate, and combinations of those situations also occurred. Another violation was failure to notify the tenants. Pesticide applicators are required to inform the owner or owner's agent, and tenants of the premises about the pesticide application with specific information about the pest, the pesticide used, and pesticide hazards. Other situations involved the use of unregistered pesticides and failure to limit pesticide application to a designated area (drift). While some investigations noted violations that *may not* have contributed to the illness or injury per se (i.e., failure to transport individual to a medical facility) most involved violations that contributed to the exposure.

The use of widely available household insecticide products may also contribute to the occurrence of illnesses. Since household use pesticide products can be purchased anywhere without license requirements, business establishments, schools and service establishments purchase them either for regular pest control or to control isolated

incidents of pest infestation. Although the regulations specify employee training in the use of pesticides in all establishments and schools, most employers are unaware of these requirements. As a result, any untrained individual can use the pesticides and if the applicator fails to read the label or ignores the instructions, various violations can be committed. Therefore, the use of household insecticide products raises several important considerations regarding safety.[39] However, if those products are used in accordance to label instructions and employers properly train their employees, illnesses will be greatly reduced.

Application Equipment

Table 9 summarizes the application equipment types, exposure category and involvement of licensed structural pest control operators. This evaluation looks at exposure category (drift, residue) because of its relationship to the application equipment and the manner in which the pesticide was applied. The data shows that hand-pump sprayers with small volume (1 to 5 gallon) tanks and aerosol cans are involved in nearly half (43%) of the illness cases.

Table 9. Summary of Application Equipment Involved in Illnesses According to Exposure and Applicator[b c] Involvement, 1996-2001

Application Equipment[a]	Drift		Residue		Total
	SPCO[b]	Non-SPCO[c]	SPCO	Non-SPCO	
Aerosol Can	7	18	35	61	121
Aerosol/Fog Generating Equipment	1	9	4	1	15
Automatic Aerosol Pesticide Dispenser	0	2	0	0	2
Backpack Sprayer	3	2	3	0	8
Bait	0	0	2	0	2
Cloth Rag	0	4	0	0	4
Foggers	0	12	1	10	23
Fog-Generating Equipment, Specific Type Not Specified	9	0	2	0	11
Gas Cartridge, Manual Placement	0	2	0	0	2

Table 9 (Continued). Summary of Application Equipment Involved in Illnesses According to Exposure and Applicator[b] [c] Involvement, 1996-2001

Application Equipment[a]	Drift		Residue		Total
	SPCO[b]	Non-SPCO[c]	SPCO	Non-SPCO	
Hand-Held Duster	2	0	1	16	19
Hand-Held Sprayer	0	0	2	0	2
Hand Pump Sprayer	21	8	113	30	172
Hand-Held Spray Equipment, Unpressurized	0	1	0	8	9
Hand-Held Equipment, Specific Type Not Specified	7	16	53	10	86
Hand, Other or Unspecified	0	0	2	0	2
Hose-End Sprayer	0	65	0	0	65
Implement with Handles	0	0	0	5	5
Implement without Handles	0	0	0	1	1
Manual Placement	0	4	8	7	19
Manual Application Method, Specific Type Not Specified	0	12	0	7	19
Pressurized Hose Line Sprayer	9	1	22	2	34
Tape Fumigation	1	0	0	0	1
Tarp Fumigation	7	0	6	0	13
Three Application Methods Not Specified	2	0	0	0	2
Ultra Low Volume Equipment	2	0	21	8	31
Watering Can	0	3	0	0	3
Unknown	0	1	2	12	15
TOTAL	71	160	277	178	686

California Department of Pesticide Regulation, Pesticide Illness Surveillance Program database query

[a] Descriptions of the types of application equipment are listed in Table A-6, Appendix A.

[b] SPCO – Structural Pest Control Operator; for the purposes of this document an SPCO refers to a licensed applicator or employees under the supervision of a licensed applicator.

[c] Non-SPCO refers to an unlicensed applicator (i.e., building maintenance, school custodian, etc.)

Among the drift cases, 71 (31%) involved licensed applicators while 160 cases (69%) involved non-licensed applicators. One episode with 61 cases (26% of 231 drift cases) involved a hose-end sprayer application of diazinon adjacent to an air vent in a high school. Hand pump-sprayer applications were involved in 29 cases (13%) and aerosol cans were involved in 25 cases (11%).

It was apparent that use of hand pump sprayers resulted in many illness when used by the licensed applicators (20% of 686 total cases), presumably because this group frequently uses them. Aside from the one incident in a high school, aerosol cans most frequently resulted in illness when used by unlicensed applicators (12% of 686 cases). In addition, the licensed applicators more commonly used equipment they were qualified to use. These were ultra low volume equipment; fog-generating equipment, fumigation equipment and pressurized hose end sprayers. On the other hand, homeowners, residents, office workers and maintenance staff commonly utilized home-use products such as aerosol cans, hand-held dusters, baits, and manual application methods, such as cloth rags, etc.

Application Methods and Circumstances of Exposure

Label directions describe various application methods including specific directions on how and where a pesticide can be applied. These methods are used in conjunction with specific application equipment. For example, when an applicator sprays insecticide with a hand pump sprayer, they can use a broadcast spray (sprays the entire surface), space spray (sprays in the air for flying insects) or baseboard spray (sprays along the baseboards of the house). This evaluation also looked at exposure category (drift and residue) because of its relationship with the application method and the likelihood that licensed or unlicensed applicators might use the method. For instance, there are application methods that only licensed applicators are allowed to perform. Table 10 summarizes the different application methods used that resulted in illnesses.

Omitting the episode that affected 61 students at a high school after an outdoor broadcast spray of diazinon, there were 170 drift cases. Among those, 35 individuals became ill from space and surface spray application methods (20% of 170 cases), 22 from fogging methods (13%), 18 from spot treatment methods (10%), and 17 from crack and crevice treatment methods (10%). Forty-two percent of the drift cases involved licensed applicators while 58% involved other applicators.

Among the 455 residue cases however, 277 involved licensed applicators (61%) and 178 involved other applicators (39%). Among the methods used by licensed applicators, surface or space spray methods were involved in 130 cases (47% of 277) while crack and crevice applications were involved in 43 cases (15% of 277) and, spot treatments were involved in 26 cases (9% of 277). Non-licensed applicators used similar methods (space and surface spray 32%; spot treatment 11%; crack and crevice 10%) that were also involved in illnesses. Application methods were unknown for 20 cases (4% of 455).

Table 10. Summary of Application Methods Involved in Structural Pesticide Application Illnesses According to Exposure and Applicator[b] [c] Involvement, 1996-2001

Application Method[a]	Drift (# of illnesses)		Residue (# of illnesses)		Total
	SPCO[b]	Non-SPCO[c]	SPCO	Non-SPCO	
Automatic Dispenser	0	3	0	0	3
Bait	0	0	2	0	2
Baseboard Spray	11	0	10	13	34
Broadcast Spray Outdoors	11	76	13	6	106
Crack and Crevice	11	6	43	17	77
Drill and Treat	2	0	19	0	21
Duster	0	0	2	16	18
Fogging	10	12	7	13	42
Fumigation	7	0	6	0	13
Hand Spray to Fences	0	0	0	1	1
Hand-Pour	0	2	0	1	3
Injection into Wood Pole	0	3	0	0	3
Manual Application	0	12	0	9	21
Manual Placement	0	4	8	5	17
Paintbrush	0	0	0	5	5
Space/Surface Spray	15	20	130	57	222
Spot Treatment	3	15	26	20	64
Sub-Area Treatment	0	0	2	0	2
Tape	1	0	0	0	1
Trench and Treat	0	0	5	1	6
Wiping Cloth	0	4	0	0	4
Wood Spray	0	1	0	0	1
Unknown	0	2	4	14	20
Total	71	160	277	178	686

California Department of Pesticide Regulation, Pesticide Illness Surveillance Program database query

[a] Application equipment types listed in this table only refers to those used in structural pesticide applications. These methods are defined in the coding manual of the California Department of Pesticide Regulation Registration Branch.

[b] SPCO – Structural Pest Control Operator; for the purposes of this document an SPCO refers to a licensed applicator or employees under the supervision of a licensed applicator.

[c] Non-SPCO refers to an unlicensed applicator (i.e., building maintenance, school custodian, etc.)

Indoor applications involving surface/spray application, crack and crevice application, baseboard treatments, fogging and spot treatments resulted in a significant numbers of illnesses from both drift and residue exposures. Those application methods were

involved in the majority of the illnesses reported regardless of who performed the application. Drift incidents occurred while people were in the area during the application.

Priority Investigations

Among the 357 incidents from 1996 through 2001, 25 incidents, involving 176 individuals were designated as priority investigations. Nineteen of these incidents involved more than one individual, while the other six only involved one person. In three of the six single person incidents, pesticides were improperly applied or label instructions were not followed. Two of the illegal applications involved licensed applicators while one involved a homeowner who was hospitalized for a health-related condition that may have involved her use of a pesticide. One of the licensed applicator-involved incidents that resulted in a fatality was due to exposure to methyl bromide described previously. Another individual eating in a restaurant reported a licensed applicator had sprayed around his feet. He developed symptoms a few minutes later. His symptoms progressed later that day and he sought medical attention that evening. He was hospitalized for two days. The applicator was cited for applying pesticides in an unsafe manner.

Among the 19 group priority investigations, 16 incidents involved five or more people while three incidents involved two to four individuals. Of the 19 incidents, 13 involved licensed applicators and among those, misuse violations contributed to the illness in three incidents. Two separate incidents occurred in medical offices. In one incident, eight employees developed symptoms from an off-label use of mothballs (para-dichlorobenzene) to repel skunks living under their building. The other incident involved seven employees who came to work the morning following a pesticide application to their office. The licensed applicator failed to properly ventilate the area. Among the six incidents that did not involve licensed applicators, misuse violations contributed to illness in three incidents. A family developed symptoms after the manager treated their apartment with pesticides. Samples revealed positive pesticide residue and the investigator also noted a distinct odor. In another incident, maintenance workers fogged a first floor office without informing or evacuating office workers on the second and third floors. Seven employees developed symptoms.

Some if not all individuals in 11 of the 19 incidents described smelling an odor before they developed symptoms. Table B-2 in Appendix B presents a summary of the cases and describes the circumstances leading to the exposure event.

RECOMMENDATIONS

Since diazinon and chlorpyrifos are no longer available for household use, illnesses that may have been associated with those pesticides may no longer be apparent in the years following 2001. However, with the cancellation of those products, use of other insecticides such as the pyrethrins, pyrethroids and other combinations may increase and we may see more illnesses related to these pesticides in the future. Pesticide misuse seems to be a very common precedent to the illnesses seen from this analysis. Although the labels have explicit instructions and warning statements, pesticide users, especially

those that use household-use insecticides, seem to ignore the labels. According to a study[40] on human behavior and the cause of warning failures, several factors affect how humans perceive warning labels and signs. Since those factors cannot be controlled, recommendations to mitigate illnesses from structural pesticide applications are limited to those factors that can be monitored and regulated.

Notification. A notification regulation is already in place in the Business and Professions Code, Article 2.5, Pesticides, section 8538 for structural pest control companies. However, this analysis shows that various illnesses resulted from the failure to inform tenants and office workers about the pesticide application. Structural pest control companies need to be informed of their responsibility to notify all persons about all pesticide applications before the application as required by law. According to discussions with some stakeholders, a majority of applicators notify apartment and office managers but the breakdown in communication occurs when the managers fail to inform the tenants and office employees. DPR and county agricultural commissioners staff should initiate discussions to explore ways to ensure that tenants and office workers are notified of pesticide applications. Additionally, these discussions should emphasize the notification requirement and its importance in preventing illnesses.

Ventilation After Indoor Application. Although this requirement is stated on labels, several illnesses occurred related to the failure to ventilate the structure after pesticide application. Emphasizing this label requirement during training sessions with licensed applicators and with maintenance employees for other business establishments should be done.

Spraying In the Presence of Other Persons. Regulations prohibiting exposures of non-target species (humans) to pesticides are already in place (Food and Agricultural Code Section 12976 and 12981). Occasionally, applicators still apply pesticides with individuals present in the vicinity of the application sites. Furthermore, some pesticide labels do not explicitly prohibit the presence of individuals during an ongoing application. We recommend evaluating options for prohibiting baseboard treatment, broadcast spray, crack and crevice spray, fogging, space/surface spray and spot spray treatments when people are present. We also recommend initiating discussions with various structural pesticide applicator organizations regarding this issue.

Training. This issue is very important to safe pesticide use in structural pest control. The illness data shows that although training is required for licensed applicators, the information conveyed is apparently not understood. In addition, other businesses that employ individuals with duties that include maintenance and pest control do not consistently train their employees nor document their training sessions. Evaluate the development of a Pesticide Safety Information (PSIS) N-Series leaflet targeted at structural pest control applicators as a training tool and employers to post them where visible. Regardless of the employer's type of business, we also recommend emphasis on training and provisions for post-training evaluations for any employee who handles pesticides. It might also be necessary to evaluate existing training modules to assess their effectiveness.

Enforcement of Existing Regulations. Several regulations pertain specifically to structural pest control in the Food and Agricultural Code and the Business and Professions code. DPR and the County Agricultural Commissioners Association recently developed an enforcement response policy whose objective is to 'take timely and effective enforcement actions against violators and promptly respond to any actual or potential harm to the public health, property, worker safety and environment of California.' [41] DPR has prioritized this policy to be written into regulation by June 30, 2006. This policy should result in more uniform and responsive enforcement actions.

Chloropicrin Measurements. Since chloropicrin is used as a warning agent in structural fumigations, fumigators should measure the air concentration after aeration as part of the structure clearance requirements. There are monitoring devices that can be used to measure air concentrations of chloropicrin and we recommend the use of these devices to monitor levels of the warning agent when using structural fumigants.

APPENDIX A

Table A-1. Degree of Correlation between Pesticide Exposure and Resulting Symptomatology

Relationship	Definition
Definite	High degree of correlation between pattern of exposure and resulting symptomatology. Requires both medical evidence (such as measured cholinesterase inhibition, positive allergy tests, characteristic signs observed by medical professional) and physical evidence of exposure (environmental and/or biological samples, exposure history) to support the conclusions.
Probable	Relatively high degree of correlation exists between the pattern of exposure and the resulting symptomatology. Either medical or physical evidence is inconclusive or unavailable. For incidents that occur indoors, symptoms experienced occur within a day of entering a treated structure that was treated within the previous three days. Development of recurring allergic reactions even if the person did not enter the treated area but was located somewhere in the building.
Possible	Some degree of correlation evident. Medical and physical evidence are inconclusive or unavailable. For incidents that occur indoors, symptoms occur with a time lapse of four days or more between application and exposure; or the affected person did not spend time in parts of the building that were treated.
Unlikely	A correlation cannot be ruled out absolutely. Medical and/or physical evidence suggest a cause other than pesticide exposure.
Indirect	Pesticide exposure is not responsible, but pesticide regulations or product label contributed in some way (e.g. heat stress while wearing chemical resistant clothing; illness attributable to the warning agent used).
Asymptomatic	Exposure occurred, but did not result in illness/injury. Cholinesterase depression without symptoms falls in this category.
Unrelated	Definite evidence of causes other than pesticide exposure including exposures to chemicals other than pesticides.
Not Applicable	Relationship cannot be established because the necessary information is either unavailable or not provided.

California Department of Pesticide Regulation (2002) Pesticide Illness Surveillance Program (PISP) Database User Documentation/Dictionary

Table A-2. Description of Incident Setting as Used in the PISP Classification Scheme

Incident Setting	Definition
Crop/Livestock Processing Facility	Facilities involved in packing, manufacturing or processing foods or beverages for human consumption and feed products for animals and fowl. This includes facilities that sort, grade and pack fresh fruits and vegetables.
Hospital / Medical	Establishments that provide medical, surgical and other health services to people. This includes offices and clinics of doctors and dentists, hospitals, medical and dental laboratories, kidney dialysis centers and other health related facilities.
Industrial Or Other Manufacturing Facility	Facilities involved in the mechanical or chemical transformations of materials or substances into new products. This excludes: 1) facilities engaged in manufacture or formulation of pesticides; and 2) facilities engaged in treatment of wood to protect against pest damage.
Multi-Unit Housing	Apartments and multi-plexes and other buildings on property. This includes swimming pools, but excludes landscaped areas on the property.
Office/Business	Commercial establishments including public and private business offices. This excludes retail establishments and service establishments.
Prison	Establishments for the confinement and correction of offenders as ordered by courts of law. This includes California Youth Authority facilities.
Residential Institution	Dormitories, nursing homes, homeless shelters and similar facilities.
Retail Establishment	Businesses engaged in selling merchandise for personal or household consumption and providing services related to the products. This excludes restaurants.
School	Establishments that provide academic or technical instruction. This includes daycare centers.
Service Establishment	Establishments engaged in providing services to individuals, businesses and government. This includes restaurants, laundries, etc. This excludes medical service establishments.

Table A-2. (Continued) Description of Incident Setting as Used in the PISP Classification Scheme

Incident Setting	Definition
Single Family Home	The house and other structures on property intended for use by a single family. This includes swimming pools, but excludes landscaped areas on the property.
Wholesale Establishment	Establishments involved in the distribution of merchandise to retail establishments or other wholesale establishments. This excludes "wholesalers" who sell directly to the public.
Other	Location of exposure occurred at a site not adequately described in any other incident setting category. This includes water supply systems and waste water treatment plants.
Unknown	The location of the incident is unknown.

California Department of Pesticide Regulation (2002) Pesticide Illness Surveillance Program (PISP) Database User Documentation/Dictionary

Table A-3. Description of Symptomatology as used in the PISP Classification Scheme

System Affected	Description
Skin	Health effects involving the skin (i.e. redness, itching, scaling, etc). Also considered a topical effect.
Eye	Health effects involving the eyes (i.e. redness, tearing etc). Also considered topical effect. This excludes outward physical signs (miosis and lacrimation) related to effects on bodily systems.
Respiratory	Health effects involving any part of the respiratory tree (i.e. nasal irritation, coughing, sneezing, etc).
Systemic	Any health effects not limited to the eye, skin and/or respiratory system (i.e. headache, vomiting, diarrhea, dizziness, abdominal pain, etc).

California Department of Pesticide Regulation (2002) Pesticide Illness Surveillance Program (PISP) Database User Documentation/Dictionary

Table A-4. Predisposition Conditions and their Definitions as Used in the PISP Classification Scheme

Predisposition Condition	Definition
Allergies	A history of immune mediated heightened sensitivity to specific substances.
Asthma	A chronic respiratory disorder characterized by recurrent attacks of paroxysmal dyspnea (difficulty breathing) and wheezing due to spasmodic contraction of the bronchi.
Concurrent Infection	Presence of infection by bacteria or other disease-producing organisms at the time of exposure.
Multiple Chemical Sensitivities	A history of sensitivity to multiple chemicals.
Pregnancy	Pregnant at the time of exposure.
Previous Episodes	Similar symptoms following similar exposures in the past.
Other Preexisting Condition	Any other preexisting condition not defined above.
Unknown	Unspecified pre-existing conditions. This applies to cases prior to 1998 when pre-existing conditions could not be specified.
Not Applicable	No pre-existing conditions.

California Department of Pesticide Regulation (2002) Pesticide Illness Surveillance Program (PISP) Database User Documentation/Dictionary

Table A-5. Types of Application Equipment as Used in the PISP Classification Scheme[a]

Application Equipment	Description
Aerosol Can	Disposable pressurized cans designed for intermittent use. The pesticide is propelled out of the can by an inert compressed gas propellant.
Aerosol/Fog Generating Equipment	Refillable application equipment designed to disperse pesticide as a small airborne droplet, either in confined spaces or outdoor areas. These include truck-mounted equipment for outdoor use, hand-carried portable units and wall mounted electric units that are found in dairies, restaurants, etc.
Back Pack Sprayer	Compressed air sprayer where the tank is worn on the back of the applicator.
Foggers	Disposable pressurized cans designed for the total release of the contents in a single use. The pesticide is propelled out of the can by an inert compressed gas propellant.
Hand, Other Or Unspecified	Hand-held application equipment, other or unspecified. The equipment must propel the pesticide from a reservoir. This includes 1) hose-end sprayers, and 2) two or more types of hand-held application equipment.
Hand Pump Sprayer	Hand-held compressed air sprayer with small volume tanks (1 to 5 gallons).
Hand-Held Dusters	Hand-held application equipment for granules or dust. This includes belly grinders, bellows, squeeze bulbs, etc.
Pressurized Hose-Line Sprayers	Hand-held spray equipment attached by a long hose to a power pressurized tank.
Implements With Handles	Mops, brushes, and other implements with handles.
Implements Without Handles	Cloths, towels, rags, sponges and other implements without handles.
Manual Placement	Manual placement of pesticide onto the target site. This includes hand-tossed pellets and direct pouring of pesticide onto a target surface from a container (such as pouring liquid chlorine into a swimming pool).

Table A-5 (Continued). Types of Application Equipment as Used in the PISP Classification Scheme[a]

Application Equipment	Description
Manual Application Methods, other or unspecified	The pesticide is not propelled by any type of equipment. This also includes two or more types of application equipment.
Unpressurized Hand-Held Spray Equipment	Hand-held spray bottles (usually plastic) with built-in finger triggers.
Other	Any application methodology not described above. This includes two or more types of application equipment not elsewhere specified. The application methodology is typically described in the comments.

California Department of Pesticide Regulation (2002) Pesticide Illness Surveillance Program (PISP) Database User Documentation/Dictionary

[a]Application equipment types listed in this table only refers to those used in structural pesticide applications. More specific categories and definitions have also been added for the project.

Table A-6. Types of Pesticide Application Methods Used in Structures[a]

Application Method	Description
Automatic Dispenser	Refillable application equipment designed to disperse pesticide as a small airborne droplet, either in confined spaces or outdoor areas. These include wall-mounted electric units that are found in dairies, restaurants, etc.
Bait	Pesticides in solid formulations or those that can be manually placed in strategic places.
Baseboard spray	Pesticide is applied by spray only the baseboards in structures, up to 6 inches from the wall.
Broadcast spray	Pesticide is spread or applied by spray over a wide area
Crack and Crevice spray	Pesticide is applied by spray only on defined spaces in the structure.
Drill and Treat	This method is used mostly for termiticides. Holes are drilled into foundations and the termiticide is applied into the holes then covered up.
Duster	This method is used for insecticide dust formulations

Table A-6 (Continued). Types of Pesticide Application Methods Used in Structures[a]

Application Method	Description
Fogging	Pesticide is released though a fogging machine or total release aerosol.
Fumigation	Pesticide is applied as a volatile vapor or liquid that becomes an aerosol and fills the volume.
Hand spray	Pesticide sprayed with an aerosol can or a 1-5 gallon hand pump spray.
Hand-pour	Pesticide is manually poured from a container to the site.
Injection into wood pole	Pesticide is injected into the pole
Manual Application	Pesticide is not propelled by any equipment.
Manual Placement	Pesticide is applied directly to the target site.
Paintbrush	Pesticide is painted onto a surface.
Space/Surface Spray	Pesticide is sprayed to surfaces or spaces by the use of hand-held equipment. This includes pressurized spray, aerosol cans, unpressurized hand-held equipment and hand-pump sprayers.
Spot Treatment	Pesticide is applied into designated areas only.
Sub-area Treatment	Pesticide is applied underneath the structure. This is mostly used for termiticide applications.
Tape or Tarp	Pesticide is applied by fumigation and the structure is taped or tarped to prevent the fumigant from drifting outside of the structure.
Trench and Treat	Pesticide is applied after digging a trench. This is mostly used for termiticide applications.
Wiping cloth	Pesticide is applied onto a cloth and wiped onto surfaces. This is a more specific type of manual application
Wood spray	Pesticide is specifically applied by spray on wood being protected from termites in an already built structure.
Unknown	Unknown method of application.

[a] Application method types listed in this table only refers to those used in structural pesticide applications. Definitions derived from coding manual of the California Department of Pesticide Regulation Registration Branch

APPENDIX B

Table B-1. Descriptions of Cases Involving Fumigants and Their Classification, 1996-2001

Case Number	Relationship	Exposure	Symptoms	Comments	Pesticides
1996-330	Possible	Drift	Wheezing, lung congestion	An elderly asthmatic woman felt exposed to a fumigant that was shot into an adjacent mobile home. She suffered respiratory problems and sought medical attention. She was treated with a nebulizer, oxygen and prednisone for at least a month.	Sulfuryl fluoride
1996-969	Indirect	Residue	Eye, nose, throat and lung irritation, nausea, headache, fatigue.	A homeowner developed symptoms 5 days after her home was fumigated. She has multiple types of symptoms related to other conditions she suffers from. The doctor's diagnosis is reactive airway disease secondary to pesticide inhalation.	Sulfuryl fluoride
1996-2018	Indirect	Residue	Nausea, burning eyes and nose, lightheadedness, pain in the chest area.	A nurse smelled a chemical odor in her work area and developed symptoms. She finished her workday before going to a doctor. The building was fumigated 5 days earlier and cleared for reentry the day before. She said she is very sensitive to chemicals.	Methyl bromide
1997-208	Definite	Drift	Coma, convulsions, death.	An SPCO overlooked and failed to seal conduits from a structure to be fumigated to a nearby guest house. The guest house tenant felt ill during the fumigation. The next day she was found comatose and seizing. Blood bromine elevated 5 days later.	Methyl bromide
1997-263	Indirect	Residue	Headache, vertigo, lightheadedness, nose irritation, sensitivity to odors, blistered lips, irritated	An unpleasant odor developed in certain areas of a home after being fumigated. One of the 2 residents developed multiple symptoms. Numerous efforts over an 8-month period to identify and eliminate the odor problem have been unsuccessful.	Sulfuryl fluoride

Table B-1 (Continued). Descriptions of Cases Involving Fumigants and Their Classification, 1996-2001

Case Number	Relationship	Exposure	Symptoms	Comments	Pesticides
1997-1448	Indirect	Residue	Watery and burning eyes, chest pain, dizziness, confusion, drowsiness, jittery feeling, headache.	A resident experienced irritant symptoms upon returning to his mobile home after it was fumigated. In subsequent days, he developed neurological symptoms including 'slight' hallucinations. He recovered fully after three to four months.	Sulfuryl fluoride
1997-1569	Indirect	Residue	Puffy burning and tearing eyes, severe nasal and sinus congestion, chest discomfort.	An SPCO fumigated a home and properly aerated it before the family reentered. Upon coming home, the family developed symptoms. Only one sought medical attention, but stated 8 others were symptomatic.	Sulfuryl fluoride
1998-357	Probable	Residue	Burning in the chest, shortness of breath, eye and throat irritation.	An office employee developed symptoms after entering the fumigated building before aeration of the building. The SPCO asked her to unlock the doors and turn off the alarm. She suffered additional symptoms 2 days later while working in the building. Reentry violation.	Sulfuryl fluoride
1998-1179	Possible	Drift	Breathing difficulty, nausea, arrhythmia	A resident developed symptoms of nausea, difficulty breathing and arrhythmia during a sulfuryl fluoride fumigation to a condominium adjacent to her home. She has suffered similar reactions to previous pesticide exposure.	Sulfuryl fluoride
1999-29	Probable	Residue	Nausea, irritation of the eyes, nose and throat.	Homeowners entered their recently fumigated home and smelled a distinct odor. They developed symptoms and reported the incident to the SPCO. The SPCO failed to aerate the house with the legally required number of hours. Reentry violation.	Sulfuryl fluoride
1999-30	Probable	Residue	Headache.	See 1999-29. Reentry violation	Sulfuryl fluoride
1999-31	Indirect	Residue	Dizziness, nausea, burning eyes.	After aeration of a fumigated building, residents entered their apartments and smelled an odor. They developed symptoms and reported to the county health office. The building was properly aerated and no violations were found.	Sulfuryl fluoride

Table B-1 (Continued). Descriptions of Cases Involving Fumigants and Their Classification,1996-2001

Case Number	Relationship	Exposure	Symptoms	Comments	Pesticides
1999-32	Indirect	Residue	Eye and throat irritation, nausea.	See 1999-31.	Sulfuryl fluoride
1999-188	Possible	Residue	Dizziness, lightheaded, abdominal pain, fatigue, headache, nausea, nervousness, forgetfulness, difficulty breathing, impaired concentration, change in hair color and texture, runny nose, itchy eyes.	An SPCO fumigated a residential building. After 3 days of aeration, the SPCO cleared the building for reentry. Two workers noticed an odor and developed symptoms upon returning to their office in the building 2 days later.	Methyl bromide
1999-189	Possible	Residue	Impaired memory, intermittent diarrhea, intermittent dizziness, fatigue, headaches, nausea.	See 1999-188. Three others also developed symptoms, but did not seek medical attention. A cleaning contractor identified a large foam mattress as the primary odor source. A NOV was issued for the SPCO not wearing SCBA while clearing the structure.	Methyl bromide
1999-364	Indirect	Residue	Burning and tearing eyes, congestion, nausea, burning in the nose and throat.	Homeowner experienced irritant symptoms after reentering her fumigated house, which had been cleared for reentry 2 hours earlier. She sought medical attention 3 days later. Her son also suffered irritant symptoms so she stayed away for 3 days.	Sulfuryl fluoride
1999-412	Indirect	Residue	Eye and throat irritation, nausea.	See 1999-31.	Sulfuryl fluoride
1999-526	Possible	Residue	Dryness of the mouth and eyes, light headache, slight dizziness.	A service technician developed symptoms shortly after reestablishing gas service to a fumigated house cleared for reentry two hours earlier. The homeowner was present before, during and after the service and experienced no symptoms. The unit was located in a closet in the house.	Sulfuryl fluoride

Table B-1 (Continued). Descriptions of Cases Involving Fumigants and Their Classification,1996-2001

Case Number	Relationship	Exposure	Symptoms	Comments	Pesticides
1999-579	Indirect	Residue	Muscle aches, fatigue, nausea, eye redness, irritated throat, shortness of breath, skin irritation. Reported vertebral subluxation diagnosed by chiropractor and attributed to exposure.	A resident complained of developing various symptoms following the fumigation of his apartment complex. Some of the symptoms may have been caused by residual fumigant or by the chloropicrin warning agent.	Sulfuryl fluoride
1999-725	Indirect	Residue	Headache, dizziness.	An office building was fumigated and cleared for entry 2 days later. The next day, an employee entered the building and developed symptoms. Four other employees remained asymptomatic. She sought medical attention 4 days later.	Sulfuryl fluoride
1999-1471	Indirect	Residue	Watery eyes, congested throat and lungs, coughing.	An SPCO fumigated an apartment building. When 3 residents returned after the SPCO cleared the building, they experienced watery eyes and scratchy throats. The woman reported taking her 2-year old child to see a pediatrician.	Sulfuryl fluoride
2000-25	Possible	Drift	Difficulty breathing, headache, nausea, slight pain upon breathing, nasal congestion, watery eyes.	A resident developed symptoms after an SPCO tarped and fumigated a neighboring house. Her husband developed similar, but less severe symptoms. Only the woman sought medical attention	Sulfuryl fluoride
2000-765	Indirect	Residue	Dizziness, nausea, lightheadedness, disorientation, throat tightness, burning in the chest, numbness.	A homeowner noted an odor upon reentering his fumigated house and developed symptoms within 30 minutes. The odor resembled that from a permethrin application 40 days earlier. The investigator detected no odor 5 days after clearing the home.	Sulfuryl fluoride, permethrin

Table B-1 (Continued). Descriptions of Cases Involving Fumigants and Their Classification,1996-2001

Case Number	Relationship	Exposure	Symptoms	Comments	Pesticides
2000-827	Probable	Drift	Coughing, nausea, headache, chest pain, intensified numbness of the hands and feet.	An elderly cancer patient noted an opening in the tent over his neighbor's fumigated house and smelled a pungent odor. A firefighter in SCBA closed the hole with duct tape. The SPCO repaired the tarp late that night. Record review located no violation.	Sulfuryl fluoride
2000-1040	Possible	Drift	Headache, nausea, coughing, chest tightness.	Eight correctional officers smelled an odor and developed symptoms 2 days after the fumigation of a prison cafeteria building. With the building still tarped, high winds caused a tarp on the roof to come loose.	Sulfuryl fluoride
2001-210	Possible	Drift	Coughing, scratchy and swollen throat, chest tightness, wheezing, sneezing, eye irritation.	See 2000-1040. This officer said his initial symptoms did not resemble previous asthma attacks, but that his asthma seemed worse for about 2 weeks after the episode.	Sulfuryl fluoride
2001-214	Possible	Drift	Headache	See 2000-1040. Officer said that he noticed odor for about 2 hours, most intensely inside one of the buildings, and that it was "like a dairy smell". All the officers interviewed said the smell did not resemble tear gas.	Sulfuryl fluoride
2001-318	Indirect	Residue	Headache, palpitations.	A homeowner developed symptoms after entering her home 2 days after it was tarped and fumigated. The SPCO had declared the home safe for reentry. She developed symptoms and sought medical attention.	Sulfuryl fluoride
2001-803	Indirect	Residue	Nausea, lethargy, shortness of breath.	Although an SPCO had cleared her home for reentry following a structural fumigation, an asthmatic woman still experienced respiratory irritation after entering her home. According to the company's log, the SPCO performed the fumigation properly.	Sulfuryl fluoride

Table B-2: Descriptions of Priority Incidents Involving Five or More Cases Per Incident, 1996-2001

Priority Number	Pesticides Involved	Number of Cases	Violations	SPCO Involvement	Summary
14-YOL-96	Chlorpyrifos	8	None	SPCO involved	Eight employees became ill after being in their building that had been treated for termites 3 days prior. Air samples taken the next day were negative. Cholinesterase tests were within the normal range.
16-LA-96	Diazinon, Pyrethrins, Piperonyl butoxide, Petroleum distillates	19	Non-contributory [a,b]	SPCO involved	An intense odor bothered fourth floor office workers. Nineteen of them developed symptoms, 9 sought medical attention. The fifth and second floors of the building had been treated with insecticides three days earlier.
37-SJ-96	Resmethrin	6	Non-contributory	Not applicable	A malfunctioning automatic fogger continued to dispense an insecticide in a prison dining room. Six correctional officers developed symptoms before protected fire fighters disabled the fogger. Five of the officers were evaluated on site by a medical technician. Only one officer was transported to the hospital for additional evaluation
7-ORA-97	Chlorpyrifos	5	None	SPCO involved	A family noticed an odor upon returning home after an SPCO treated it for termites. That night, they developed symptoms. The SPCO attempted to reduce the odor 2 days later. Very little odor remained 4 days after treatment. Two individuals in this episode also has predisposing factors
26-COL-97	DDVP	5	None	SPCO involved	A warehouse and office were fogged with DDVP. The buildings were aerated 3 days later, before the employees returned to work. The employees complained of an odor, four of whom sought medical attention.

Table B-2: Descriptions of Priority Incidents Involving Five or More Cases Per Incident, 1996-2001

Priority Number	Pesticides Involved	Number of Cases	Violations	SPCO Involvement	Summary
28-MER-97	Propetamphos	11	Non-contributory	SPCO involved	An SPCO treated an office with propetamphos. The next morning, twelve workers noticed a strong odor & developed symptoms; 7 sought medical attention.
44-PLU-97	Rotenone, Piperonyl butoxide	62**	Unknown	No SPCO involved	Application of piscicide to Lake Davis in an eradication effort for Northern Pike. These 5 people were indoors when they smelled an odor.
12-LA-98	Propetamphos	4	None	SPCO involved	An SPCO applied propetamphos to the baseboards in a hospital room. Later that day, a housekeeper smelled an odor before mopping the floor with a sanitizer. She developed symptoms & was subsequently hospitalized. Two other hospital workers entered the room and became ill. A hospital patient in a room 100 feet away also complained of symptoms. Employees noted a strong odor in the room
30-SCL-98	Propetamphos Methoprene	11	Non-contributory	SPCO involved	An SPCO applied pesticides to the carpet of an office building. Three days later, most employees noticed an odor upon arriving at work. Ten employees developed symptoms by that evening and one the next day.
33-LA-98	Boric acid, Permethrin, Pyrethrin, Piperonyl butoxide	5	Cited for label violation and inappropriate application.	No SPCO involved	A family of five developed symptoms after the manager treated their apartment with pesticides. Residue sample results showed positive pesticide residue in the apartment. The investigator also noted a pesticide odor.

Table B-2 (Continued): Descriptions of Priority Incidents Involving Five or More Cases Per Incident, 1996-2001

Priority Number	Pesticides Involved	Number of Cases	Violations	SPCO Involvement	Summary
35-SBD-98	Permethrin	7	Failed to notify tenants about pesticide application, unsafe application	No SPCO involved	Two maintenance workers fumigated a first floor office without informing or evacuating the workers from upstairs. Several workers noticed smoke-like odors coming up the stairwell. One called security to report a fire and then they evacuated. They later learned of the application.
4-BUT-99	Para-dichloro-benzene	8	Cited for off-label use of product.	SPCO involved	Hospital office workers were disturbed both by skunks under their building & by mothball applications meant to repel the skunks. The insecticidal fogger also applied in the crawl space appears not to have contributed to the odor.
5-SCL-99	Cyfluthrin	15	Overapplicatio n of insecticide.	No SPCO involved	Contrary to label directions, a hotel employee applied full strength cyfluthrin powder to the Jacuzzi plumbing motor boxes throughout 2 floors of the hotel. Over the next 2 days, 15 employees developed symptoms.
9-SBD-99	Propetamphos	13	None	SPCO involved	After a series of uneventful monthly pesticide applications to a warehouse, an SPCO treated a business's office and production areas. Workers returned an hour after the application. 13 of them developed symptoms.
32-ORA-99	Diazinon, Chlorpyrifos, Esfenvalerate, Methoprene	5	Non-contributory	SPCO involved	A family noticed sticky, slippery residue on their floors upon returning to their treated home. The mother and 15-month-old developed rashes. The other three children experienced a burning sensation on contact with water.

Table B-2 (Continued): Descriptions of Priority Incidents Involving Five or More Cases Per Incident, 1996-2001

Priority Number	Pesticides Involved	Number of Cases	Violations	SPCO Involvement	Summary
36-LA-99	Propetamphos	7	Failure to notify occupants and failure to ventilate after application.	SPCO involved	Seven medical office employees developed symptoms after they came to work the morning following a pesticide application. The SPCO failed to give notice to the employer and failed to properly ventilate the area after application.
12-LA-00	Propetamphos Methoprene	14	None	SPCO involved	The day after an SPCO treated an office building for fleas, workers complained of an odor and the staff of about 100 was evacuated. Fourteen complained of symptoms and sought medical attention.
13-LA-00	Diazinon	11	Overapplication failure to apply pesticides in a safe manner, fogging application instead of crack and crevice treatment	Unlicensed SPCO involved	An unlicensed SPCO treated a file storage room in an office basement. Within a short period of time, 9 employees developed symptoms and called 911. All were treated and released at the scene.
9-KIN-01	Sulfuryl fluoride	8	None	SPCO involved	Eight correctional officers smelled an odor and developed symptoms 2 days after the fumigation of a prison cafeteria building. With the building still tarped, high winds caused a tarp on the roof to come loose

[a] Non-Contributory violation - the identified violation did not contribute directly to the illness, Examples of non-contributory violations are: 1) failure to record pesticide safety training; 2) failure to report the correct label registration number or 3) failure to maintain safety-training record.

b 44-PLU-97. This priority incident involved residents around Lake Davis during the eradication of Northern Pike in 1997. Other individuals involved in the incident were not classified as “routine indoor, residue” cases because of different circumstances regarding their exposure and location at the time of the incident. Only 5 people were included in this study with a “routine indoor” “residue” category.

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